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Essays on the Macroeconomic Effect of Natural Resource Rents

Salim Araj

University of Wisconsin-Milwaukee

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ESSAYS ON THE MACROECONOMIC EFFECT OF NATURAL
RESOURCE RENTS

By Salim M. Araj

A Dissertation Submitted in
Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy

In

Economics

At

The University of Wisconsin Milwaukee

May 2014

ABSTRACT

ESSAYS ON THE MACROECONOMIC EFFECT OF NATURAL RESOURCE RENTS

The University of Wisconsin-Milwaukee, May 2014

Under the Supervision of Professor Hamid Mohtadi

This dissertation comprise of two chapters on the macroeconomic effect of natural resource rents. Specifically, we focus on the effect of resource rents on human capital accumulation. In chapter one, we present a new mechanism for the curse of natural resources, i.e., “why natural resource rents if distributed as transfers to individuals’ income might retard economic growth and development: their effect on incentives to invest in human capital”. Extending an OLG model for this purpose, we show that the windfall rents from natural resources, when transferred directly to citizens distort their incentives *away* from accumulating the optimum level of human capital and thus from economic growth. 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.

In chapter two, we present a dynamic panel data model, and a cross section model to see the effect of transfers in countries with high natural resource rents per person on human capital accumulation. We use tertiary education as a human capital indicator, since at this educational level, people choose to accumulate professional skills and direct their talents to sectors with the highest expected return. Using a dynamic panel data model for five years averages of tertiary education, one can see that the combined effect of government

transfers and natural resource rents per labor have a negative and significant effect on human capital. However, using a cross section analysis for the same purpose, one can see that not only the combined effect of resource rents per labor and government transfers have a negative and significant effect on tertiary education, but also resource rents per labor alone have a negative and significant effect on tertiary education. Our cross section results coincide with the natural resource curse literature as it shows that resource rents have a long-term negative effect on social capital investments such as tertiary education.

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To My Parents.

INCOME TRANSFERS AND HUMAN CAPITAL: APPLICATION TO RESOURCE RICH COUNTRIES

1. INTRODUCTION

We present a new mechanism for the curse of natural resources, i.e., “why direct transfers stemming from natural resource rents retard economic growth and development in resource rich countries: their effect on incentives to invest in human capital”. Extending an OLG model for this purpose, we show that the windfall rents from natural resources, when transferred to citizens’ income, distort their incentives *away* from the accumulation of human capital and thus economic growth. 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.

Intuition suggests that rents from natural resources should accelerate economic growth by expanding the production possibilities frontier and enhancing the accumulation of factors that contribute to growth.¹ However, evidence suggests a more complex picture. For example, the Middle Eastern and North African regions with their wealth in oil and other natural resources, experienced low or negative long-term growth.² Yet other countries as

¹ For example, Thorvaldur Gylfason (2007) cited several factors: increased savings, accelerating the accumulation of physical and human capital; foreign trade and the accumulation of foreign reserves; manufacturing and industrialization to enhance diversification in production and increased economic growth.

² Esfahani (2008) showed that economic growth for the oil producing MENA countries between 1970 to 2006 was only 0.7 percent. Further, Looking at growth for the period between 1986 and 1995, one can see that growth was -0.8 percent (Esfahani 2008).

diverse as Botswana, Chile, and Norway who possess vast natural resources have experienced acceptable rates of economic growth. Explanations for these contradictory phenomena are also varied. Some natural resource curse explanations focus on the interaction of institutions and natural resources.³ Others focus on the so-called Dutch disease, in which resource booms induce an appreciation of the real exchange rate that leads to a lower production of tradables, retarding diversification and growth.⁴ Higher resource rent volatility is another key factor affecting lower long run growth especially in countries that are highly dependent on resource profits and their government spending is pro-cyclical (Gylfason 2001)⁵.

However, because it is well known that economic growth is also highly influenced by human capital investments, the question arises of whether natural resources might have an inherently adverse effect on human capital accumulation. Evidence suggests this may indeed be the case. For example, in a cross-country study Behbudi *et al.* (2010) showed that there is an inverse relationship between secondary education and resource abundance in oil producing nations. If we recast their results for *tertiary* education (a form of education more closely tied to R&D and, thus, to economic growth-via new growth theory), we find that for a sample of countries that include most of the developed and developing resource rich nations, natural resource rents (as a percentage of GDP) and

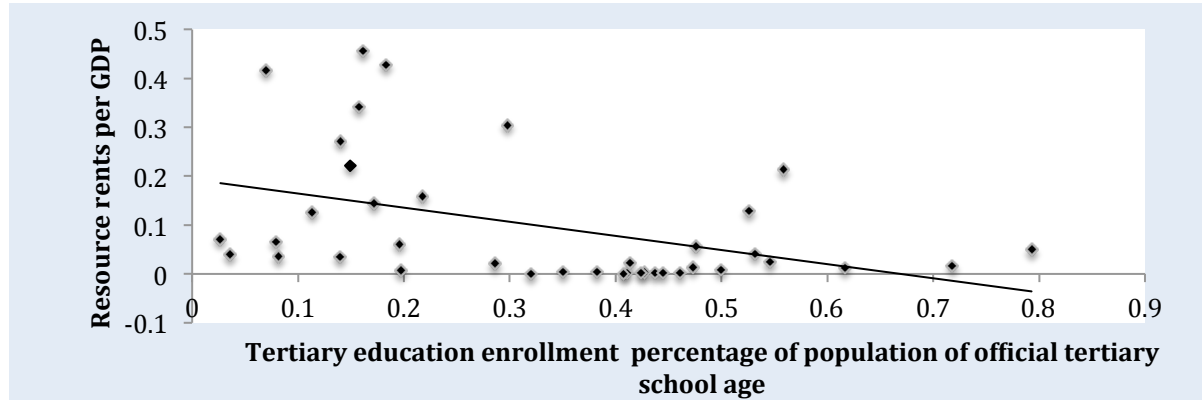
³Yet, the fact that a majority of natural resource-rich economies suffer from poor governance or that indicators of both democracy and corruption in these countries are found to belong to the lowest range. In this explanation, countries with poor institutions become subject to the "curse" (e.g., the Middle Eastern economies) while those with good institutions have a greater chance of escaping the curse (e.g., Norway and Botswana) (Mehlum et al. 2006).

⁴ See Corden and Neary (1972) for the original Dutch disease hypothesis in the Netherlands.

⁵ Higher growth volatility in natural resource countries reduces the certainty of investment in physical capital, and lower growth. Philippot (2010) argued that fluctuations in international resource prices create a high level of uncertainty in private and public investments.

tertiary education (as a percentage of population of official tertiary education age) are *negatively* correlated (Figure 1).

FIGURE 1: NATURAL RESOURCES PERCENTAGE OF GDP AND TERTIARY EDUCATION



Source: By the authors

In this paper, we seek to explain the adverse outcome of distributed rents by focusing on the effect of natural resource on the *incentive* to accumulate human capital. We argue that natural resource rents result in an *adverse incentive* problem that *retards* the optimal desire to invest in one's human capital if rents are distributed to individuals' income. This happens as resource rents enter the individual's budget constraint via a lump-sum transfer. To examine this issue, we extend an overlapping generations model by Iyigun and Own (1997) and incorporate natural resource rents into it. The model will show how natural rents, when distributed as lump-sum transfers, reduce the optimum expected returns to human capital in the long run. It is true that transfers may occur with and without natural resources. However, transfers from sources *other* than the windfall rents would have to be financed by tax revenues. As such, their "incentive reducing" effect (as we shall see), will be countered by the income taxes that need to be generated to finance them. It is in this sense that the transfers of the type we model in this paper are closely tied to resource rents, as resource rich countries (mainly resource dependent) have an

income transfer stemming from resource rents, and significantly lower tax rates compared to non-resource countries⁶.

The basic idea is simple, yet intuitive. Transfers from natural resource rents are distributed to the society at large. These transfers append citizens expected income, both in human capital and the unskilled labor sector. Evidence suggests that resource rich countries do provide this form of income premium transfers, possibly to placate society or reduce the risk of social and political unrest. For example, the Kuwaiti authorities spent 4.12 billion dinars in 2008 on lump-sum cash transfers to national citizens, which were up to 43% of government aggregate expenditures (El-Katiri et al. 2011). Further evidence of such transfers can be found in the case of Saudi Arabia and United Arab Emirates as well (IMF 2012). For example, in Saudi Arabia, these transfers show up in the form of wage premia that stem from oil rents. To indicate the extent of such transfers, one can compare the wages of Saudi nationals with those of foreign workers. According to the IMF, on average, non-skilled labor income of Saudi nationals is 4.1 times of that the expatriates. Gelb and Decker (2011) argued that the levels of transfers received by citizens of the UAE through guaranteed employment and other mechanisms probably discourage work effort and education aspirations for many individuals. It is obvious that citizens of such nations enjoy this wage premia generated either directly from resource rents or after investing resource rents in SWFs (sovereign wealth funds). To link government transfers with resource rents, Gelb and Decker (2011) argued that average fiscal revenues from natural resources in 14 Middle Eastern natural resources exporter countries were around 57.2% of total revenues. This gives anecdotal evidence that

⁶ According to the 2012 CIA fact-book, the majority of resource rich developing countries have tax rates below ten percent, and some of them go down to zero percent.

transfers distributed in such countries stem mainly from resource rents. Further, authors including Sala-i-Martin and Subramanian (2003) advocated direct resource rents distribution for countries such as Nigeria and Iraq.

We study how human capital's expected returns depend on resource rents using two types of human capital (entrepreneurship and professional). Our findings indicate that more distributed rents to the society at large reduces the aggregate level of both types of human capital leading to more unskilled labor force in the long run. Additionally, the fraction of resource rents transferred mainly to human capital generates a misallocation of talent between entrepreneurial and professional capital yet changing the income growth dynamics along the growth path. This causes the income to enter a low-level equilibrium trap in a multi-equilibria setting. We do find, however, that if the initial level of technology is sufficiently advanced, countries can still converge to a high level steady state of expected income, regardless of the level of resource rents distributed.

The remainder of the paper is organized as follows: section 2 conducts an extensive review of the literature on natural resources and economic growth, stressing the literature that is most relevant to our study. Section 3 presents the theoretical model, which specifies the behavior of households when resource rent are distribution by the government as direct transfers, and it also explains the findings of our model with some concluding remarks.

