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Natural Resources: A Blessing or a Curse?

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It is commonly assumed that countries are blessed if they have an abundant reserve of natural resources. Poorer countries may be jealous of the luxurious living standard that comes from oil in the Middle East, which seems to be an easy success. At the same time, we are amazed at how gold and diamonds are concentrated in African countries through our classes in geography. However, despite such high income, the economic growth rates of Oman (0.36% in 2006) are incomparable to those of Japan (2.41% in 2006) or Korea (4.42% in 2006), resource-poor countries. Diamonds and gold do not help the general prevailing poverty in African countries either. This surprising paradox raises the question of whether natural resource abundance is a blessing or actually a "curse."

There are many economists such as Sachs and Warner (1995) who conduct research on natural resources and confirm that the resource curse exists. However, at the same time, this view is challenged by others such as Ding and Field (2005) or Manzano and Rigobon (2001). Therefore, the theory of the resource curse itself is controversial, and more research should be done to investigate its validity. Besides, Bulte and Damania (2005) suggest that "formal modeling of the linkages between resource endowments and institutional structure should be a high priority for those who seek to understand how the resource curse works." This is true, as I can see that the relationship between institutional quality and natural resources attract the most scholars studying about the resource curse. As a result, my study mainly focuses on testing the validity of the resource curse as well as the interaction between institutional quality and natural resources.

I use panel data for a period of five years from 2003 to 2007 for my empirical model to test whether the resource curse exists. This idea comes from the research done by Manzano and Rigobon (2001) and Iimi (2007). My results show that there is a positive relationship between natural resources and economic growth. However, when I take into account the interaction terms between natural resources and institutional quality, the total effect of natural resources on economic growth can be negative. This raises the question that the management of natural resources by the government may change its effect on economic growth. Hence I formulate my second model to test the relationship between natural resources and institutional quality. In this sense, the measure of natural resources is understood as the countries' dependence level on resources. I find evidence that when some of the factors to measure institutional quality get higher, the countries depend less on natural resources. This suggests that there must have been some fundamental changes in the economic structures of the resource-rich countries during recent years. Therefore, the negative effect of natural resources on economic growth may not be a curse, but only a result of the government's effort to shift the economy toward other sectors such as manufacturing or services.

I. Literature Review

A. Ideas Supporting the Natural Resource Curse

Although there are economists who offered earlier speculation about the negative effect of natural resources on growth such as Gelb (1988) and Auty (1993), Sachs and Warner (1995) were the first to present an empirical study to confirm that effect. They use the annual growth rate in GDP per capita as the dependent variable and the ratio of primary product export to GNP as the independent variable – to compare levels of natural resources in different countries – and find that there is an inverse relationship between them during the period 1970 – 1990. The relationship remains robust even when they control for other factors such as initial GDP, openness policy, investment, human capital, institution quality, etc. Furthermore, only two out of the eighteen resource-abundant developing countries, Malaysia and Mauritius, could sustain a growth rate of 2% annually. In 2001, Sachs and Warner did a case study of the natural resource curse in seven Latin American countries. They employ time-series data to identify whether resource booms occurred in those countries and analyze how growth rates differ before and after such booms. In countries with resource booms, Bolivia, Mexico and Venezuela suffered slower growth afterward, while Ecuador raised its GDP initially but its growth rate afterward was not faster.

Norrbin et al. (2008) test the validity of the natural resource curse by reexamining Sachs and Warner's model. Using the same variables with updated data from 1970 to 2000 but changing the sample selection, they discover that the curse turns out to be insignificant. However, they realize that during such a long period of thirty years, there can be different growth patterns that make it difficult to estimate the natural resource curse. Hence they divide the period into three decades and six semi-decades, and find that the curse becomes robust again even when the sample selection varies. Most recently, Butkiewicz and Yanikkaya (2010) partially confirm that the natural resource curse exists, but only in developing countries and not in developed countries.

B. Ideas against the natural resource curse

However, other economists have refuted the natural resource curse theory by offering different explanations. In the same year that Sachs and Warner start their empirical study on the curse, Davis (1995) reports that a sample of 22 countries rich in natural resources from 1970 to 1991 perform well as a group in comparison to other non-mineral developing countries. He does not agree that natural resource abundance generally leads to economic underperformance, and refers to those with slow economic growth as exceptions.

