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Long Term Economic Impact of the Natural Resources and Human Capital on the Growth Rate

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LONG TERM ECONOMIC IMPACT OF THE NATURAL RESOURCES AND HUMAN
CAPITAL ON THE GROWTH RATE.

by

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BS, Southern Illinois University, 2006

MS, Southern Illinois University, 2010

A Research paper

Submitted in Partial Fulfillment of the Requirements for the

Master of Arts.

Department of Economics

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Southern Illinois University Carbondale

May 2013

RESEARCH PAPER APPROVAL

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Approved by:

Dr. AKM Mahbub Morshed

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AN ABSTRACT OF THE RESEARCH PAPER OF

IBRAHIMA COULIBALY, for the MASTER OF ARTS degree in ECONOMICS, at Southern Illinois University Carbondale.

TITLE: LONG TERM ECONOMIC IMPACT OF THE NATURAL RESOURCES AND HUMAN CAPITAL ON THE GROWTH RATE.

MAJOR PROFESSOR: Dr. AKM Mahbub Morshed

They have been growing debate among economists and others social-scientists about the relationship between natural resources and human capital and growth. Although most economists agreed, in short run that natural resources do impact growth negatively through human capital. But, the long term relationship seems to be unsettled, and they have not been too many studies focus on the long term equilibrium between natural resources and human capital. Therefore, this paper aims to contribute in growth literature, by studying at the long term relationship between natural resources, human capital, and growth, using Mali as a case study. Natural resource seems to exert positive effect on human capital over time, and the negative effect on growth decline in the long horizon.

ACKNOWLEDGMENTS

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CHAPTER 1: INTRODUCTION

As natural resources curse debate continues among growth economists that the main cause (transmission channels) remain unsettled. Natural resources endowment has been the main catalysis for many developed countries such as United States, Canada, Australia, and Scandinavia region. According to many growth economists, abundance of the natural resources endowment should promote economic growth. According to Stevens, 2003, study, argued that natural resources should produce revenues to enhance economic growth and development; the revenues obtained from endowment should provide capital which can alleviate foreign exchange fluctuation, an important barrier to economic growth. At the very minimum, the presence of natural resources should not slow economic development growth (Stevens, 2003). Despite, natural resources abundance in many countries, the general feeling about the resources endowment seems to be mixed blessing (Gylfason, 2000). Many studies have shown that there is a negative correlation between resource abundance and growth rate. These negative relationships between natural resources abundance and growth rate is called 'the resource curse, which studies were conducted by Sachs and Warner (1985, 1997, &2007).

According to many economists that the presence of natural resources does not stop economic growth, but natural resource abundance do encourages certain alterations in the economy indices, which in turn affect economic growth. Previous literature, such as, Alexis Manning, 2004, study attributes the resource curse to long-term declines in terms of trade, primary export revenue volatility, Dutch Disease, crowding out effects, government mismanagement, corruption, as well as low levels of human capital, which was associated with mixed results. Despite overwhelming support among growth economists on the existence of resource curse, the main cause remains an unsettled issue among researchers (Gylfason, 2000).

This study examines the relationships between natural resources abundance, human capital, economic growth and level of income in sub-Saharan Africa. This study also examines long term relationships between natural resources abundance, human capital, and level of income, utilizing the context of Mali as a focal point. Gold production has brought revenues to Mali but it has not induced dominant effects on other industries nor improved regular Malian life. Developing countries, in general, have higher rates of child labor and higher repeater rates in schools, according to the study done by Thorvaldur Gylfason in 2000. The same study, state, that quantity and quality of education tends to move comparative advantage away from primary production (such as agriculture, fisheries, and mining), and toward manufacturing and services, the latter which accelerate learning by doing and economic growth (Gylfason, 2000). Other studies ,such as, Barro and Lee's,2000, which study points out, that human capital obtained through education have the greatest impact on economic growth progress. As previous studies that found a positive relationship between human capital and growth seems to point out, that increases in human capital accumulation will increase worker productivity, therefore induced more growth.