2. LITERATURE SURVEY

2.1. A HISTORICAL OVERVIEW

The economic history of the last two centuries demonstrates conflicting evidence concerning the connection between resource abundance and economic growth (Behbudi, Mamipour, and Karami 2010). The development experience in many of today's industrial economies, during the 19th century and the first half of the 20th century saw natural resources as an engine of growth (Stevens, 2003).⁷ Yet, even for these countries and even in 19th century that assumption was not universally borne out. For example, many resource-poor economies outperformed Spain despite its immense reserves of gold and silver brought from the colonies. Continuing into the 20th century, resource-poor nations such as Japan and Switzerland surged ahead of resource-rich countries such as Russia. The same anomaly is observed in the developing world in the second half of the 20th century. The world's star performers over the past three decades have been the resource-poor economies of East Asia while many resource-abundant countries including oil producers such as Nigeria, Venezuela, Mexico, and the MENA countries have not performed nearly as well.⁸

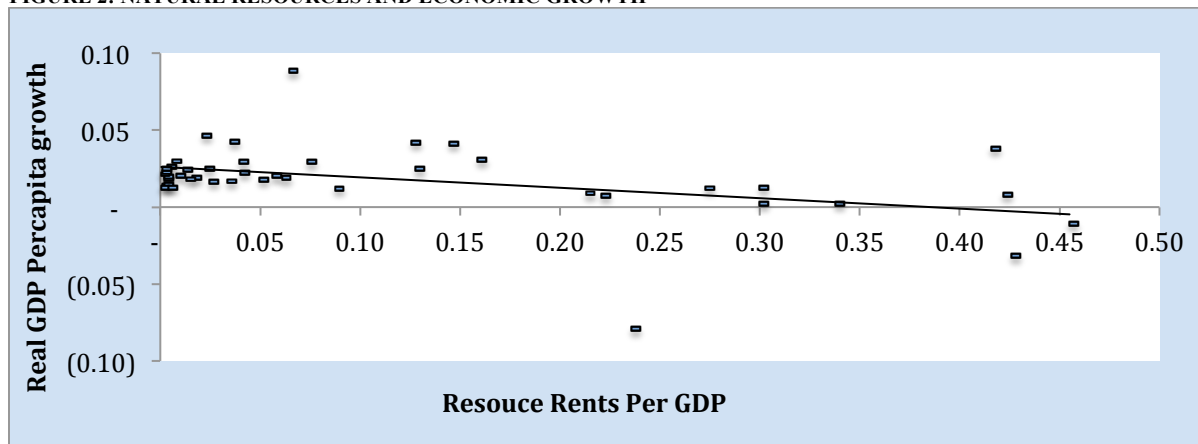
2.2. NATURAL RESOURCES AND ECONOMIC GROWTH

⁷Stevens (2003) presented a review of the historical growth experience of the US, the Scandinavian countries, Australia, and Canada. Pointing to the positive role, his analysis logically implies that natural resources should actually boost economic development in the above countries. His main argument is 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.

⁸Bravo-Ortega and Gregorio (2007) go further by arguing that natural resources may even be blamed for the slow-down in the development of countries such as Latin America., and now the MENA regions.

A large body of literature points to the adverse impact of resources on economic growth in developing countries over the past four decades (Behbudi, Mamipour and Karami 2010), a relationship now termed "the resource curse". We highlight these findings here in Figure 2.

FIGURE 2: NATURAL RESOURCES AND ECONOMIC GROWTH



Source: the authors

This negative association poses a puzzle, as it runs counter to economic logic and intuition. For example, resource rich nations have sought to utilize the vast rents from oil to finance investments in industrial and financial sectors. An example from the 19th century, can be found for the U.S., Germany, and Britain, which were highly endowed in natural resources, experienced a rapid industrial development during that period. The availability of coal deposits in such countries was the *sine qua non* for the development of the local steel industry (Gylfason, and Zoega 1999). Surprisingly, however, Japan and Korea in the past century succeeded in becoming world-class steel manufacturers *despite* of their virtual dependence on imported iron ore. While natural resources are no longer a key to economic development in the above-mentioned developed countries, it is

surprising that for other developing nations these resources might actually *hinder* development.

2.3. MECHANISMS LINKING NATURAL RESOURCES AND ECONOMIC GROWTH

Theories that address the association between natural resource abundance and economic growth have been traditionally based on various forms of crowding effects. Our work offers a fresh perspective that differs from this general approach. However, before we present our perspective and model, a select overview of existing literature seems warranted. In general, four mechanisms can be identified for the transmission of the detrimental effects of natural resource abundance on economic growth. We present each briefly.

2.3.1. NATURAL CAPITAL AND THE DUTCH DISEASE

The Dutch disease hypothesis argues that natural resource abundance influences prices through the overvaluation of the country's currency associated with high inflation, which reduces exports of non-resource tradable goods and increases production of non-tradable goods (Frankel 2010). Sachs and Warner (2001) claimed that if the traded sector is the engine of growth, then a resource shock retards growth by reallocating factors such as labor and land from the traded (manufacturing) to the non-traded sector. Moreover, higher inflation stemming from higher government spending via taxes or royalties contributes to a higher return in the non-traded sector. These crowded-out non-resource exports are mainly in the manufacturing sector, which results in deindustrialization in the long run. Supporting evidence of this crowding out phenomenon can be observed among

the Middle Eastern oil exporter countries for whom total non-oil exports as a share of GDP declined over the last five decades while non-oil producing nations saw a significant increase in their total exports (Gylfason, 2004).

Frankel also argued that the Dutch disease might arise from sources other than the commodity price boom. A discovery of new reserves or an expansion in resource supplies leads resource exports to increase dramatically along with a heightened capital inflow to develop new reserves. Any of these factors will contribute to a shifting of labor and other resources to the non-tradable sector.

2.3.2. NATURAL RESOURCE, SAVINGS/INVESTMENTS AND PHYSICAL CAPITAL

Natural resource endowment has the potential to reduce public investments and private incentives to invest domestically, hence impeding economic growth (Gylfason and Zoega 2001, IMF 2012). A key-contributing factor in this effect is thought to be the volatility of natural rents, which leads to great uncertainty in reducing investments in different types of capital (both physical and human), (Gylfason 2001).

This volatility of natural resource rents specifically hinders public investments especially in countries that run pro-cyclical fiscal policies. Consistent with this, Behbudi, Mamipour and Karami (2010) have shown that resource abundant countries have a low level of domestic (public and private) investments and thus have a lower social return on investments, yet growing slower than resource-poor economies.

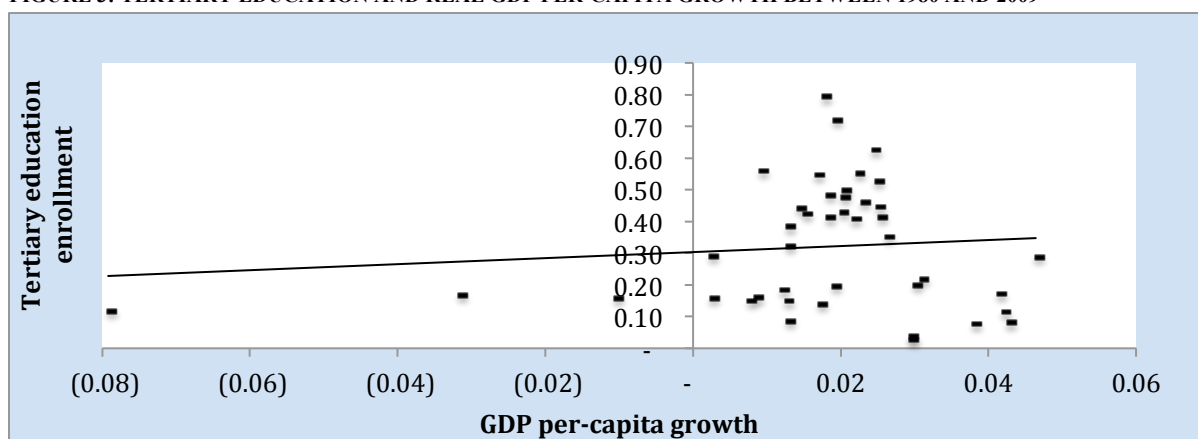
Expectations and perceptions may also matter. The IMF 2012, in its annual report on resource rich economies, argued that natural resources may create a false sense of security when there is a rapid rise in output that natural resources create. This in turn

reduces demand for domestic investments, and prudent governments save resource rents abroad in the form of sovereign wealth funds (SWFs). This results in lower rates of domestic consumption and investments in the short and the medium run. Gylfason (2001) also argued that an increase of 10 percent in natural capital share decreases investment by approximately 2 percent per GDP.

2.3.3. NATURAL RESOURCES, HUMAN CAPITAL AND GROWTH

Numerous studies have confirmed the positive contribution of education to economic growth.⁹ Given our focus on tertiary education, it is worthwhile to examine this effect for tertiary education. Figure 3 confirms this positive influence between tertiary education and GDP per-capita growth for 46 nations.

FIGURE 3: TERTIARY EDUCATION AND REAL GDP PER-CAPITA GROWTH BETWEEN 1980 AND 2009



Source: the authors

Coupled with the findings from Figure 1, one can deduce the adverse role of natural resources on economic growth via the channel of human capital. The literature seems to support this view. For example, Gylfason (2001), Bravo and Gregorio (2000) and Stijns

⁹A recent study by the World Bank revealed that human capital has the greatest influence on income as opposed to physical or natural capital (Philippot, 2010).

(2001) have investigated the effect of natural resource endowment on human capital accumulation. In his empirical analysis, Gylfason concluded that natural capital seems to crowd out human capital hence suppressing growth.¹⁰

The mechanism by which natural resources may suppress human capital accumulation, if they do, is unclear. Some evidence implicates government spending: government expenditures on education as a fraction of GDP and school enrollments have both been found to be negatively related to the level of natural resources (Gylfason, Herbertsson, and Zoega 1999). Similarly, Birdsall, Pinckney and Sabot (2001) showed that resource-rich countries invest less in training than resource-poor countries¹¹. A similarly poor performance was reported for Northern Africa, and Latin America. However, the disparity in human capital accumulation in Africa between resource-rich and resource-poor countries was found to be ambiguous due to the existence of civil wars and fragility in such countries. Highly skilled workers in most African resource rich countries are generally educated in foreign countries and often belong to the political elites (Birdsall, Pinckney and Sabot 2001). In such countries, resource rents may be concentrated within a small portion of the society. Others have focused on natural resources, human capital and the growth nexus via a lack diversification (Brunnshweiler, 2006). In this vein, Leamer (1999) argued that the under-accumulation of human capital makes it difficult for resource abundant nations to pursue industrial diversification, and the development of sectors other than the resource sector.

¹⁰Gylfason showed that nations that rely heavily on their natural capital as their most vital source of production may unintentionally overlook the development of their human resources, and allocate an inadequate attention on their expenditure on skill accumulation and research.

¹¹Resource poor countries in Asia showed an average of 60 percent school enrollment in the 1980s, but there was only 38 percent average enrollment in resource abundant countries.

The issue of comparative advantage also plays a role in the adverse effect of resources on human capital. For example, Behbudi, Mamipour and Karami (2010) have argued that countries, endowed with large natural reserves, find it easier to engage chiefly in the production or extraction of such resources because their comparative abundance of these resources requires low levels of initial investments. Further, resource-based industries do not require an intensive level of human capital compared with sectors such as manufacturing. Thus the exploitation of such resources comes at the expense of social services, specifically human capital development. Relatedly, Gylfason (2001) argues that focusing on natural resources as the main source of national income, retards the development of the manufacturing sector because skilled jobs are scarce and hence returns to human capital are low. Birdsall, Pinckney, and Sabot (2001) argue that citizens do not therefore find it necessary to pressure governments into providing skill intensive sectors.

2.3.5 OTHER MECHANISMS THAT LINK NATURAL RESOURCES TO HUMAN CAPITAL

There are other channels through which the presence of natural resources affects human capital accumulation. Birdsall, Pinckney and 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. Another explanation of the curse is that natural resources encourage corruption. When corruption is high, it is possible for civil servants, ministers and bureaucrats to divert money intended for building schools and human capital investments (Sala-I-Martin

and Subramanian 2003). Natural resources also tend to decrease political stability and encourage civil conflicts.¹²

3. THEORETICAL MODEL

The previous transmission mechanisms of the effect of natural resource transfers on human capital and growth have not considered the key role of incentives, although the point by Gylfason (2001) of low returns to human capital comes close. In this section we extend an overlapping generations model that captures the incentive channel and shows how natural resource rents influence human capital if rents are distributed as income transfers. This behavior diminishes the possibility of countries with a low initial level of technology to converge to high-income groups. The model adopts an overlapping generations framework with a structure similar to Owen and Iyigun (1997). We add to their model the role of resource rents and its influence on the individual's choice to accumulate more skills. Further, we distinguish between resource transferred to the society at large, and the fraction targeted to human capital. The inclusion of the resource rents distribution mechanism into an overlapping generations model is an important innovation that allows us to study the effect of the resource curse in a dynamic setting. It shows the consequences of natural resource rents for the incentive of citizens to accumulate human capital and therefore increase economic growth at large.