Ding and Field (2005) contest the definition of natural resource abundance by Sachs and Warner. They redefine natural resource abundance as a combination of natural resource endowment and natural resource dependence, and state that Sachs and Warner's ratio of primary exports to GNP only measures the dependence. Using a three-equation recursive model and taking human capital into account, they show that the natural resource curse disappears, which means that there is no negative relationship between natural resource abundance and economic growth. Brunnschweiler and Bulte (2008), having the same definition of natural resource

abundance, present similar evidence that resource dependence does not affect growth, and further demonstrate that resource endowment is actually associated with higher growth.

Manzano and Rigobon (2001) refute the natural resource curse in two steps. First they observe that all the studies that support the curse use cross sectional data. Hence they use panel data instead and discover that the curse is not significant, suggesting that previous studies have incurred omitted variable biases. Then they explain that the slow growth of the countries with resource abundance may be due to a debt overhang. In the 1970s, when the commodity prices were high, those countries borrowed excessively, using their resources as collateral. As a result, when commodity prices fell in the 1980s, they suffered from a debt overhang, a situation in which their debts accumulated and they did not have enough revenue to fund it, which hindered their economic growth. However, these two explanations are once again refuted by Butkievwicz and Yanikkaya (2010) because they present evidence with panel data that the natural resource curse exists, and at the same time show that it exists independently of a country's national debt.

C. Institutional quality and natural resources

Besides the relationship between natural resource abundance and economic growth, other economists investigate the relationship between natural resource abundance and other factors in politics and the economy such as institutional quality, civil conflict, human capital development, investment, trade openness, and the financial market. However, the relationship between natural resources and institutional quality seems to be most prominently researched by economists because there are numerous such studies in the literature. Ades and Tella (1999) are the first to examine the relationship between natural resources and corruption. They notice that natural resource abundance in many countries tends to generate rent seeking behavior, which in turn leads to corruption. Their empirical model verifies that countries with firms that enjoy higher rents tend to have higher corruption levels. Therefore, institutional quality can be a channel through which resource abundance hurts economic growth. Leite and Weidemann (1999) confirm this result, adding that corruption has even a greater negative effect on growth in less developed countries.

Torvik (2001) suggests that there will be more entrepreneurs engaged in rent seeking activities in the countries with more natural resources, which reduces the number of entrepreneurs in the productive activities of the economy. This results in a drop in income that is greater than the increase in income from natural resources, which eventually leads to slower growth rates. Ross (2001) observes that a rise in income usually generates better democracy in a country. However, he finds that if this rise in income comes from oil or mineral wealth, there will be an inverse relationship on democracy. It is easy to see that there is not much democracy in Saudi Arabia or Brunei although they have high levels of income per capita.

Damania and Bulte (2003) develop a lobbying game, the manipulation of producers on decisions made by politicians, to investigate how rent seeking firms interact with corrupt governments. They use a measure of democracy index, which determines whether there is presence or absence of political competition, to show that countries with low democracy will suffer from the natural resource curse. Without much political competition, the governments will follow a development path to maximize the surplus in the lobbying game, putting the economy further and further away from its optimal path. With the same view, Acemoglu et al. (2004) find

that countries with abundant resources but low democracy, a small group of politicians will have enough wealth from rents to buy off their political opponents and stay in power, which in turn gives them more wealth. Robinson et al. (2006) further elaborate on this causal link. They suggest that when a resource boom occurs, if it is not a permanent one, the politicians tend to over-extract natural resources because they discount their future of being in power too much. In case of permanent ones, they will realize that there is more benefit to stay in power longer. However, this in turn encourages them to use their proceeds from natural resources to manipulate the outcomes of the elections. Therefore, in either case, a lack of democracy leads to the resource curse. The only solution is a good government with sufficient accountability to eliminate such activities.