This study hypothesizes that if natural resources can function as subsidies to increase the stock of human capital by boosting quality and quantity of education in Mali (especially in rural Mali), then the reduction of income inequality, a poverty reduction tool, will be realized, and the growth rate will also become steady. This study seeks to examine the existence of the natural resource curse at least in the short run among Sub-Saharan Africa countries.

In order to address these hypotheses, this study is organized in the following way: 2) Section 2 focuses on the literature review, which has two parts. The first part, part A, is on the resource curse literature, which explains different transmission channels at which natural

resources have negative impacts on growth. Part B of the literature review emphasizes the long term relationship between human capital and growth, given that natural resources are controlling in the model. 3) Section 3 of this study gives intuitive economic values. 4) Section 4 focuses on the composition of the data. 5) Section 5 is about the methodology, which has two components. Part A used OLS (Ordinary least square) techniques to get cross-sectional regression for Sub-Saharan Africa. Part B of section 4 utilized Malian data collected over a 33 year period; this study will seeks to confirm the existence of long term relationship between natural resources and human capital accumulation. 6) Section 6 contains the results of the study. 7) Section 7 contains the conclusions and the implications part of this study for the Sub-Saharan region in general, and for Mali in particular.

CHAPTER II: LITERATURE REVIEW

Section A: Resource Curse

In recent decades, most of the empirical evidence from the resource curse literature agrees that there is an inverse relationship between natural resource abundance and economic growth in developing countries (Auty, 1997; Sachs, 1995). Sachs and Warner (1995, 1999, and 2000) analyze the relationship between natural resource abundance reliance and economic growth. Sachs and Warner ,1995,&1997,2000,studies examine 95 developing countries, using natural resource abundant countries that only achieve a slight, 2% annual GDP Growth rate from 1970-1989, as the threshold for a resource curse. Sachs and Warner, 1997, study, define natural resource abundance as a ratio of primary products to exports over GDP to 1970, which used SXP as a proxy for natural resources. Their empirical studies have shown a negative correlation between resource abundance and growth rate, a phenomenon closely associated with the concept of the resource curse (Sachs and Warner).

According to Sachs and Warner, natural resource abundance encourages rent-seeking, corruption, and poor government management. It has also encouraged developing countries to engage in protectionist paths through state-led projects of development, in fear to fight against the "Dutch disease effects of the resource abundance" (Sachs and Warner). Countries with a lot of natural endowments would encounter higher overall demand and higher relative prices of non-traded commodities. Natural resource endowment leads to increase of overall demand, which shifts labor far from learning by doing sectors and lowers growth in labor productivity.

Sachs and Warner's results showed that resource intensity is strongly correlated to variable institutional quality and broad policy. The results of their studies also point out that resource abundance impedes the manufacturing sector, as in the Dutch Disease. As

manufacturing gets hurt, countries respond with protectionist measures to promote industrialization, which in turn hurts growth (Sachs and Warner, 1995, 1999, 2000). Sachs and Warner's studies used different transmission channels, with variables such as SXP as a proxy for variables natural resources, (SOPEN) as a proxy for rate of openness, (LINV), as a proxy for variable investment, rule of law, investment deflator over GDP deflator in 1970 (logarithm GDP of 1970), and regressions over average annual growth in real GDP, divided by the economically active population between the years 1970 and 1990.

Sachs and Warner, 1997, results find that overall; natural resources still have negative impacts on growth. Indeed, all the other variables claimed to be important by other studies were still robust and remaining important to explain cross country growth. Despite different econometrics techniques, utilizing different transmission channels, most results of these studies still show that there is a negative correlation between natural resources and economic growth.

Furthermore, Alexis Manning's, 2004, study investigates the relationship(s) between natural resource abundance, human capital, and economic growth. The results of his study show that there is a negative correlation between human capital (measured as a literacy rate) and resource abundance (arable land use as a proxy). According to Manning, this strongly supports the presence of a "resource curse".

Elissaios and Reyer, 2004, study examines the direct and indirect impacts of natural resource abundance on economic growth. This study looks at the transmission channels through which natural resources abundance impacts other economic indices (such as corruption, openness, and terms of trade, schooling, and investment). Elissaios and Reyer's study used Sachs and Warner's variable economic growth (based on average annual growth in real GDP per person from 1975 to 1996) as a dependent variable, and run several regressions. The results of

Elissaios and Reyer's, 2004, results show that natural resources have negative effects on growth in the absence of other economic indices, but there is a positive direct impact on growth in the presence of each of several transmission channels, including corruption, investment, openness, terms of trade, and schooling.