In this model, there are three periods. In the first period, citizens choose either to invest in human capital or to supply unskilled labor in the labor market. In the second period, if an

¹²Philippot (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 poor rule of laws, and the high influence of militias.

individual invests in human capital, she will receive an expected income plus a resource based transfer known *ex ante*. Otherwise she works as an unskilled worker, earning a fixed income " ω " and a resource-based lump-sum transfer (predetermined by the government in the first period) in the first and the second period. In the third period both skilled and unskilled workers consume generated income.

Human capital is of two types: professional and entrepreneurial. In period 2, professional human capital income is certain and dependent on the level of technology accumulated and the lump-sum resource transfers, whereas the entrepreneur's income is uncertain with some probability of success. The role of entrepreneurial human capital in this paper is essential for several reasons. First, economic theory suggests that technological advancements and growth rely on both professional and entrepreneurial capital. Second, anecdotal evidence suggests that in oil rich economies resource booms do not necessarily lead to the accumulation of professional human capital. Instead, resource booms lead to a large increase in self-employed activities in non-manufacturing (usually non-tradables) sectors such as commercial and residential projects, wholesale and retail merchandise trade, and restaurants and hotels. For example, in 2001, Saudi Arabia's manufacturing sector was only 9.8 percent of its GDP, while self-employed activities such as restaurants and hotels, transportation, and construction projects accumulated to almost 30 percent of total GDP activities (Saudi's Ministry of Economics 2012).

Third, the mechanism by which resource booms lead to increased self-employed activities involves disincentives compared with other alternatives such as accumulation of professional human capital via tertiary education. This dynamic has its roots in governments' massive direct and indirect transfer programs especially in oil rich (or more

generally resource rich) economies, regardless of the uncertainty of self-employment return. Given this background, we convey this stylized fact by adding a stochastic entrepreneurial return to our utility maximization problem, associated with a rent-based lump-sum transfer given by the government for both professional and entrepreneurial capital. We look at the effect of resource wealth on an individual's choice while selecting her profession, and how this will influence the macroeconomic growth process in resource-rich countries.

A key simplifying assumption of this paper, which allows for a sharper focus on the role of natural resources in incentives to invest in human capital, is to abstract from other channels such as the Dutch disease, volatility, and political economy. To this end, the paper does *not* model the production of the resource itself but instead focuses on its distribution to society. This is captured by considering the role of natural resources in generating windfall profits but not otherwise contributing to the production process. While a simplification, this consideration allows us to focus on an important and overlooked channel, namely the incentive channel.

3.1. ASSUMPTIONS

We consider a perfectly competitive economy made up of homogenous goods. At any time (t), production (Y_t) is a highly simplified function of human capital (H_t) and unskilled labor (L_t)

$$Y_t = A_t H_t + \omega L_t \tag{1}$$

Each factor input earns its marginal productivity, which in the case of human capital is associated with the level of technology (A_t). (Later, we will see that A_t will itself depend on mean education and entrepreneurship of the previous period)

$$\frac{\partial Y_t}{\partial H_t} = A_t \quad (2)$$

$$\frac{\partial Y_t}{\partial L_t} = \omega, \quad (3)$$

SOCIETY

Each individual faces three periods and the size of the society is normalized to one. We will assume a zero population growth and every individual is endowed with a certain level of innate ability a_i . Innate ability a_i is uniformly distributed¹³ between 0 and 1. Where $a_i = 0$ represent the lowest percentile and $a_i = 1$ is the highest percentile of innate ability.

$$\int_0^1 g(a_i) d(a) = 1, \quad (4)$$

Individuals choose to invest in human capital or work as an unskilled laborer depending on their level of innate ability. A relatively high level of innate ability, above a certain threshold, will increase the chance of an individual to invest in human capital.

At each period an individual is endowed with one unit of time (t). If she chooses to invest in human capital, she will spend (s_i) on schooling and $(1 - s_i)$ on entrepreneurship, where $(1 - s_i)$ is considered 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 $(1 - s_i)$, for any given level of resource transfer distributed by the

¹³ The use of the uniform distribution will show up in Section 3.4.

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}^i), is an increasing function of (s_i). Similarly, accumulation of entrepreneurial capital (e_{t+1}^i) is an increasing function of ($1 - s_i$).

$$e_{t+1}^i = a_i f(1 - s_i) \quad 0 < s_i < 1 \quad (5)$$

$$p_{t+1}^i = a_i f(s_i), \quad f'(\cdot) > 0, f''(\cdot) < 0 \quad (6)$$

3.2. THE ROLE OF NATURAL RESOURCES

Earlier, we highlighted the role of transfers in the case of Kuwait, Saudi Arabia, and United Arab Emirates. In our model, we assume that resource rents are distributed to the society at large. Incorporating natural resource rents in the form of transfers will have a significant effect on the model's outcome. In this model we assume that country (k) accumulates resource rents (Ω) every period. Individuals in society (k) enjoy a fraction $\Omega_{\text{net}} = (1 - \gamma)\Omega$ of the resource rents (Ω), where ($\gamma\Omega$) is the fraction that the government keeps.¹⁴ Leaving $\gamma\Omega$ to the government to extract the political influence on resource rents out of our model, yet leave us with the net level of resource transfers distributed to the masses Ω_{net} .

The fraction of total resource rent Ω_{net} is distributed as a lump-sum transfer to all agents. We assume agent (i) has a perfect insight concerning the size and the timing of future transfers by the government. If an individual chooses to invest in human capital in period (t), she will receive a predetermined transfer $\alpha\Omega_{\text{net}}$ in period ($t+1$). However, if she chooses not to accumulate skills, she will receive $(1 - \alpha)\Omega_{\text{net}}$ in (t) and ($t+1$) such that

¹⁴ This fraction goes to the government to spend on public goods. However, in our model we do not model the role of public goods.

$0 < \alpha < 1$. In our model the size of resource rents distributed Ω_{net} and the fraction distributed to human capital (α) will have a significant influence on the human capital accumulation process. The last assumption of the model is that the national level of technology depends on the economy wide average of both professional and entrepreneurial capital:

$$A_{t+1} = A(e_t, p_t) \text{ with the following properties}^{15}, \quad (7)$$

$$A^e > 0, \text{ and } A^{ee} < 0 \quad (7.1)$$

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

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

Given the level of technology, an individual's total income including the resource transfer will be as follows, for income from human capital forms we have the following:

Human capital income (y_{t+1}^i) with superscript (p) represent professional human capital,

$$(y_{t+1}^i)^p = w_{t+1}^h P_{t+1}^i + \alpha \Omega_{net} = A_{t+1} P_{t+1}^i + \alpha \Omega_{net} \quad (8)$$

while human capital income (y_{t+1}^i) with superscript (e) represents entrepreneurial human capital,

$$(Y_{t+1}^i)_{success}^e = w_{t+1}^h e_{t+1}^i + \alpha \Omega_{net} = A_{t+1} e_{t+1}^i + \alpha \Omega_{net}, \text{ with probability } q \quad (8.1)$$

$$(Y_{t+1}^i)_{failure}^e = \alpha \Omega_{net}, \text{ with probability } (1 - q)$$

¹⁵ Absence of A_t on the right hand side of (7) suggests that it is the stock of technology being determined by the previous level of professional and entrepreneurial human capital, rather than technological change. This aspect of our paper which follows Iyigun and Owen (1997)'s similar assumption would not affect the modeling of the dynamics.

where the subscripts (*sucess*) and (*Failure*) represent a successful entrepreneur with probability (q) and a failed entrepreneur with probability ($1-q$), respectively, given that return on entrepreneurship is uncertain. Labor income Y^i in period (t) and ($t + 1$) is fixed in every period and given by,

$$Y^i = \omega + (1 - \alpha)\Omega_{net}, \quad (8.2)$$

3.3. HOUSEHOLDS

We assume a simple natural log form for the utility function, $U(c) = \ln(c)$. An unskilled laborer earns income in periods (t) and ($t + 1$), and consumes all generated income in period ($t + 2$). Given that the unskilled laborer income is constant in both periods, and then her utility maximization problem will be as follows,

$$\underset{c_i}{Max} [U(c_{t+2}^i) = \ln(c_t^i) + \ln(c_{t+1}^i)] \quad (9)$$

$$\text{Subject to } Y^i = [\omega + (1 - \alpha) \Omega_{net}]$$

However skilled workers maximize the following:

$$\underset{s_i}{Max} [E[U(c_{t+2}^i)|t] = [q \ln(c_{t+2}^i)_{Success} + (1 - q) \ln(c_{t+2}^i)_{Failure}]] \quad (9.1)$$

$$\text{Subject to: } Y_{t+1}^i = (Y_{t+1}^i)^p + (Y_{t+1}^i)^e,$$

Where $(c_{t+2}^i)_{Success}$ represents consumption if the entrepreneur is successful. Similarly, $(c_{t+2}^i)_{Failure}$ is consumption if the entrepreneur is a failure. Substituting the budget constraint into the maximization problem (9.1), then the expected utility will take the following form,

$$E[U(c_{t+2}^i)|t] = q \ln[(Y_{t+1}^i)^p + (Y_{t+1}^i)^e]_{Success} + (1 - q) \ln[(Y_{t+1}^i)^p]_{Failure} \quad (9.2)$$

Substituting (8) and (8.1) in equation (9.2),

$$\begin{aligned} \max_{s_i} \{EU[(c_{t+2}^i)|t] &= q \ln[A_{t+1}(p_{t+1}^i + e_{t+1}^i) + \alpha \Omega_{net}] + (1 - q) \ln[A_{t+1} p_{t+1}^i \\ &+ \alpha \Omega_{net}] \} \end{aligned} \quad (10)$$

The first order condition (F.O.C. = 0) for this maximization problem (10) with respect to (s_i) yields to individual's optimal choice of schooling (s_i^*) :

$$\begin{aligned} -q[A_{t+1} a_i f(s_i^*) + \alpha \Omega_{net}] [f'(s_i^*) - f'(1 - s_i^*)] \\ = (1 - q) \{A_{t+1} a_i [f(s_i^*) + f(1 - s_i^*)] + \alpha \Omega_{net}\} f'(s_i^*) \end{aligned} \quad (10.1)$$

If we rearrange (10.1), we will get the following¹⁶,

$$\frac{(c_{t+2}^i)_{Success}}{(c_{t+2}^i)_{Failure}} = \frac{q}{(1-q)} \frac{f'(1-s_i^*) - [f'(s_i^*)]}{f'(s_i^*)} \quad (10.2)$$

Suppose there is a threshold innate ability \tilde{a}_t such that any individual that has $a_i > \tilde{a}_t$, will choose to invest in human capital. However, if $a_i < \tilde{a}_t$, she will choose to work as an unskilled laborer. Given any threshold ability \tilde{a}_t , equation (11) must hold with equality as individuals' returns equate, and people are indifferent between investing in human capital or work as an unskilled laborer.

$$\begin{aligned} q \ln\{A_{t+1} \tilde{a}_t [f(s_i^*) + f(1 - s_i^*)] + \alpha \Omega_{net}\} + (1 - q) \ln\{A_{t+1} \tilde{a}_t f(s_i^*) + \alpha \Omega_{net}\} = \\ \ln 2\{\omega + (1 - \alpha) \Omega_{net}\} \end{aligned} \quad (11)$$

¹⁶ The second order condition is less than zero, S.O.C < 0 as shown in Appendix A.