Mehlum et al. (2006) are the first to analyze how the natural resource curse can be eliminated by institutions with good quality. They divide institutions into two groups: the ones that are grabber friendly, or are easily influenced by the manipulation of the rent-seeking parties through illegal acts, and the ones that are producer friendly. The grabber friendly institutions create the incentives for the entrepreneurs to get out of productive activities to be involved in unproductive activities. This is when rent seeking and production become competing activities, which eventually leads to the natural resource curse. However, on the other hand, producer friendly institutions help countries take full advantage of their natural resources. Rent seeking and production then become complementary activities, which leads to better economic growth. To test this hypothesis, Mehlum et al. find evidence through an interaction term that if a country can reach a certain threshold of institution quality index, the resource curse will disappear, and a higher index leads to positive growth rate. Boschini et al. (2007) expand this finding by taking into account different types of natural resources. They find that some natural resources create more political problems than others. For these resources, if institutional quality is low, their negative effect on growth will be worse than that caused by the others. However, at the same time, if institutional quality is high, those resources will promote better economic growth than the others will. Natural resources will then be an asset rather than a curse. Butkiewicz and Yanikkaya (2010) investigate the same finding in more depth and present evidence that the natural resource curse only exists in developing countries with weak institutions, but not in those with strong institutions.

Brunnschweiler and Bulte (2008) and Norman (2009) investigate the relationship between natural resource abundance and institutional quality by using two measures of resource abundance similar to the ones used by Ding and Field (2005): resource endowment and resource dependence. Brunnschweiler and Bulte find an ambiguous but very interesting result: resource endowment has a negative effect on institutional quality, but not on economic growth, while resource dependence has a negative effect on economic growth, but not on institutional quality. On the other hand, Norman finds that there is no relationship between resource dependence and economic growth, but resource endowment actually has a positive effect on institutional quality and growth. In both senses, natural resources do not create a curse.

Iimi (2007) and Kolstad (2009) offer two interesting empirical models to study the relationship between natural resources and institutional quality. Iimi, instead of using only rule of law to measure institutional quality like other studies, uses five other variables: voice and accountability, political stability, government effectiveness, regulatory quality, and control of corruption. Furthermore, he uses an interaction term between natural resources and each of those

six measures of institutional quality. He then finds that countries abundant in natural resources with strong public voice and accountability, government effectiveness, regulatory quality, and control of corruption enjoy high economic growth. Regulatory quality and control of corruption are especially important in developing countries. Kolstad, realizing that other economists either use rule of law or democracy index to study the relationship between natural resources and institutional quality, combines them into one model. Like Iimi, he uses two interaction terms between natural resources and these two variables. He finds that only rule of law remains significant, implying that institutions governing private sector are more important than the ones governing public sector.

D. Civil conflicts and natural resources

Besides institutional quality which is studied most extensively by economists who do research on natural resources, other minor but not necessary less important factors are also explored. Collier and Hoeffler (1998) are pioneers in studying the relationship between natural resources and civil conflict. Based on the utility theory which states that people will find the most efficient points on their utility curves, they claim that rebels will start a civil war if they can receive more benefit from it than paying the cost for it. Using data from 1960 to 1992, their study shows that natural resource abundance is strongly related to the probability of civil wars and their duration. However, this is a non-monotonic relationship. Initially, an increase in natural resources corresponds to an increase in the risk of wars. However, when natural resources reach a certain level, further increment reduces the risk of wars. In 2002, Collier and Hoeffler conduct further research into this relationship by taking into accounts different reasons of civil wars, but this time they only find a monotonic positive relationship between natural resources and the risk of wars. They also discover that in countries with natural resource abundance, greater ethnic and religious diversity can reduce the risk of conflict. However, Hodler (2004) refutes the latter result by showing that resource-rich countries with more ethnic diversity have higher risk of conflict than the more homogenous ones do. That is why Nigeria, a country with more diversified ethnicity, has more conflicts than Norway does.

Snyder and Bhavnani (2005) reaffirm the importance of institutional quality in resource-abundant countries in the sense of civil conflict. They raise the question of why loot-able resources like diamond creates conflict in some countries while peace in others. They then emphasize that institutional quality, the ability of the government to use natural resources to bring about peace and order, is more important than material incentives of the rebellious groups. However, Humphreys (2005) suggests that weak institutions should not be blamed for the positive relationship between resource abundance and the risk of civil wars. At the same time, he opposes to Collier and Hoeffler's result in 1998 by finding that natural resources actually lead to shorter duration of wars. Collier and Hoeffler's claim that natural resources increase the risk of wars is also challenged by Brunnschweiler and Bulte (2009), who demonstrate that resource abundance in fact reduces the probability of wars.