Other study focus on the positive relationship between growth and other transmission channels, such as Paul Stevens', 2004, study, which study chooses countries that may be at risk of experiencing the 'resource curse' or may benefit from resource endowment. Study selected 4 countries (Botswana, Chile, Indonesia, and Malaysia) based on their export revenues from fuel or minerals, which exceeded 30 percent of their total merchandise exports. Stevens' ,2004, paper, find that there is a positive impacts of natural resource endowment on the economies of these four different countries ,which gives a different results than Sachs and Warner,1997, &2000, studies . According to Stevens, 2004 study, which points out that the four suspect countries on the verge of being cursed or blessed did quite well compared to other countries. These four countries also did well in relation to the regional income benchmarks. The study pointed out that Botswana did well compared to the Asian Tigers in the period 1965-2000, and in the meantime, Chile did better than the rest of the Latin American region and the Upper Middle Income countries (Stevens, 2004).

Elissaios and Reyer (2004)'s study also points out ,that there is a strongly positive impact of natural resources abundance on economic growth when including each of the transmission channels; furthermore, the investment channel seems to be the most important.

Section B: Human Capital and Resource Curse

Barro and Lee, 2000, study, define human capital as set of skills, knowledge and productivity of workers. Since, beginning of industrialization, human capital has been considered

as an engine of development because it foster productivity, learning by doing, which is obtained through education . Human capital seems to have a greater impact in the economic development than any other economic indices(Gylfason; Barro, Lee; Ortega and Gregorio;2000;2001;2002) . According to Barro and Lee, 2000, study, a greater amount of education attainment indicates more skilled and more productive labor, which in turn increases economic growth. As education attainment seem to have a positive strong effect on social outcomes, such as child mortality, fertility, education of children, and income distribution . In most of the developed countries that human capital acquired through education seems to fulfill an important role for economic development. According to Auty, 2001, study, human capital instead of natural resources or physical capital has the greatest influence on economic growth. Other studies, such as, Gylfason, 2000, which study state that quantity and quality education tend to give comparative advantage to manufacturing and services over primary production (such as agriculture, fisheries, and mining). Also, Ortega and Gregorio, 2002, study asserts that the negative effect on growth rate can be improved over time by accumulating a large level of human capital. Their study also assumes that a resource-rich endowment country begins with high levels of income, increases its human capital accumulations and then growth speeds up. The results of this study also indicate that natural resources are harmful to economic growth in countries with low human capital accumulation. This effect is due to the fact that natural resources attract resources from other economic sectors capable of stimulating more economic growth. Nonetheless, as the process of development continues, the presence of higher human capital accumulation may reduce this effect. Therefore, according to Ortega and Gregorio, 2002, study, that the negative effects of natural resources on growth could be offset through human capital accumulation.

In other hand, there are many other studies that find a negative relationship between natural resources and human capital, which in turn reduces growth. For instance, Patrick K. Asea and Amartya Lahiri, 1999, study examines the effects of natural resources and growth by using a two sector, which is an endogenous growth model where human capital stimulates growth. According to Asea, and Lahiri, 1999, study, in the presence of the increasing of economic incentives for unskilled labor, natural resources have negative impacts on schooling.

This study states that as long there are complementary inputs in the production process between factor labor and natural resources abundance, increases in natural resources raise the labor wage. Asea and Lahiri, 1999, run several regressions. The results of this study suggest that natural resources might have negative impacts on human capital accumulation if there is greater complementarity between natural resources and unskilled labor than skilled labor (human capital accumulation sector).

CHAPTER III: INTUITIVE ECONOMIC VALUE

Although many resources curse studies include Sub-Sahara Africa; fewer have look impact of human capital accumulation on growth, given natural resources are in the model, in the context of sub-Saharan Africa . This study examines the relationships between natural resources abundance, human capital, economic growth and level of income in sub-Saharan Africa. This study seeks to examine the existence of the natural resource curse at least in the short run among Sub-Saharan Africa countries. This study also examines long term relationships between natural resources abundance, human capital, and level of income, utilizing the context of Mali as a focal point.