A lower threshold value of the innate ability will increase the incentive of individuals to invest in human capital. From equation (11) we see that the threshold level of innate ability is influenced by the resource portion transferred to human capital (α), the size of resource rents distributed to the society Ω_{net} , and the level of technology A_{t+1} .

Proposition 1:

The threshold innate ability (\tilde{a}_t) decline as the share of resource rent distributed (α), and professional and entrepreneurial human capital e_t and p_t increase. However, (\tilde{a}_t) increases as resource rents distributed, Ω_{net} increases, therefore declining the incentive to invest in both types of human capital.

Proof:

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

$$\frac{\partial \tilde{a}_t}{\partial e_t} < 0, \frac{\partial \tilde{a}_t}{\partial p_t} < 0, \frac{\partial \tilde{a}_t}{\partial \alpha_t} < 0, \frac{\partial \tilde{a}_t}{\partial \Omega_{net}} > 0, \quad (11.1)$$

Given that the proportion of resource rents transferred to human capital (α) lowers the threshold ability, more citizens will have an incentive to invest in human capital due to the higher expected return generated in period 2. Interestingly, however, the windfall from resource rents transferred behaves in the reverse fashion: An increase in Ω_{net} acts to increase the threshold innate ability at which skilled and unskilled incomes equalize, thus *reducing* citizen incentives to invest in human capital, and less people will be willing to invest in both professional and entrepreneurial capital. As a result of an increase in total transfers Ω_{net} , the average level of human capital $A(e, p)$ will decrease in future period. This is an important result that points to the distinction between fractions distributed to human capital (α) and overall resource rents distributed Ω_{net} on their effect on (\tilde{a}_t).

Revisiting and rearranging equation (10.2), while focusing on individuals with $a_i > \tilde{a}_t$, so as to focus on skilled workers only, the optimal level of schooling can be written as follows,

$$\frac{q}{1-q} = - \frac{\{A_{t+1}a_i[f(s_i^*)+f(1-s_i^*)]+\alpha \Omega_{net}\}}{[A_{t+1}a_i f(s_i^*)+\alpha \Omega_{net}]} * \frac{f'(s_i^*)}{[f'(s_i^*)-f'(1-s_i^*)]} \quad (12)$$

The above first order condition indicates that the optimum schooling level (s_i^*) depends on innate ability, the combined effect of resource rents and the fraction transferred to human capital $\alpha \Omega_{net}$, and technology A_{t+1} . The left hand side of equation (12) shows the ratio of probabilities in being a successful relative to a failed entrepreneur while the right hand side yields the return ratios from the two states. Given that this equality must hold at the optimum level of schooling (s_i^*), any positive resource shock will lead the denominator to increase proportionally more than the numerator. Agents will then lower their optimum level of schooling and increase investments in entrepreneurship over time. This behavior is logical since the utility function has a decreasing absolute risk aversion (D.A.R.A.) property. Any increase in resource rents distributed allows agents to enjoy higher consumption, where a D.A.R.A. utility function makes individuals less risk averse as a result of an income transfer and increase their risk appetite to invest more in uncertain projects.

Proposition 2:

Part A: For $\forall (q)$, ($0 > q > 1$), and an innate threshold ability such that $\tilde{a}_t < a_i < 1$, the optimal amount of schooling (s^) holds if $s_i > \frac{1}{2}$. Part B: The optimal level of schooling (s^*) declines as the level of total resource rents distributed Ω_{net} increases. Similarly*

(s^*) decline with resource rents fraction distributed to human capita (α). However, (s^*) increases in the average level of technology A_{t+1} .

Proof:

Part A of *proposition 2* holds because any value of $s_i^* < \frac{1}{2}$ will lead the right hand side of equation (12) to be negative, where $[f'(s_i^*) - f'(1 - s_i^*)] > 0$ due to the diminishing marginal return. Having an $s_i^* > \frac{1}{2}$ can be explained intuitively: Given that individuals are risk averse, and entrepreneurial capital is uncertain, people choose to invest in entrepreneurial capital only when the expected return is significantly high. To prove part B of *proposition 2*, we use again the implicit function theorem to find the following from (12) (See Appendix A for additional proof):

$$\frac{\partial s^*}{\partial p_t} > 0, \text{ And } \frac{\partial s^*}{\partial e_t} > 0, \frac{\partial s^*}{\partial \Omega_{t_{\text{net}}}} < 0, \frac{\partial s^*}{\partial \alpha} < 0 \quad (13)$$

3.4. MODEL DYNAMICS:

Suppose at time (t) there exists a situation where $\tilde{a}_t > 1$, then no individual will choose to invest in human capital. This is seen from equation (14),

$$\begin{aligned} \mu \equiv & \left\{ \{e_t, p_t, \Omega_{\text{net}}\} [q \ln A_{t+1} a_i (f(s_i) + f(1 - s_i)) + \alpha \Omega_{\text{net}}] + [(1 - q) \ln(A_{t+1} a_i f(s_i) + \right. \\ & \left. \alpha \Omega_{\text{net}}] \leq \ln [2(\omega + (1 - \alpha)\Omega)] \right\} \quad \text{given } \tilde{a}_t > 1, \end{aligned} \quad (14)$$

where μ represents the set of all agents who choose to remain unskilled given $\tilde{a}_t > 1$. This is represented by the shaded area in Figures (4) and (5). However, in the case of $\tilde{a}_t < a_i < 1$, the model dynamics can be illustrated by equations (15) and (16) showing the aggregate level of human capital in the long run.

$$e_{t+1} = \begin{cases} \int_{\tilde{a}_t}^1 (1-\tilde{a})f(1-s_i^*)da_i & \text{if } 1 > \tilde{a}_t > 0 \\ f(1-s_i^*) & \text{if } \tilde{a}_t < 0 \end{cases} \quad (15)$$

$$p_{t+1} = \begin{cases} \int_{\tilde{a}_t}^1 (1-\tilde{a})f(s_i^*)da_i & \text{if } 1 > \tilde{a}_t > 0 \\ f(s_i^*) & \text{if } \tilde{a}_t < 0 \end{cases} \quad (16)$$

From equation (11), and (12) (s_t^*) and (\tilde{a}_t) are functions of $A_{t+1}(e_t, p_t)$, and $\alpha \Omega_{\text{net}}$ respectively then,

$$e_{t+1} = \Sigma((e_t, p_t), \alpha \Omega_{\text{net}}), \text{ and } p_{t+1} = B((e_t, p_t), \alpha \Omega_{\text{net}}) \quad (17)$$

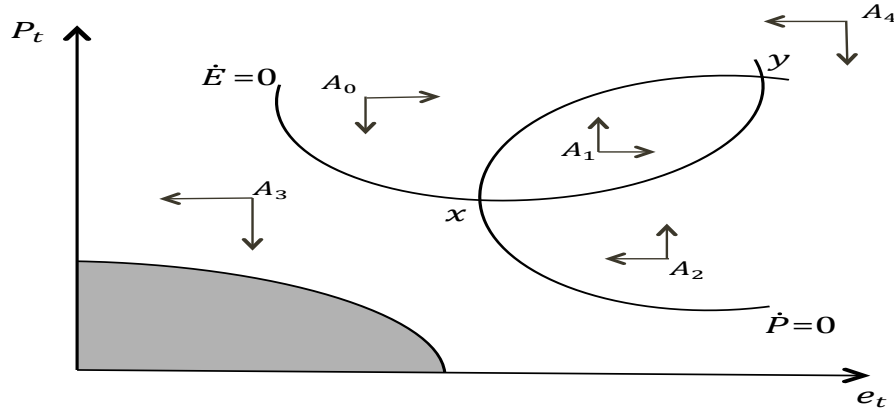
Proposition 3:

For any (q), such that $0 < q \leq 1$, there exists a non-trivial stable steady state equilibrium in the space of (e_t) and (p_t) from equation (15) and (16), if the initial level of technology is sufficiently high.

Proof:

Proposition 3 can be illustrated graphically by showing that at a given level of \bar{e} and \bar{p} , and $A(\bar{e}, \bar{p})$, there exists $e_{t+1} = p_{t+1} = \bar{e} = \bar{p}$. This observation is obvious from equation (12). For simplicity assume that $q = 1$ and $s_t^* = \frac{1}{2}$, then $e_{t+1} = p_{t+1}$. Therefore for any $\bar{e}_t = \bar{p}_t$ both curves will cross exactly on the 45° line. This stable equilibrium is represented by point (y) in Figure 4.

FIGURE 4: GRAPHICAL INTERPRETATION OF THE MODEL'S DYNAMIC



The above graph stipulates that only a sufficiently high average level of initial professional and entrepreneurial human capital will lead to a high non-trivial steady state represented by point (y), where the $\dot{P} = 0$ and $\dot{E} = 0$ loci intersect (see Appendix A for proof). Point (x) is not a stable steady state because for any initial level of technology (A_3) outside $\dot{E} = 0$ and $\dot{P} = 0$, the long-term income will converge back to the shaded area. Countries starting at an initial level of technology as low as A_3 will end up being unskilled as the average level of e_t and p_t decreases in the long run. However, countries with a sufficiently high initial level of technology (represented by points A_0, A_1, A_2 , and A_4), income will converge to a stable steady state level represented by point (y) in the long run.

Proposition 4:

An exogenous positive shock to resource rents distributed Ω_{net} and/or the fraction transferred to human capital (α) leads to a contraction of the convergence region of a high-income level, thus increasing the possibility of convergence to a low-level equilibrium trap.

Proof:

Our model shows that resource rent transfers behave as a curse rather than a blessing, as they distort the efficient allocation of talent for any positive resource rents shock. From *proposition 4*, as a result of higher (α) and/or Ω_{net} , those who have $a_i > \tilde{a}_t$ invest less in optimum schooling which in turn move $\dot{E} = 0$ and $\dot{P} = 0$ loci leading to a significant change in the steady state level of income and the overall model's dynamics. This change will lower the incentive to invest in human capital in the long run. Looking at Figure 5, one can see the consequences of a positive resource rents shock. If a country encounters an increase in distributed resource rents, then professional human capital loci $\dot{P} = 0$ will shift downward to $\dot{P}' = 0$ and $\dot{E} = 0$ to shift rightward to $\dot{E}' = 0$. As shown in Figure 5, $\dot{P} = 0$ will shift downward in a higher magnitude than $\dot{E} = 0$ shifting rightward due to the concavity structure of $f(\cdot)$. A decrease in (s_t) will marginally decrease $f(s_t)$ more than the increase in $f(1 - s_t)$.