E. Human capital development and natural resources

Human capital development is considered to be the fundamental tool for economic development of any country, thus it raises the question on the relationship between itself and natural resources. Gylfason and Herbertsson (1999) and Gylfason (2000) find a negative

relationship between resource abundance and human capital development with education being the proxy. Gylfason and Herbertsson first argue that education leads to higher economic growth. Then by adding in resource abundance, they realize that its effect on economic growth drops in size and significance. Gylfason also finds evidence that resource abundance leads to lower enrollment rates, expenditures on education, and years of schooling. He attributes this result to the false sense of security in resource-rich countries which leads them to be negligent about human capital accumulation. Bulte, Damania and Deacon (2005) confirm the result, and further point to institutional quality as the indirect links that causes such a negative relationship. However, Ding and Field (2005) present evidence that the relationship between natural resources and human capital development is insignificant. There are also other economists who nevertheless claim that there is a positive relationship between natural resources and human capital development. Stijns (2005) finds such a positive relationship. He specifically uses mineral and fuel to measure natural resource abundance, and discover that they improve human capital accumulation. He is suspicious that the negative relationship between them may have come from a wrong definition of natural resources. Other economists may have taken land, agriculture, forest, etc. into account, while a strict definition of natural resources only refers to minerals and fuel. To support their positive view of natural resources on human capital, Bravo-Ortega and Gregorio (2005) use an interaction term between natural resources and human capital. They successfully show that high levels of human capital can eliminate the resource curse and can even lead to positive growth rate at higher levels.

F. Openness, Investment, and the Financial Sector

Contrary to general belief that openness in trade promotes economic growth, Falkinger and Grossmann (2002) and Butkiewicz and Yanikkaya (2010) argue that openness in trade in natural resource-rich countries with weak institutions may harm their economic growth. Without democracy in the country and realizing their potential wealth in natural resources, the government will use their power to limit education on the population to create cheap labor to attract international trade. Therefore, there should be well-established democracy before trade openness to prevent the negative growth impact caused by natural resources. In their study, Butkiewicz and Yanikkaya (2010) also point out that Sachs and Warner's indicator of openness is misleading because it is "negatively determined in part by black market exchange rate premium data." Therefore, they use the ratio of exports plus imports to GDP as an indicator of trade openness instead. However, this indicator is not without fault. Birdsall and Hamoudi (2002) claim that such an indicator cannot describe efficiently the openness of resource-rich countries. After the fall of commodity prices in the 1980s, all the resource-rich countries had to reduce their imports to close their trade deficits. As a result, using the ratio of exports plus imports over GDP will pick out the resource-rich countries as less being open.

The investment rate and financial sector also have particular meanings in resource-rich countries. Atkinson and Hamilton (2003) present evidence that the natural resource curse exists in countries with low rates of investment. It is due to the governments that are unable to manage overwhelming revenue coming from natural resources. Therefore, the countries with efficient governments that are capable of turning the revenue from natural resources into public investment avoid the curse totally. This fact relates institutional quality to the resource curse once again, in the sense that resource-rich countries with good institutions have high rates of

investment. Ploeg and Poelhekke (2009) attribute the resource curse to the development of the financial sector in a country. A less developed financial sector in an economy cannot predict the volatility of commodity prices and diversify them efficiently. Therefore, even though natural resources may have positive economic implications, they will lead to a greater negative effect through unanticipated volatility. As natural resources have more volatility than other export products, resource-rich countries are exposed to higher risk than the countries with more stable-price products. Therefore, natural resources cause them to have slower growth indirectly through the financial sector. However, the resource curse can be avoided if the countries have good financial systems that are able to reduce the risk of volatility. They can even turn a potential curse into a blessing.

Because the relationship between natural resources and institutional quality draws the most attention of the economists studying about natural resources, it seems to me that this debatable issue certainly needs more extensive investigation. Moreover, Bulte and Damania (2005) also state that the study of this relationship is of high priority for the researchers who want to learn about the natural resource curse. Therefore, my research will explicitly focus on this relationship in a quest to explore how things may have changed in a more recent time frame. However, first and foremost, I need to test for the validity of the resource curse in order to establish the basis for my investigation. This calls for the framework of two models, which I will build based on the ones that were formulated earlier by other economists in the literature. Nevertheless, by doing that, I look forward to seeing the possible changes in the behavior of natural resources among countries rather than refuting their arguments because of the time difference and the data set that I consolidate by myself from various sources. Lastly, to take full advantage of my panel data set, I will test for possible bias in my primary model regarding the validity of the resource curse by implementing a fixed effect and a random effect model, which I have not come across in the literature.