According to the IMF ranking, Mali is one of the poorest countries in the world, and it also ranks 111th out of 180 countries with a score of 2.8 out of 10 grade index establish by Transparency International, which is based on perceptions of corruption by national and international experts (risk agencies, country analysts) and business leaders (Manguy, 20011).

Mali gold production has brought revenues to the government but it has not induced dominant effects on other industries nor improved regular Malian life. According to Manguy, 2011, study, state, that gold exploitation in Mali brought enormous revenues stream to the government, but it also brought enormous environmental and social degradation to Mali that is ignored by elect officials. Mali can be categorized as being natural resource abundant, since gold, having become a key economic sector, represents 14.3% of its GDP and 72% of its exports in 2007 (IMF, 2006, 2007) . Mali also has one of the poorest human capital indicators among Sub-Sahara countries, based on the World Bank database indicators.

Therefore, this study hypothesizes that if natural resources can function as subsidies to increase the stock of human capital by boosting quality and quantity of education in Mali

(especially in rural Mali), then the reduction of income inequality, a poverty reduction tool, will

be realized, and the growth rate will also become steady.

CHAPTER IV: DATA

This study collected the secondary data from World Bank indicators database. The timeframe of data was from 1980 to 2012.Variables chosen are based on the specification done by Asea and Lahiri's, 2000. In this study, the dependent variable is GR8011, defined as average annual growth rate in real GDP per midyear population between 1980 and 2011, according to World Bank database indicators.

Due to the problem of missing data, the mean average was taken to replace the missing data at each point of time for each Sub Saharan African country. Some countries were eliminated due to inefficient data collected, including Somali, Eritrea, Mauritius, etc. For the sub-Saharan table, this study defined the variables based on the specifications done by Asea and Lahiri, which in turn have looked at Sachs and Warner's, and Barro and Lee's data set specification approach. The dependent variable is real growth per capita annually, according to original computation done by Sachs and Warner (1985).

For Mali, this paper is based on the idea that education is an engine of long term growth. Therefore, the dependent variable is a difference of log of real GDP, PPP, adjusted (constant) between current year and the previous year; which data were collected from the World Bank database. According to Gylfason's (2000), study, "More and better education is a prerequisite for rapid economic development around the world."

CHAPTER V: EMPIRICAL APPROACH

Section A: Sub-Saharan Africa (Cross-Sectional Approach)

This study runs several regressions, based on the empirical approach of Asea and Lahiri, but applying to Sub-Saharan Countries, this regression show as the following:

First regression:

Regress the growth rate between 1980 and 2011(GR8011) against the secondary enrollment rate in 1980 and 2011(ENROLLS), as well as investment (INVSH), given that the factor, initial income per economically active person in 1980 (LGDP), is in the model.

Second Regressions:

Regress the growth rate between 1980 and 2011 (GR8011) against the secondary enrollment rate in 1980 (ENROLLS), investment (INVSH), term of trade 1980 and 2011 (TOT) given the factor initial income per economically active person in 1980 (LGDP) is in the model.

Third Regressions:

Regress the growth rate between 1980 and 2011 (GR8011) against the secondary enrollment rate in 1980 (ENROLLS), investment (INVSH), term of trade 1980 and 2011 (TOT) and natural resources (SXP) based on Sachs and warner definition, also given the factor initial income per economically active person in 1980 (LGDP) is in the model.

Fourth Regressions:

Regress the growth rate between 1980 and 2011 (GR8011) against the secondary enrollment rate in 1980 (ENROLLS). Investment (INVSH), term of trade 1980 and 2011 (TOT) and natural resources (SXP) and openness, also given the factor initial income per economically active person in 1980 (LGDP) is in the model.

Robustness:

Regress the growth rate between 1980 and 2011 (GR8011) against the secondary enrollment rate in 1980 (ENROLLS), investment (INVSH), term of trade 1980 and 2011 (TOT) and natural resources (SXP) and openness, also given the factor initial income per economically active person in 1980 (LGDP) is in the model.