To see why less people invest in human capital as a result of a resource shock, one can analyze the effect of resource rents on countries with technology levels such as A_0 and A_2 in both Figure 4 (before a resource shock) and Figure 5 (after a resource shock). Looking at levels of technology such as A_0 and A_2 , one can see that the same points lead to a different steady state level of income before the resource shock (Figure 4) compared to *ex post* (Figure 5). If resource rents are not present, countries starting at either A_0 or A_2 will converge to a high steady state level of income (represented by point y) as the average level of human capital increases each period. However, if a country encounters a resource shock, $\dot{E} = 0$ and $\dot{P} = 0$ will shift to $\dot{E}' = 0$ and $\dot{P}' = 0$ respectively leading A_0 and A_2 to fall outside $\dot{E}' = 0$ and $\dot{P}' = 0$ curves. As a result of positive resource shock, countries with an initial technology levels such as A_0 and A_2 are not capable to increase income as both types of human capital decreases overtime. Figure 5 explains that due to resource windfalls, countries with an initial technology that is exactly

at the border of $\dot{E} = 0$ and $\dot{P} = 0$ *ex ante* will be negatively affected by the positive resource rent shock due to the changes in growth dynamics *ex post*. One interesting observation is that an over accumulation of one type of human capital relative to the other (such as the technology level A_5) may still result in a higher growth in the long run. However, this is constrained by the minimum level of professional human capital¹⁷. In reality there are very few countries where they have a lot of actually innovative entrepreneurs and at the same time not too many highly educated workers. So, the chance of being in that region is significantly small.

Our findings explain why countries such as Saudi Arabia, Libya, Kuwait, Oman, and Venezuela may experience a low level of skilled labor and a low level of technology in the long run compared to countries such as, Canada, and Norway. Usually, advanced resource rich economies are highly endowed with technology where the effect of resource shocks is negligible. Further, any positive shock to technology works in an opposite manner compared to resource shock. One can conclude that resource rents transfers and technology works in opposite directions.

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

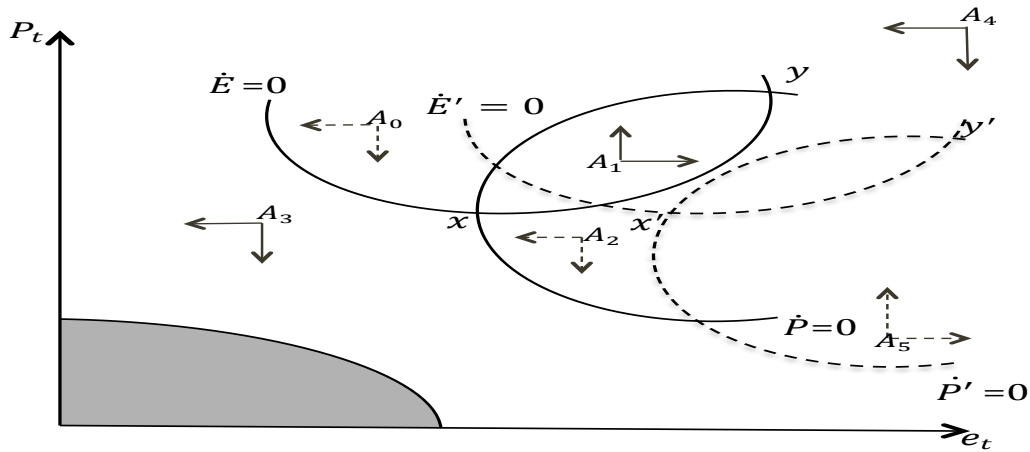


Figure 5 describes the effect of natural resources on human capital accumulation after a positive shock in resource rent. The figure demonstrates that due to their higher level of

¹⁷ As assumed earlier the level of technology $A(e, p)$ is a function of the average level of both types of human capital. This explains why a minimum level of both types of human capital is needed.

overall technology, only higher income countries escape the resource curse. However, resource shocks have more influence on lower-income countries, as those countries will eventually converge back to a low or unskilled labor economy being caught in a development trap.

3.5. FINAL IMPLICATIONS

The aim of this theoretical model is to explain the role of natural resources in hampering investments in human capital accumulation if resource rents are distributed as lump-sum transfer. Including natural capital rents in an overlapping generation model clarifies how incentives are distorted when it comes to the decision of choosing what skills to acquire. From our model presented above, if developing countries are rich in resources, any income transfer to the society at large will be devastating to human capital investments. While resource rent transfers have a minimal negative effect on developed countries especially if they invested enough in technological advancements and innovation upfront. The main finding is that natural resource rich countries are likely to be characterized by a low level of innovation and technology associated with a high level of unskilled industries, due to the inefficient allocation of resource rents over time. Regardless of how rich in natural capital these countries are, if resources are distributed directly to individual's income they will converge back to a relatively low level of GDP per-capita measured by the technology parameter (A_t). Looking at the curse from the incentive corner, our findings justify that government in most developing resource rich countries are not capable of locating their nations on a positive human capital growth path even though resource rents are tremendously high, and capabilities to invest in technologies are high as well.

The distribution of resource rents to the society at large is a crucial policy. Besides the nations that were discussed earlier, one specific case namely Alaska where the state law says that the resource fund must distribute half of the investment earnings on an equal per capita basis through transfers (Frankel 2010). Sala-I-Martin and Subramanian (2003) also suggest that Nigeria should similarly distribute its oil earnings on an equal per capita basis, and Birdsall and Subramanian (2004) make the same proposal for Iraq. However, our research indicates that government policies that depend on distributing generated rents as income transfers will discourage investments in human capital, and keep agents wellbeing almost under the mercy of transfers fluctuations, especially in countries that have a low initial level of technology to start with. Our research tries to fill a gap that has not been discovered by the previous literature, hence giving a better understanding of one of the most important policy issue that resource rich countries are facing.

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APPENDIX A:

I. Proposition 1:

Using the implicit function theorem and equation (11) one can prove the following:

$$\frac{\partial \tilde{a}_t}{\partial p_t} < 0, \frac{\partial \tilde{a}_t}{\partial e_t} < 0, \frac{\partial \tilde{a}_t}{\partial \alpha_t} < 0, \frac{\partial \tilde{a}_t}{\partial \Omega_{net}} > 0 \text{ let,}$$

$$F(e_t, p_t, \alpha_t) = F(\{q \ln\{[A_{t+1} \tilde{a}_t [f(s_i) + f(1 - s_i)] + \alpha \Omega_{net}\} + (1 - q) \ln\{A_{t+1} \tilde{a}_t f(s_i) + \alpha \Omega_{net}\} - \ln\{\omega + 2(1 - \alpha) \Omega_{net}\}\} = 0),$$

$$\text{then, } \frac{\partial \tilde{a}_t}{\partial p_t} = -\frac{F_{p_t}}{F_{\tilde{a}_t}} < 0, \frac{\partial \tilde{a}_t}{\partial e_t} = -\frac{F_{e_t}}{F_{\tilde{a}_t}} < 0, \frac{\partial \tilde{a}_t}{\partial \alpha_t} = -\frac{F_{\alpha_t}}{F_{\tilde{a}_t}} < 0$$

$$, \frac{\partial \tilde{a}_t}{\partial \Omega_{net}} = -\frac{F_{\Omega_{net}}}{F_{\tilde{a}_t}} > 0$$

II. Proposition 2:

$$^{Max}_{s_i} \left[E[U(c_{t+2}^i) | t] = [q \ln(c_{t+2}^i)_{Success} + (1 - q) \ln(c_{t+2}^i)_{Failure}] \right]$$

$$\text{Subject to: } Y_{t+1}^i = (Y_{t+1}^i)^p + (Y_{t+1}^i)^e$$

The first order condition (F.S.O) with respect to (s_i) :

$$\frac{\partial E[U(c_{t+2}^i) | t]}{\partial s_i} = \frac{q A_{t+1} a_i [f'(s_i) - f'(1 - s_i)]}{\{A_{t+1} a_i [f(s_i) + f(1 - s_i)] + \alpha \Omega_{net}\}} + \frac{(1 - q) A_{t+1} a_i f'(s_i)}{[A_{t+1} a_i f(s_i) + \alpha \Omega_{net}]}$$

This can be written as:

$$\frac{\partial E[U(c_{t+2}^i)|t]}{\partial s_i} = \frac{qA_{t+1}a_i[f'(s_i) - f'(1-s_i)]}{(c_{t+2}^i)_{Success}} + \frac{(1-q)A_{t+1}a_i f'(s_i)}{(c_{t+2}^i)_{Failure}}$$

taking the second order condition (S.O.C) with respect to (s_i) :

$$\begin{aligned} & \frac{\partial^2 E[U(c_{t+2}^i)|t]}{\partial^2 s_i} \\ &= \frac{qA_{t+1}a_i[f''(s_i) + f''(1-s_i)] \cdot (c_{t+2}^i)_{Success} - qA_{t+1}^2a_i^2[f'(s_i) - f'(1-s_i)]^2}{(c_{t+2}^i)_{Success}^2} \\ &+ \frac{(1-q)A_{t+1}a_i f''(s_i) (c_{t+2}^i)_{Failure} - (1-q)A_{t+1}^2a_i^2[f'(s_i)]^2}{(c_{t+2}^i)_{Failure}^2} < 0 \end{aligned}$$

To prove the following condition: $\frac{\partial s^*}{\partial p_t} > 0$, And $\frac{\partial s^*}{\partial e_t} > 0$, $\frac{\partial s^*}{\partial \Omega_{net}} < 0$, $\frac{\partial s^*}{\partial a_i} > 0$ we also use

the implicit function theorem from equation (12). Let,

$$G(s_i, e_t, p_t, \Omega_{net}) = G\left\{\frac{q}{1-q} + \left\{\frac{\{A_{t+1}a_i[f(s_i^*) + f(1-s_i^*)] + \alpha\Omega_{net}\}}{[A_{t+1}a_i f(s_i^*) + \alpha\Omega_{net}]} * \frac{f'(s_i^*)}{[f'(s_i^*) - f'(1-s_i^*)]}\right\} = 0\right\} \text{ then,}$$

$$\frac{\partial s^*}{\partial p_t} = -\frac{G_{p_t}}{G_{s_t^*}} > 0, \frac{\partial s^*}{\partial e_t} = -\frac{G_{e_t}}{G_{s_t^*}} > 0, \frac{\partial s^*}{\partial \Omega_{net}} = -\frac{G_{\Omega_{net}}}{G_{s_t^*}} < 0$$

III. Proposition 3 and 4:

Assume the following: $\dot{E} = 0$, $\dot{P} = 0$ will not intersect with the shaded area i.e. :

$$\begin{aligned} \mu = \{ & (e_t, p_t, \Omega_{net}) | q \ln[A_{t+1} \tilde{a}_t [f(s_i) + f(1 - s_i)]] + \alpha \Omega_{net} \\ & + (1 - q) \ln\{A_{t+1} \tilde{a}_t f(s_i) + \alpha \Omega_{net}\} - \ln \{\omega + 2(1 - \alpha) \Omega_{net} \\ & > 0 \} \end{aligned}$$

- 1- From $\dot{P} = 0 = p_{t+1} - p_t = 0$, and $\dot{E} = 0 = e_{t+1} - e_t = 0$, equation (15) and (16) and given $0 \leq \tilde{a}_t \leq 1$, one can prove the following :

$$\frac{\partial p_t}{\partial e_t} | \dot{E} = -\frac{\Sigma_e^{-1}}{\Sigma_p}, \text{ and } \frac{\partial p_t}{\partial e_t} | \dot{E} \text{ will be negative if } \Sigma_e > 1, \text{ and positive otherwise.}$$

$$\frac{\partial p_t}{\partial e_t} | \dot{P} = -\frac{B_e}{B_p - 1}, \text{ and } \frac{\partial p_t}{\partial e_t} | \dot{P} \text{ will be negative when } B_p > 1, \text{ and positive otherwise.}$$

The slope of $\dot{E} = 0$ and $\dot{P} = 0$ will have the following characteristics:

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

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

C- Given that s_t , and \tilde{a}_t are continuous on e_t and p_t , there exist a value p' , and e'

such that $\frac{\partial p_t}{\partial e_t} | \dot{P} = 0$

D- Given that s_t , and \tilde{a}_t are continuous on e_t and p_t , there exist a value p' , and e'

such that $\frac{\partial p_t}{\partial e_t} \dot{E} = 0$.