II. Econometric Analysis

A. Empirical Specification

Since Mehlum et al. (2006) employ an interaction term between natural resources and institutional quality into the regression, other economists who want to do research about the relationship tend to use the same method, such as Iimi (2007) and Kolstad (2009). As a result, my model will employ this method as well and also develop it based on the models by Iimi and Kolstad. While Iimi uses 6 institutional quality indices and Kolstad uses democracy index, I incorporate all of them into my model to offer even a broader view on the effect of natural resources on economic growth through institutions. There are seven interaction terms as well. Moreover, while Kolstad uses the same data by Sachs and Warner (1995) from 1970 to 1990 and Iimi uses cross-sectional data from 1998 to 2002, I will use the updated panel data from 2003 to 2007. My primary linear growth regression model has the following form:

$$(1) \quad GTH = \beta_0 + \beta_1 NR + \Psi_1 INQ_i + \Psi_2 NR \bullet INQ_i + \beta_2 ln(inGDP) + \beta_3 POP\_GTH + \beta_4 EDU + \beta_5 INV + \beta_6 OPEN + \beta_7 LLOCK + \beta_8 AFR + \beta_9 LA + \beta_{10} EA\_SEA + u$$

GTH: Annual growth in real GDP per capita; NR: Natural resource export per capita (measuring resource abundance); INQ_i: Each of the 7 institutional quality index; $NR \bullet INQ_i$: Each of the interaction terms between natural resources and an institutional quality index; ln(inGDP): Natural log of the initial GDP per capita (the Steady State theory suggests that initial GDP level can affect subsequent growth of a country and I take its log to reduce its fluctuation among countries); POP_GTH: population growth; EDU: Secondary school enrollment rate; INV: Investment rate; OPEN: Trade openness; LLOCK: Dummy variable for landlocked countries; AFR: Dummy variable for African countries; LA: Dummy variable for Latin American countries; EA_SEA: Dummy variable for East Asian or Southeast Asian countries.

I change my measure of natural resource abundance as natural resource exports per capita instead of the ratio of primary exports to GDP by Sachs and Warner due to Immi's critique that it is inconsistent with standard growth theory. There are seven interaction terms between natural resources and institutional quality in the model. I include initial GDP, population growth, education, investment rate, and trade openness as my control variables because other economists in my literature review suggest that there may be a correlation between them and the primary independent variable natural resource abundance. The other dummy variables are used to test the robustness of the relationship between natural resource abundance and institutional quality adjusted for different economic and geographical conditions. I choose a period of five years for my research because according to Iimi (2007), it is a conventional duration in the standard growth literature to avoid changes in economic structure.

I use another set of equations to test for the possible relationship between natural resources and institutional quality, as it may have implication on economic growth:

$$(2) \quad NR = \beta_0 + \beta_1 INQ_i + \beta_2 ln(inGDP) + \beta_3 POP\_GTH + \beta_4 EDU + \beta_5 LLOCK + \beta_6 AFR + \beta_7 LA + \beta_8 EA\_SEA + u$$

This model is formulated based on similar models by other researchers. The variables used here are similar to the ones from my primary model.

Because I use panel data, it is common to test for the possible effect of time-constant unobserved factors on my primary model which may cause bias by employing a fixed effect and a random effect model that is based on this model:

$$(3) \quad GTH = \beta_0 + \beta_1 NR + \Psi_1 INQ_i + \Psi_2 NR \bullet INQ_i + \beta_2 ln(inGDP) + \beta_3 POP\_GTH + \beta_4 EDU + \beta_5 INV + \beta_6 OPEN + \beta_7 LLOCK + \beta_8 AFR + \beta_9 LA + \beta_{10} EA\_SEA + a + u_t$$

This model is formed from my primary model by adding *a*, the time-constant unobserved factors, and modifying *u* to u_t, the time-varying unobserved factors. We take the first difference of this model to remove *a* to construct the fixed effect and random effect models.