Section B: Mali (Time-Series Approach)

This study also looks at the Mali case, to see if there is any long term relationship between real GDP, PPP adjusted (constant), and SXP and ENROLS, given other economic indices are in the model (such as INVSH, TOT, and SOPEN). Malian data collected over a 33 year period; this study ran the Dickey Fuller unit root test to see whether the series contains unit root. This study assume the error terms are no correlated over time, since the log differential is taking for the dependent variable real growth rate , given log of initial income is controlling in the model. Then, this study run robustness test as a regression to see long term relationship between growth rate and human capital given natural resources, investment, openness, and term of trade are controlling in the model. In the Mali case, this study's hypothesis is that there are long term relationships between real growth rates per capita adjusted to inflation and human growth, given natural resources in the model.

CHAPTER VI: EMPIRICAL RESULTS

Section A: Empirical Results on Sub-Sahara Africa

In this model, human capital stock is the main transmission channel that affects growth in the presence of natural resources. As natural resource curse theorists suggest, human capital will lose is explanatory power to explain growth rates, given the level of natural resources in the model. This seems to be the case in Sub-Saharan, rich resource economies. To test the prediction about natural resources (SXP) having a curse to Sub-Saharan Africa countries, this study starts with regression 1, in which investment variable (INVSH) and human capital variable (ENROLS) enters in regression, respectively as positive signs and negative signs. Regression 1 results suggest that variable INVSH changes signs to negative signs and it is almost significantly, while ENROLS variables stays negative but has insignificant explanatory power. In the regression 2, this study add variable SXP to the previous regression, the results shows that INVSH keeps positive signs and has significant explanatory power. ENROLS still has a negative relationship with growth rates when added to variable SXP. Because of the negative sign of variable SXP, and ENROLS staying negative, these results seem to suggest the presence of the curse.

Natural resources are defined as the share of primary products in GNP in 1970, but in this study we use natural resources as the share of primary products in GDP in 1980 (since the data collected come from the World Bank database). Primary products are defined as fuels and non-fuel products, according to Sachs and Warner's (1995) data definition. To test the robustness of this theory, this study adds the variable openness (SOPEN), to control for the effects of trading regimes and external policies, based on Asea and Lahiri,1999, empirical study approach. Regression 3 results show that the INVSH variable is still positive and significant. Perhaps domestic investment is still an important factor to explain growth. ENROLS keeps its negative

sign in the presence of openness. Perhaps openness creates private externality of school. SXP keeps its negative sign and has significant explanatory power. For more robustness tests, this study adds term of trade shock.

This results in the regression 4, which shows that the INVSH variable stays positive and keeps significant power to explain growth. The ENROLS variable, surprisingly, becomes positive but insignificant. According to Asea and Lahiri, 1999, the steady growth rate under governments and policy makers is greater than the steady growth rate under competitive solutions in the presence of externalities. Increases in capital to specific sectors induce the government to reduce labor supply and increase schooling, therefore increasing the growth rate, according to Asea and Lahiri's, 1999. Perhaps this is the case for sub-Saharan countries, where the governments try to fight the Dutch disease theory, by increasing schooling, in order to induce growth. In the regression 4, also, the variables, SXP, and INVSH keep their respective signs and they're still significant. This indicates that natural resources (SXP) and domestic investment (INVSH) are still dominant explanatory factors when it comes to explaining the growth rate.

Table1:**The growth effects of human capital and natural resources**

	Dependent variables: GR8012			
	(1)	(2)	(3)	(4)
LGDP	0.0012	0.0016	0.0017	0.0021
	(-0.449)	(-0.678)	(-0.718)	(-0.866)
ENROLS	0.00002	0.00003	0.00001	0.00006
	(-0.170)	(-0.293)	(-0.129)	(0.114)
INVSH	0.00036	0.00039	0.00038	0.00037
	(1.595**)	(1.833**)	(1.836**)	(1.795**)
SXP		-0.00021	-0.0002	-0.00019
		(-3.174**)	(-2.947**)	(-2.800**)
SOPEN			0.00013	0.00017
			(0.548)	(0.699)
TOT				0.00012
				(1.253)
CONSTANT	0.059395	0.059395	0.066185	0.043807
	(2.406)	(2.887)	(1.696)	(1.397)
R-SQAURED	0.35	0.41	0.5	0.51
SE	0.01614	0.01482	0.01456	0.014660
F-TEST	7.290**	8.343**	7.622**	6.332**
OBSERVATION	43	43	43	43
Note: T-ratio appears on the brackets of each column				
** (level of significant at 5% and 10%)				