Points A, B, C, D justify the shape of $\dot{E} = 0$ and $\dot{P} = 0$ loci in the space of e_t and p_t .

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

p_t .

Assume a value of $q=1$, then equation (12) will hold only if, $f'(s^*) = f'(1 - s^*) = f'(\frac{1}{2})$.

Then, $e_{t+1} = p_{t+1} = (1 - \tilde{a})f(\frac{1}{2})$. Given this, for any value of e and p , (e^*, p^*) , such that $e^* = p^*$ on $\dot{P} = 0$, and a value of e and p , (\bar{e}, \bar{p}) , such that $(\bar{e} = \bar{p})$ on $\dot{E} = 0$, then $\bar{e} = \bar{p} = e^* = p^*$ and there exist a steady state exactly on the intersection of $\dot{P} = 0$ and $\dot{E} = 0$ loci. Further both $\dot{P} = 0$, and $\dot{E} = 0$ must intersect exactly at a 45° straight line.

3- To test the effect of resource rents on the shape of \dot{P} and \dot{E} loci, then given the optimum

level of schooling from equation (12), and using the implicit function theorem, $\frac{\partial s^*}{\partial \Omega_{t_{net}}} <$

0. This will shift the \dot{E} , and \dot{P} , in different directions since \dot{E} , and \dot{P} , are continuous on (s^*) .

To prove that the curves are shifting one can divide both curves $p_{t+1} - p_t = 0$, and

$e_{t+1} - e_t = 0$ by each other,

$$p_t = \frac{f(s_t)}{f(1 - s_t)} e_t$$

This shows that the steady state location is changing with (s_t)

THE EFFECT OF GOVERNMENT TRANSFERS ON HUMAN CAPITAL IN RESOURCE RICH COUNTRIES

1. INTRODUCTION

We present dynamic panel data and cross section models to see the effect of natural resource rents transfers on human capital accumulation. We use tertiary education as a human capital indicator, since at this educational level, people choose to accumulate professional skills and direct their talents to sectors with the highest expected return. Using a dynamic panel data model, one can see that the combined effect of government transfers and natural resource rents per labor have a negative and statistically significant effect on human capital. However, using a cross section analysis for the same purpose, we show that not only the combined effect of resource rents per labor and government transfers have a negative and significant effect on tertiary education, but also resource rents per labor have a negative and significant effect on tertiary education.

Our empirical models employed in this research are related to various studies in the economic growth literature: Barro and Sala-i-Martin (1995) studied the effect of secondary education on economic growth, Sachs and Warner (1995, 1997, 2001) showed that economies with a high ratio of natural resource exports to GDP in 1970 (as a base year) tended to grow slowly during the subsequent 20-year period 1970-1990. Using cross-country evidence, Gylfason (2001) reviewed the relationship between natural resource dependence and economic growth. He particularly stressed how natural capital intensity tends to crowd out social capital, human capital, physical capital, and financial

capital, thereby impeding economic growth across countries. Sala-I-Martin and Subramanian (2003) showed that Nigerian long term *low* growth is blamed on the wastes and corruption from oil rather than the Dutch disease. Bravo-Ortega and De Gregorio (2005) showed that having a large level of human capital can offset the resource curse. In a panel data model, 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.

There are two factors that distinguish this study from the earlier ones discussed above. First, given the theoretical structure of our model in chapter one, our hypothesis is ***not*** that natural 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 resource rents have a deleterious impact on the incentive to accumulate human capital. Our argument states that countries having a high level of natural rents per person experience a negative effect on human capital accumulation if these rents are distributed as unconditional government transfers. This unique aspect derived from the model, has not been examined before. Second, previous studies focused on secondary education as a measure for human capital, while we focus on ***tertiary*** education in our analysis. Not only has this measure been somewhat neglected in the literature, we also believe that it is more pertinent to the notion of specialization and skills, and crucial to technological innovation and the process of economic growth.

Our paper employs two empirical methodologies to study the effect of transfers on human capital. First, using a dynamic panel data fixed effect model, we see that the

combined effect of government transfers and natural resource rents has a negative and statistically significant effect on the conditional mean of human capital. Further, if we classify countries by the level of dependence on resources rents and by regions, our results do not change. Second, to study the combined effect of resource rents and government transfers on human capital between different countries, we employ a cross section analysis. We show that the combined effect of natural resource rents and government transfers have a negative effect on human capital. Further, over a 30 years average, resource rents per labor have a negative and significant effect on tertiary education. This negative effect of resource rents per labor coincides with the resource curse literature as natural capital rents hinder social capital such as physical and human capital.

The remainder of the paper is organized as follows: section 2 conducts a brief review of the literature on natural resources and human capital investments, stressing on the transfers literature that is most relevant to our analysis. Section 3 presents the model estimations, covering both methods; dynamic panel data analysis, as well as the cross section analysis to support our theoretical findings explained in chapter one. Section 4 includes concluding results, and policy recommendations.

2. BRIEF REVIEW

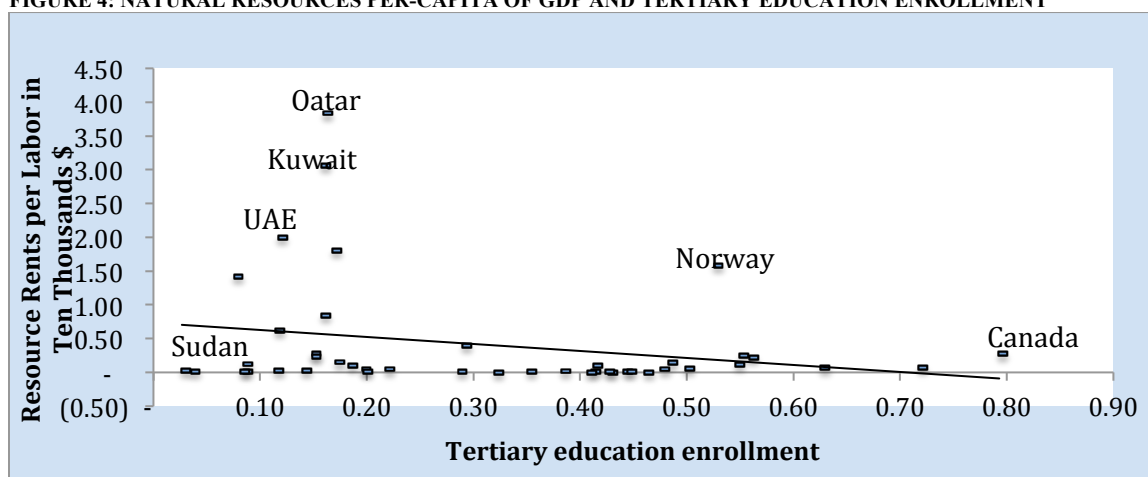
2.1. HUMAN CAPITAL ACCUMULATION IN RESOURCE RICH COUNTRIES

Numerous studies used two measures of government spending on education merely government expenditures on education and skill accumulation as a fraction of total GDP and school enrollments. Both measures found to be negatively related to the level of

natural resources (Gylfason, Herbertsson, and Zoega 1999). Birdsall, Pinckney and Sabot (2001) showed that resource-rich countries invest less in trainings and skills accumulation than resource-poor countries. Looking at resource-poor countries in Asia, average secondary school enrollment was 60 percent during the 1980s, compared to only 38 percent average enrollment in resource abundant countries (World Bank 2010). Poor performance was also reported for Northern Africa, and Latin America.

If we slightly recast the relations between human capital and natural resource rents using tertiary education instead of secondary education, results does not change. We show in Figure 2 the there is a negative relation between natural resource rents and tertiary education for 46 countries. One interesting observation is that resource dependent countries, especially those in the MENA region were part of the worst performing group for the past 30 years. However, a unique example of a positive correlation between tertiary education and natural rents per labor is Norway. As a natural resource rich country, Norway always perceived its natural resources as a blessing combined with an educated labor force, which made it easier for the Norwegian society to control resources windfalls (World Bank 2010). It is evident in Norway that human capital accumulation was a significant driver behind the economic prosperity, while natural capital was a secondary driver as rents are saved for future generations. A World Bank study has shown that on average 60 percent of Norway's national wealth was related to intangible capital, including human capital and skills, and only 13 percent to natural capital (World Bank, 2010).

FIGURE 4: NATURAL RESOURCES PER-CAPITA OF GDP AND TERTIARY EDUCATION ENROLLMENT



Source: By the authors

Various reasons can be identified to explain this downward slope in the above curve. First, the issue of comparative advantage can play a significant role for the adverse effect of resources on human capital. For example, Behbudi, Mamipour and Karami (2010) have argued that countries endowed with large natural reserves, find it easier to engage chiefly in the production or extraction of such resources, since their comparative advantage in these resources means low levels of required initial investments. But production or extraction in resource-based industries does not require an intensive level of human capital as compared to sectors such as manufacturing. Thus, the exploitation of such resources comes at the expense of social services, in particular human capital development. Likewise, Gylfason (2001) argues that a focus on natural resource as the main source of national income retards the development of the manufacturing sector, because skilled jobs are scarce and hence returns to human capital are low. Birdsall, Pinckney and Sabot (2001) argue that due to lower return in such countries, citizens do not find it necessary to pressure governments to provide skill intensive sectors.

Second, Beck (2010) claims that aside from price increase, the resource curse distorts the incentives to invest in human capital because of higher windfall gains from natural resource rents. Profits generated from resource rents are considered short-term profits compared to manufacturing plants, equipment, and machinery returns. Furthermore, these profits depend less on market creation, human capital, and on research and development (R&D) investments (Besley and Persson, 2011). All these factors contribute to low incentives to invest in types of human capital specifically tertiary education. It is also crucial to point out that if countries fail to invest in human capital, it will be difficult for them to move away from their dependence on resources to more sophisticated products in the long run. Over the past fifty years mainly Finland and South Korea managed to escape from depending on their resource income toward more sophisticated manufacturing. Further, these countries have a higher level of human capital compared to other countries (Gelb 2010). However, most resource dependent countries especially those that have high resource rents per labor among others have a low level of human capital. Anecdotal evidence from Table 1 suggests that resource rich industrialized countries do exhibit higher tertiary education while, for example, resource rich countries of the MENA region that are highly dependent on resources have a generally lower levels tertiary education.

TABLE 1: AVERAGE TERTIARY EDUCATION AS A PERCENTAGE OF TOTAL EDUCATION

High Human Capital Countries	30 years average percentage of tertiary education	Low Human Capital Countries	30 years average percentage of tertiary education
Australia	0.531	Bahrain	0.121
Canada	0.714	Kuwait	0.123
Norway	0.525	Oman	0.073
United States	0.694	Qatar	0.173
New Zealand	0.343	Saudi Arabia	0.169

2.2. HUMAN CAPITAL, NATURAL RESOURCES AND TRANSFERS

Over the past 30 years transfer policies were the most famous tool to boost education investments, especially in Latin American countries. These transfer programs are classified into two types: conditional cash transfers and unconditional cash transfers. Conditional transfers are focused on households conditional on specific guidelines that shall be fulfilled such as school enrollment. Generally, these transfers are a popular public policy especially in Brazil, Mexico, Venezuela, and Colombia. Conditional cash transfers showed effectiveness, mainly on early stages of education (for young children in pre-school and primary education), but there is shallow or no evidence on the effect of transfers on human capital in resource rich countries, especially at the tertiary level.