B. Data Description

As I formulate my model based on the one by Iimi (2007), I use data for my project for a period of 5 years (2003 to 2007). This is a conventional duration in the standard growth literature to avoid the changes in economic structure. However, instead of using cross-sectional data like

Iimi does, I use panel data. I combine the collections of countries from the World Bank and the United Nations to include 221 countries and territories in my sample. However, due to extensive missing data in the independent variables, I am not able to cover all of them in my regression.

In my model, GTH is the dependent variable to measure economic growth in percentage term. It is the annual growth rate of real GDP per capita. This variable is also used by Sachs and Warner (1995) and all other later economists. Data for GTH is from Penn World Table 6.3.

NR measures the natural resource abundance of each country. I use this variable according to the definition by Iimi (2007): the ratio of natural resource exports to population, based on the assumption that most natural resources extracted are exported. This variable is different from the one used by Sachs and Warner (1995): the ratio of primary export to GDP. I do not use this measure because it is not consistent with the standard growth theory, as stated by Iimi (2007). I collect data on natural resource export from the United Nation Conference on Trade and Development for each year. The products include fuels, minerals, and precious stones (categories 3, 27, 28, 68, 667, 971 of the Standard International Trade Classification Revision 3). I then divide them by the population of each country (Penn World Table 6.3).

ING_i is each of the 7 variables measuring institutional quality as it is widely believed in the literature that good institutional quality can contribute to higher economic growth, and vice versa. They are voice and accountability (VOI), political stability (POL), government effectiveness (GOV), regulatory quality (REG), rule of law (RUL), control of corruption (CORR), and democracy index (DEM). Data for the first 6 variables are from the Worldwide Governance Indicator Project by the World Bank. Originally these data are measured from a range approximately about -2.5 to 2.5. However, for the ease of interpretation in my project, I transform them to the scale of 0 to 1, which is similar to what Iimi (2007) does. Democracy index data are from the Integrated Network for Societal Conflict Research. I also transform them from the scale of -10 to 10 to the scale of 0 to 1.

$NR \bullet INQ_i$ is each of the 7 interaction terms between natural resource capital and each of the measure of institutional quality. Iimi (2007) uses the first 6 measures of institutional quality together with their interaction terms with natural resources, while Kolstad (2009) employs the democracy index and its interaction term with natural resources. They use these interaction terms to test whether a country abundant with natural resources can improve growth through their institutional quality.

ln(inGDP) is the log of initial GDP per capita, or the GDP per capita in 2003. All the authors studying the natural resource curse in my literature review include this variable, because they believe initial GDP may have an impact on economic growth according to the Steady State theory. I collect data for GDP per capita from Penn World Table 6.3. I then take its natural logarithm to reduce the fluctuations in the difference of GDP per capita among countries.

POP_GTH measures population growth in percentage. Because I am measuring natural resource abundance based on population, I need to include this variable in my regression. Besides, population growth is considered as an important factor in explaining economic growth. This variable is included in the model by Iimi (2007). Its data are from the World Bank.

For other non-binary control variables, I use education (EDU), investment (INV), and openness in trade (OPEN) because some economists used them before, and I think that they are rational predictors of economic growth. EDU measures the enrollment rate of primary school (in percentage), which is a popular measure used by other economists. It comes from the World Development Indicator by the World Bank. INV is the percentage of investment in GDP, coming from Penn World Table 6.3. OPEN is the ratio of imports plus exports to GDP, also collected from Penn World Table 6.3.

As the economic structures can be different among countries of different geographical properties, I include 3 binary variables to control for such factors: LLOCK (take the value of 1 if the country is landlocked), AFR (take the value of 1 if the country is in Africa), EA_SEA (take the value of 1 if the country is in either East Asia or Southeast Asia). They are all used by Iimi (2007) and some other economists. I determine the values of these variables based on my geography knowledge and the World Map.

To carry out the Chow Test, I include the binary variable DED which takes the value of 1 if the country is developed. To determine the DED's values, I consult the World Economic Outlook 2009 by the International Monetary Fund. DED is used most recently by Butkiewicz and Yanikkaya (2010). Many economists believe that the effect of natural resources on growth can be different between developed and developing countries.