This result confirm the presence of natural resources curse theory, in the meantime, regression 4, also shows that natural resources do not necessarily impede growth. As Sub-Saharan countries' primary commodities exports get higher in relation to their GDP, they begin to be more open to world trade, and therefore the production externality of human capital will get higher since the returns to schools are lower compared to wage earnings by the natural resources sector. So, the solution is that Sub-Saharan African governments should utilize their mineral revenue in subsidies to promote education, which eventually induces growth.

Section B: Empirical Results on Mali

The results of this study in Table 2 below shows that there is a long–term relationship between growth rates, natural resources and human capital accumulation, since there is no presence of unit root. Perhaps, the externality of human capital will decrease over time when natural resources are used to promote quality and quantity of schooling. As a country like Mali accumulates higher human capital stocks, the negative effects of natural resources on growth decline over time, which is shown in the Table 2.

In this table, the variable SXP enters with a negative sign, but loses the negative sign over time. Perhaps the natural resources and labor are not complementary in Mali's case, but instead, perhaps increases in the natural resources have little effect on attracting labor from other sectors. This is the case for Mali, since mining sector only utilized 10% of total employment, according to IMF, 2006, reports. Therefore, natural resources may be used as investment to increase income levels in Mali, since the returns to schooling are higher when natural resources are utilized as subsidies to promote quality education. The variable openness keeps its initial negative sign but does not gain significant explanatory power over time. The variable term of trade shock keeps its

negative sign and still has significant negative explanatory power over growth in long periods. In the long run, the variable investment becomes negative and insignificant.

Perhaps, poor countries like Mali that depend on foreign investment may need more foreign and domestic investment to promote future industries that involve learning by doing. The Variable ENROLS has a positive sign but statistically insignificant, perhaps if natural resources and foreign investment used as subsidies to build quality and quantity education in Mali, then future generation in Mali may see their livelihood improved. Although, the marginal effect of each individual variable were insignificant, the overall test was significant. It could be that there is other issue needs to be looking at econometrics wise, or the missing data effect, which issue are beyond the scope of this study.

In this study, all the explanatory variables (ENROLS, SXP, INVSH, TOT) come out positive except SOPEN, and 42 percent of variation on growth rate can be explained by these five variables. The overall model is statistically significant given initial income is in model. Perhaps, all these variables above needs to be including in the model, to see the long term stability between growth rate, natural resources and human capital accumulation.

Table2: **Long-run equilibrium between growth and Human capital and Natural resources**

INDEPENDENT VARIABLES	COEFFICIENT	T-STATISTIC
LGDP	0.005	1.29
ENROLS	0.00008	0.85
INVSH	0.0002	1.68**
SXP	0.003	1.32
SOPEN	-0.004	-0.07
TOT	0.00007	1.38
ADJUSTED R-SQURED	0.42	
OVERALL F-TEST	3.22**	
TIME PERIOD (1980-2012		
Note: F-test represents overall goodness of fit		
** (level of significant at 5% and 10%)		
R-squared (level of variation)		

Also, the figure 1 gives indication , variables natural resources rent as represent by SXP2, and variables human capital (such as   ENROLS) have positive slope.
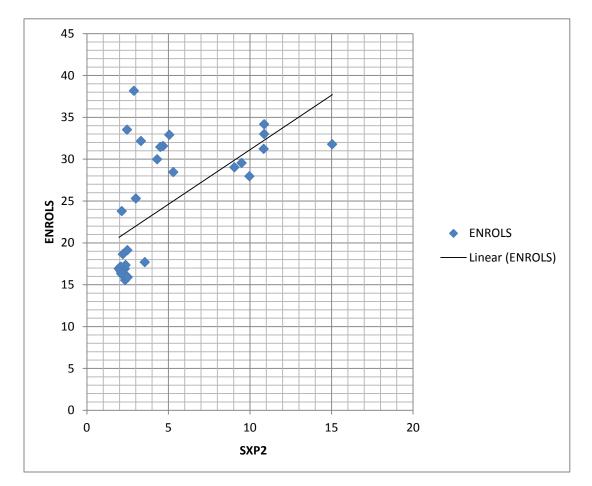
Figure 1: **Long run association between Natural resource and Human capital over time**