There are also various governmental unconditional cash transfers (UCTs) directed to an individual's income to cover a wide range of needs in different countries. UCTs are defined as government distribution of wealth with no conditions assuming that individuals will behave rationally (UK Aid, 2011). Usually, resource rich-countries distribute unconditional cash transfers to the society at large, without generating future taxes. Oil-producing countries do provide this form of lump-sum unconditional transfers, potentially to placate society or reduce the risk of social unrest. For example, the Kuwaiti authorities spent 4.12 billion dinars in 2008 on lump-sum transfers to national citizens, which correspond to 43% of government aggregate expenditures (Elkatiri et. al. 2011). Further evidence of such transfers in resource rich countries can be found in the case of Saudi Arabia (IMF, 2012). These transfers show up in the form of wage premia that stem from oil rents. To indicate the extent of such transfers, one can compare wages of Saudi nationals with those of foreign workers. According to the IMF 2012, Saudi national's

non-skilled labor income is 4.1 times higher than that of the expatriates. To link government transfers with resource rents, Gelb and Decker (2011) argued that average fiscal revenues from natural resources in 14 Middle Eastern natural resources exporter countries were around 57.2% of total revenues. Further, in most countries with high resource rents per person and/or high resource rents per GDP, income transfers to the society stems mainly from resource rents, as these countries have a lower tax rates compared to other countries¹⁸.

In general, there is limited evidence on the effect of transfers on human capital accumulation mainly tertiary education. Regardless of the types of transfers, research showed welfare improvement only when rents were distributed to boost consumption (World Bank, 2011). Yet, the literature on cash transfers claims that these welfare transfers increase dependency and undesirable behavior (Heinrich 2011). Heinrich argued that cash transfers increased the society's welfare through fulfilling short term consumption needs, and at the same time did not promote long term goals such as investments in human capital accumulation and human development. One can conclude that there is a lot to be learned about the effect of transfers on the incentive to invest in human capital. Resource-rich countries shall realize that cash transfers to the society at large, especially those that are stemming from resource rents, will not effectively promote human capital accumulation in the long run. It is obvious from the previous literature that transfers might work if these transfers are directly target issues such as poverty and health.

¹⁸ According to the 2012 CIA fact-book, the majority of resource rich developing countries have tax rates below ten percent, and some of them go down to zero percent.

3. EMPIRICAL ANALYSIS

This part will examine how natural resources, government transfers, and human capital interact. As was discovered in previous sections and relating to the literature of economic growth, the effect of natural resource rents on human capital and economic growth is negative. Further, the key innovation in our theoretical model in essay one was to show the effect of lump-sum transfer, $\alpha \Omega_{\text{net}}$, to reduce the incentive to accumulate human capital. In this section we will add an additional evidence to support our theoretical results empirically through showing the influence of resource rents and government transfers on schooling using tertiary education as an indicator of human capital. First, we examine the effect of transfers on human capital while resource rents are present by using five years averages of tertiary education between 1980-2009. Using five years averages of tertiary education coincide with major conventional analysis linking education and human capital with economic growth specifically Barro (2000). The implication of this analysis will be determined using a dynamic panel data of 45 countries. Second, we capture the long-term effect of resource rents and government transfers on human capital *between* countries using a cross section analysis.

3.1. DYNAMIC PANEL DATA

The dynamic panel data model employed in our analysis follows the following general form,

$$y_{it} = \alpha + \beta_0 y_{i(t-1)} + \beta_1 Z_{it} + \beta_2 X_{it} + u_i + \psi_t + \epsilon_{it}$$

A dynamic estimator is used as we seek to analyze a panel data that have dynamic relation overtime. It is clear from the economic growth literature that the initial levels of

education are considered as a base for higher growth. From our hypothesis above, our benchmark equation is as follows¹⁹

$$\begin{aligned} TertiaryEdu_{it} = & \alpha + \beta_0 TertiaryEdu_{it-1} + \beta_1 ResourceRents\ per\ labor_{it} + \beta_2 Gov.Transfers_{it} \\ & + \beta_3 (Gov.Transfers * Resource\ rents\ per\ labor)_{it} + \beta_4 X_{it} + u_i + \psi_t + \epsilon_{it} \end{aligned}$$

We use Arellano-Bover and Blundell-Bond estimator for the above model due to the following reasons: First, the regressors might be endogenous as some of the control variables might have a causality that is going in both directions. Second, the lagged dependent variable $TertiaryEdu_{it-1}$ is correlated with the first difference of the error term. Arellano-Bover and Blundell-Bond estimation starts through transforming regressors to eliminate the country specific intercept u_i , and then one can use instruments for regressors that might be endogenous. Further, Arellano-Bover and Blundell-Bond estimation instruments the lag of the dependent variable $TertiaryEdu_{it-1}$ by $TertiaryEdu_{it-2}$ to avoid autocorrelation. In this model we assume a sequential moment restriction to insure that our independent variables are sequentially exogenous conditional on the unobserved effect.

$$E(\epsilon_{it} | X_{it}, X_{it-1}, \dots, X_{i1}, u_i) = 0$$

The above assumption insures that using the first difference as an instrumental variable is sequentially exogenous.

¹⁹ See Appendix B for variables specifications.

Here, "*Tertiary Edu*" and its lagged value "*TertiaryEdu_{it-1}*" are defined as the tertiary education enrollment as a percentage of total population of tertiary education age. Five years average data from 1980 to 2009 is collected from the World Bank Development Indicators including both sexes. *Resource Rents per labor* is the measure of resource profit generated per unit of labor. According to the World Bank Development Indicators, natural resource rents are the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents, net of cost. *Gov. Transfers* represent 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, as taxes in most developing and least developing resource rich nations are minimal.

*Gov. Transfers * Resource rents per labor* captures the combined effect of natural resources and government transfers on tertiary education over time and across countries. We consider this variable as a proxy of the $\alpha\Omega_{net}$ innovation in our theoretical model. This variable examines the effect of government transfers on countries that have a high level of resource rents per person. As mentioned earlier, most resource rich countries have a tax rate that is less than 10 percent where most government transfers stems from resource rents. Finally, X_{it} is a set of other control variables including education expenditures as a percentage of total expenses, GDP per capita, foreign direct investments as a percentage of GDP, savings rates, time dummies, and terms of trade as a percentage of GDP.

3.1.2. MODELS ESTIMATION

Table 1 presents our results from the dynamic panel data regressions. First, we use a data set that includes 44 countries, and then for robustness we stratified two data sets from our original sample based on different country characteristics such as the level of resource dependence, and MENA region countries. This was done to capture the effect disparity of resource rents and government transfers on tertiary education. Looking at government transfers and resource rents per labor in all three regressions, each variable *alone* has a negligible effect on tertiary education. However, the key result is that the ***combined*** effect of transfers and natural resource rents per labor is negative and significant at a less than 5% significance level. Further this negative effect is persistent in resource dependent and MENA region countries.

From regression (1), if the product of resource rents per labor and government transfers increases by one unit, tertiary education will decrease by 3.06 units²⁰. If we investigate only resource rich dependent countries, one can see that the combined effect of resource rents per labor and government transfers have also a negative and significant effect on tertiary education. From regression (2), a one-percentage increase in the product of resource rents per labor and government transfers will decrease tertiary education by 2.127 percent. Looking at the MENA region, an increase in (*government transfers*resource rents per labor*) by one percentage point will decrease tertiary education by 2.8 percent. One interesting observation is that the initial level of tertiary education has a significant effect on the path of tertiary education only in regression (1)

²⁰ (*Government transfers*resource rents per labor*) is expressed by 1/10000 of a unit.

and (2). However, in MENA region countries, the initial level of tertiary education is not significant.

Additional observations are as follows: looking at regression (1) public spending on education has a positive and significant effect on tertiary education. An increase in one percentage point of public spending as a percentage of total government expenditures will increase tertiary education by 2.6 percentage points. However, looking at regression (2) and (3), the effect of public spending on tertiary education is negligible. These results are expected as most resource rich dependent countries have relatively inefficient government spending associated with a high level of rent seeking activities and corruption²¹.

In this dynamic panel data model, our empirical findings adds more evidence to our theoretical interpretation in chapter one, on how resource rent transfers lower the incentive to invest in schooling. The adverse role of resources *via lump sum transfers* is brought home further, when we note that either variable *alone* exhibits a negative and significant effect. Our findings in Table 2 showed that for five years averages of tertiary education, it is not the level of natural resource endowment that matters. What matters is how these resource rents are distributed and their effect on the level of human capital.

²¹ Besides Norway, and according to the International Country Risk Guide, countries such as Saudi Arabia has a corruption level of 2.5 out of 5, Kuwait 2.3 out of 5, Iran 1.75 out of 5, and Venezuela 2.8 out of 5. These numbers are based on averages of 25 years of data for each country.

TABLE 2: DYNAMIC PANEL DATA TO STUDY THE COMBINED EFFECT OF TRANSFERS AND RESOURCE RENTS ON HUMAN CAPITAL

	All Countries (1)	Resource Dependent Countries (2)	MENA Region (3)
Lag of tertiary education	1.159 (12.92)**	1.243 (9.39)**	0.021 (-0.08)
Lag log gdp-per capita	-0.093 -0.51	-0.196 -1.79	0.172 (-1.19)
Lag FDI	0.012 (-1.47)	0.007 (-1.17)	-0.003 (-0.74)
Resource rents per labor	0.506 (-1.05)	0.304 (-0.08)	0.202 (-0.06)
Gov. transfers	0.106 (-1.46)	0.054 (-0.46)	-0.042 (-0.26)
Gov. transfers* resource rents per labor	-3.063 (-2.39)*	-2.127 (-2.52)*	-2.887 (-3.14)**
Education expenditures	2.627 (3.11)**	1.755 (-1.65)	-1.292 (-1.26)
Tax revenues per gdp	0.042 (-0.25)	0.24 (-1.07)	0.651 (2.60)**
Terms of trade	-0.002 (-0.05)	0.018 (-0.30)	0.019 (-0.41)
Democracy	-0.017 (-1.13)	-0.03 (-1.58)	-0.013 (-0.90)
Time dummies	✓	✓	✓
Constant	0.1 (-0.62)	-0.104 (-0.68)	-0.075 (-0.53)
<i>N</i>	220	60	56

Notes: The numbers in parentheses are t statistics. Variables were taken from the World Bank Indicators. Note that the significance level is: *p<0.05; **p<0.01. Model (1) includes our overall sample including resource rich and resource poor countries. Model (2) represents countries with resource rents higher than 20% of total GDP. Model (3) represents resource countries in the MENA region.

In addition to the models employed above, we tested if results are robust to different model specifications such as trying different natural resource rents variable specification, different types of education, and different time brackets. First, we used resource rents per gdp instead of resource rents per labor and secondary education instead of tertiary education. The combined effect of resource rents per gdp and transfers have the same

statistical effect on tertiary education as resource rents per labor. However, the effect of government transfers and human capital is positive and *not* statistically significant on secondary education.

Second, employing a dynamic panel data model with annual data of tertiary education, our results coincide with table 2. The combined effect of resource rents and government transfers is negative and statistically significant on tertiary education.

3.2. CROSS SECTION ESTIMATION

Table 1 highlighted the combined effect of resource rents per labor and government transfers using averages of five years of tertiary education. In Table 2 we study the same combined effect of resource rents and government transfers on human capital between countries through averaging over the entire period (An average of all years between 1980 and 2009). Our benchmark equation is as follows,

$$\begin{aligned} TertiaryEdu_i = & \alpha + \beta_1 Resource\ rents\ per\ labor_i + \beta_2 Gov.transfers_i \\ & + \beta_3 (Gov.Transfers * Resource\ rents\ per\ labor)_i + \beta_4 X_i + \epsilon_i \end{aligned}$$

In this cross section regression we added additional control variables such as the stock of technology, and corruption, that might influence tertiary education enrollment in the longer run. To see the effect of technological advancement, we utilize the Technological Output Index²² to measure the innovation level. Technology output is measured as a weighted average of knowledge creation, knowledge impact, and knowledge diffusion.

²² Technology output was taken from the Global Innovation Index. The index was created through a joint effort by INSEAD, Cornell University, and World Intellectual Property Organization.

We also added democracy and corruption to control for the institutional performance in our studied countries.²³

3.2.1 MODELS ESTIMATION

Looking at Table 2, one can see that not only the combined effect of resource rents per labor and government transfers have a negative effect on tertiary education, but also resource rents per labor alone have a negative and significant effect on tertiary education as well. Our results coincide with the natural resource curse literature as natural resources have a long-term negative effect on social capital investments such as tertiary education. A one unit increases in resource rents per labor; will significantly decreases tertiary education by .124 units. This ties well with our previous theoretical model reflecting the increase in Ω_{net} . Specifically, any increase in Ω_{net} will increase the threshold innate ability to invest in human capital, and decrease the overall level of income.

Additional to the resource curse effect, the combined effect of resource rents and government transfers have a negative and significant effect on tertiary education among 44 countries. For countries having a high level of resource rents per labor, an increase in government transfers by one unit; reduce tertiary education by 1.179 units. One interesting observation is that the initial level of tertiary education can significantly influence tertiary education enrollment in the short run (Table 1), and the long run (Table 2). From Table 2, an increase of 1 percent in the 1980's level of tertiary education, will improve tertiary education by 0.6 percent between countries. Further, looking at the

²³ In this cross section analysis we try different regressions, including a regression with the same number of variables as our dynamic panel regressions reported in table 1). However results are not robust due to the high degree of endogeneity. The reported regression in table 2 includes additional control variables so to reduce the endogeneity issue and increase the robustness of our results. (Please see Table 4 in Appendix A)

combined effect of technological output and resource rents shows that any improvement in technological output index will significantly increase tertiary education. If the combined effect of technology output and resource rents per labor increase by 1 unit, tertiary education will increase by .008 units.

TABLE 3: CROSS SECTION MODEL TO STUDY THE COMBINED EFFECT OF RESOURCE RENTS AND GOVERNMENT TRANSFERS ON TERTIARY EDUCATION.

	Robust standard errors
Initial tertiary education	0.609 (2.06)*
Resource rents per labor	-0.124 -(2.05)*
Gov. transfers	0.22 (2.19)*
Gov. transfers* resource rents per labor	-1.791 -(2.17)*
Education expenditures	-0.739 -(1.04)
Tax revenues per gdp	-0.036 -(0.21)
Terms of trade	0.03 -(0.59)
Democracy	0.016 (0.99)
Log gdp per capita	0.028 -(1.38)
Savings	-0.204 -(1.23)
Corruption	0.047 (1.74)
Technology output	-0.003 -(2.49)*
Technology output* resource rents per labor	0.008 (2.63)*
Constant	-0.186 -(1.50)
R^2	0.82
N	44

Notes: The numbers in parentheses are t statistics. Variables were taken from the World Bank Development Indicators. Note that the significance level is: * $p < 0.05$; ** $p < 0.01$

4. CONCLUSION

In our analysis, both the dynamic panel data and the cross section models show that, as government transfers increases in countries with high natural resource rents per person investments in schooling will decrease, and the effect is statistically significant. We find that government transfers that stem from resource rents distort human capital investments over time especially in human capital scarce economies. The empirics showed a negative and significant relationship between the *interaction* of government transfers with natural resource rents, and human capital (tertiary education). The empirical models presented above show how natural resources might retard the incentives of individuals to invest in human capital if rents are transferred to the society at large. Our findings justify why resource rich countries such as the MENA region or parts of Latin America, which may consider income transfers as their preferred policy, end up with a low level of human capital, relative to others along the growth path. According to our models explained above transfers make it more difficult to invest in tertiary education especially in countries that have a high resource rents per person.

In both, the theoretical and empirical models in chapter one and two, our results present a thorough understanding of an economic development issue in resource rich countries. Our findings facilitate effective formulation and implementation of efficient and successful government policies in resource abundant countries, especially in countries that are not able to build a higher human capital stock. Eventually, public policy needs to be assessed in terms of its contribution to development.

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APPENDIX A:**TABLE 4: CROSS SECTION MODEL TO STUDY THE COMBINED EFFECT OF RESOURCE RENTS AND GOVERNMENT TRANSFERS ON TERTIARY EDUCATION.**

	(1)	(2)	(3)
Initial tertiary education	0.489 (1.42)	0.508 (1.47)	0.609 (2.02)
Resource rents per labor	-0.046 (-1.49)	-0.14 (-2.11)*	-0.124 (-2.05)*
Gov. transfers	0.11 (1.18)	0.279 (2.57)*	0.22 (2.19)*
Gov. transfers* resource rents per labor	0.64 (0.80)	-1.816 (-1.59)	-1.791 (-2.17)*
Education expenditures	0.599 (-0.62)	0.154 (-0.16)	-0.739 (-1.04)
Tax revenues per gdp	0.025 (-0.12)	0.013 (-0.07)	-0.036 (-0.21)
Terms of trade	-0.03 (-0.60)	0.023 (-0.41)	0.03 (-0.59)
Democracy	0.02 (1.21)	0.023 (1.39)	0.016 (0.99)
FDI	0.006 (-0.43)	-0.015 (-0.71)	
Log gdp per capita	0.053 (2.24)*	0.042 (-1.80)	0.028 (-1.38)
Savings		-0.37 (-1.49)	-0.204 (-1.23)
Corruption			0.047 (1.74)
Technology output		-0.002 (-1.85)	-0.003 (-2.49)*
Technology output* resource rents per labor		0.008 (2.23)*	0.008 (2.63)*
Constant	-0.352 (2.28)*	-0.21 (-1.35)	-0.186 (-1.50)
R^2	0.77	0.8	0.82
N	44	44	44

Notes: The numbers in parentheses are t statistics. Variables were taken from the World Bank Development Indicators. Note that the significance level is: *p<0.05; **p<0.01

Appendix B:

Variables	Explanation	Source
Per-Capita Income	Gross Domestic Product Per-capita Growth	<i>World Bank</i>
Resource rents per labor	Resource Rents per unit of labor force	<i>World Bank</i>
Savings	Total Savings as a percentage of GDP	<i>World Bank</i>
FDI	Total FDI as a percentage of GDP	<i>World Bank</i>
Education Spending	Government Expenditures on Education Per Capita	<i>World Bank</i>
Trade	Terms of Trade As a percentage of GDP	<i>World Bank</i>
Manu-Per-GDP	Manufacturing Products as a Percentage of GDP	<i>World Bank</i>
Government Transfers	Government transfers and subsidies of total expenses	<i>World Bank</i>
Democracy	Democracy level going from 0(Nondemocratic) to 6 (Democratic)	<i>ICRG</i>
Technological output index	Innovation and production of high tech products	<i>Global Innovation Index</i>
Corruption.	Corruption level going from 0(corrupt) to 5 (not corrupt)	<i>ICRG</i>

Curriculum Vitae

EDUCATION

DOCTOR IN PHILOSOPHY (PH.D.) IN ECONOMICS: EXPECTED COMPLETION: MAY 2014

- University of Wisconsin, Milwaukee, WI

Dissertation Title: Essays on the Macroeconomic Effect of Natural Resource Rents

Fields of Interest: *Economic Development and Policy, Economic Growth, and Macroeconomics*

MASTER OF BUSINESS ADMINISTRATION (MBA), MAJOR IN FINANCE: MAY 2007

- Eastern Michigan University, Ypsilanti, MI

BACHELOR OF ARTS (BA) IN FINANCE: DEC 2004

- Davenport University, Grand Rapids, MI

RESEARCH

- Income transfers and human capital: Application to resource rich countries. A theoretical approach. (*Presented in multiple conferences, and won the Best Paper Award at the Economic Research Forum Conference, Cairo*)
- Effect of resource rent lump-sum transfers on human capital accumulation. An empirical approach. (*Presented in multiple conferences*)
- Natural resource revenues, and its effect on the pattern of domestic investments relative to international investments. (*Working paper*)
- Economic growth stress tests and tail events robustness: An empirical analysis. (Research in Progress)

TEACHING EXPERIENCE

UNIVERSITY OF WISCONSIN-WHITEWATER: COBE SCHOOL OF BUSINESS (AACSB ACCREDITED)

<i>Lecturer, Statistical Methods in Economics and Business Administration</i>	2012–Present
<i>Lecture, Principles of Microeconomics Theory</i>	2013–Present
<i>Lecturer, Applied Macroeconomics (Graduate level, MBA)</i>	Spring-2013
<i>Lecturer, Principles of Macro-economics</i>	Spring-2013

UNIVERSITY OF WISCONSIN-MILWAUKEE: DEPARTMENT OF ECONOMICS

<i>Instructor, Intermediate Macroeconomics</i>	2010–2012
<i>Instructor, Principles of Macroeconomic Theory</i>	2009–2012
<i>GTA, Principles of Macroeconomic Theory</i>	2009–2010
<i>GTA, International Economics</i>	Spring-2010

SEMINARS & CONFERENCES

Statistic and Economic Research Center for Islamic Center, Ankara, Turkey **Feb 2013**

Presented: Income transfers and human capital: Application to resource rich countries.
A theoretical and empirical approach.

U of Wisconsin Madison: 10th Midwest International Economic Development Conference **Apr 2013**

Presented: Income transfers and human capital: Application to resource rich countries.
Commented On: "The Joint impact evaluation of asset and cash transfers in Brazil"

Economic Research Forum (ERF): 20th Annual Conference, Cairo , Egypt **Mar 2014**

Presented: Income transfers and human capital: Application to resource rich countries. A theoretical and empirical approach. *Won the Best Paper Award*

PROFESSIONAL EXPERIENCE

PHD-Researcher **2011-Present**

- Render high level of research, including theoretical and empirical analysis, especially in macroeconomics
- High expertise in areas such as human capital development, natural resources, international economics, and economic growth
- Compile and analyze financial and economical information using econometric modeling.
- High proficiency in using statistical software such as STATA, R-Studio, Minitab, MS Office, and LaTeX
- Carry out complex research and experimentation in strict conformance with established protocols

ERNST & YOUNG ■ MUSCAT, SULTANATE OF OMAN

Associate Financial Analyst **2007-2008**

LONE MORTGAGE ■ DEARBORN, MI, USA

Loan Specialist **2004-2006**

PROFESSIONAL AFFILIATIONS

The American Economic Association
European Association of Environmental and Resource Economists
Midwest Economic Association
Midwest International Economic Development Association
Lebanese Economic Association

ADDITIONAL PROFICIENCY

TECHNICAL SKILLS: Stata, R-Studio, MATLAB (Beginner), E-Views, Minitab, and Microsoft Office Suite

LANGUAGES: Bilingual in Arabic (mother tongue) and English