This long run positive association between variable natural resources rent (express as SXP2) , and variables human capital may indicates, as natural rent increases that there needs to be deliberated affords from the Malian governments to improve quality of schooling by utilized natural resources rent money.

The results of table 4 below, shows that log of natural resources and log of public spending on education have positively significant impact on long run enrollment.

Table3: **The Effect of natural resources rent and public spending on education over human capital**

INDEPENDENT VARIABLES	COEFFICIENT	T-STATISTIC
LNPST	0.4395	1.26
LNSXP	0.2885	3.22**
ADJUSTED R-SQURED	0.54	
OVERALL F-TEST	17.64**	
TIME PERIOD (1980-2012		
Note: F-test represents overall goodness of fit		
** (level of significant at 5% and 10%)		
R-squared (level of variation)		
Dependent Variable: Log Enrollment		

This result indicates that the variable natural resources rent are positive and statistically significant. It also indicates that one percentage change on public spending on education can results of a 43% increase in human capital accumulation over the long run, given natural resources are used as subsidies in this model.

This result shows that, natural resources if used as subsidies to increase quality and quantity of education in Mali, then, it can reduce income inequality, Mali will have a sustainable growth rate. This prediction seems especially true since the private returns to education can be reduced. Natural resources, when used as investments to promote increases of income at all

levels, can be powerful poverty reduction tools as long as they are used to promote future

manufacturing.

CHAPTER VII: CONCLUSION AND RECOMMENDATION

This study confirms the presence of the resource curse in Sub-Saharan African countries using human capital as the main transmission channel. This study also looks at time series analysis to test long term equilibrium between growth rate, natural resources and human capital. This study found there is a long-term, stable, positive relationship between growth, natural resources and human capital. This finding confirms the needs for Sub-Saharan Africa, and Mali in particular, to use natural resources as investment to promote human capital accumulation, which seems exert the greatest impact on growth (Barro, .al., 2000, etc.).

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APPENDICES

Appendix 1: Data Definition

All the variables used in the for Sub-Sahara Africa and Mali models are taking as proxies from World Bank database; based on Sachs and Warner,1985, study formulation .

LGDP per capita is real GDP, PPP, adjusted Gross domestic Product divided by economically active population (or midyear population). Natural log of GDP per capita based on purchasing power parity (PPP); PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2005 international dollars.

GR8012 represent average annual growth rate in real GDP per economically active population between 1980 and 2012. Which is obtained, by taking (Log80-Log2012)/33; according to Sachs and Warner, 1997; study; computation of GR8012. GR8012 is used as the dependent variable in the Sub-Sahara Africa Model.

GR8012 represent average annual growth rate in real GDP per economically active population between 1980 and 2012. Which is obtaining, from taking: Log80-Log20123; and used as dependent variable in the Mali time series model.

INVSH (Gross capital formation (% of GDP): Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads,

railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Gross capital formation as a % of GDP represents the domestic investment (Private public).

ENROLS represent human capital; which is Gross enrolment ratio of Secondary as a percentage of the population of official secondary education age, include all programs. Total is the total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age. GER can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.

PST represents variable public spending on education, total (% of GDP).

SXP represents natural resources; which define as Ores and metals exports as a % of merchandise exports.

SXP2 represents natural resource rents as % of GDP, according to World Bank database indicators.

TOT represent terms of trade shock; which is terms of trade adjustment (constant LCU).

SOPEN represent openness of country; which represent tariff rate, most favored nation, weighted mean, primary products (%)(World bank database). According to Sachs and Warner ,1997,crireria of openness ; an economy is say to be open if average tariff rates are below 40%; or average quota and licensing coverage of imports less than 40%.

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