There are 1105 observations for my sample because I collect data for 221 countries for 5 years. However, I can see that there are a lot of missing data on some of the variables, especially the democracy index (DEM) and its interaction term with natural resources (NR_DEM): there are only 786 and 774 observations respectively. The growth rate can go from -34.95% (Iraq 2003) to 53.52% (Zambia 2004), which is a wide spread because its mean is only 3.93%. This shows that over my period, there are countries that develop really fast, while there are others that develop really slowly, but the general trend is that the world is developing as a whole. For my primary independent variable, natural resource export over population (NR), there is also a widespread of values as well, as it can take any value from .002 to 46424.39, with the mean being at 1171.446. The data are skewed to the right, which means that there are more countries with limited natural resources.

The data for the log of initial GDP are evenly distributed, centering at 8.71 with its maximum value being 11.08 (Luxembourg) and minimum value being 5.89 (Congo). The data for all the institutional quality indices seem to be centered at 0.5 and their deviations are within 0.32 unit, which shows that they are evenly spread. None of the data for institutional quality seem to have notable differences in their distributions. The population growth of the world is center at 1.44% with a small deviation of 1.43%, given that the values range from -7.95% (Cayman Islands 2004) to 17.35% (also Cayman Islands but in 2006). It is interesting to see that education, measured as the primary school enrollment rate, can exceed 100%, as its maximum is

TABLE 1. Descriptive Statistics

Variable	Number of Observation	Mean	Standard Deviation	Minimum	Maximum
Economic Growth (GTH)	934	3.926	5.442	-34.948	53.522
Natural Resources (NR)	934	1171.446	3716.825	0.002	46424.390
log(Initial GDP) (ln(inGDP)	935	8.711	1.186	5.891	11.089
Voice and Accountability (VOI)	1035	0.555	0.243	0	1
Political Stability (POL)	1033	0.670	0.209	0	1
Government Effectiveness (GOV)	1020	0.514	0.215	0	1
Regulatory Quality (REG)	1018	0.581	0.213	0	1
Rule of Law (RL)	1042	0.573	0.216	0	1
Control of Corruption (CORR)	1023	0.449	0.223	0	1
Democracy Index (DEM)	786	0.675	0.325	0	1
NR•VOI	934	592.053	1805.053	0	19886.310
NR•POL	934	913.182	3109.070	0	39832.820
NR•GOV	929	751.111	2451.518	0	25217.290
NR•REG	929	821.364	2653.071	0	31592.880
NR•RL	934	814.183	2734.006	0	34238.140
NR•CORR	929	704.555	2458.089	0	31390.480
NR•DEM	774	530.105	1572.285	0	21407.730
Population Growth (POP_GTH)	1027	1.448	1.437	-7.955	17.355
Education (EDU)	832	102.475	15.077	32.560	157.742
Trade Openness (OPEN)	936	97.607	53.379	2.008	456.562
Investment (INV)	936	23.164	13.904	1.522	93.598
Landlocked (LLOCK)	1105	0.195	0.396	0	1
Africa (AFR)	1105	0.240	0.427	0	1
Latin America (LA)	1105	0.172	0.378	0	1
East Asia or Southeast Asia (EA_SEA)	1105	0.086	0.280	0	1
Developed (DED)	1015	0.207	0.405	0	1

157.74% (Sierra Leone 2007), while its average is also above 1 at 102.47%. There is a huge spread of trade openness among countries. Its minimum is 2.01 (Somalia 2004) while its maximum is 456.56 (Singapore 2006). As its average is 97.61, the data is skewed to the right, which means that there are more countries with lower level of trade openness. The general trend of investment in the world seems to be low, at an average of only 23%. There are countries that spend most of their GDP on investment, as reflected by the maximum of 93.6% (Kiribati 2005). The data on the 5 dummy variables are not surprising as they show that there are fewer landlocked and developed countries in the world.

C. Results

Using the same method by Iimi (2007), I run my regressions of growth on natural resources, each institutional quality index and its interaction term with natural resources. Therefore, there are 7 regressions based on my primary model (Table 2).

Population growth has negative effect on economic growth in all of the 7 cases, which shows that it is a very important explanatory variable for economic growth. An increase of 1 percentage point in population growth is associated with a reduction of economic growth in the range of 0.41 to 0.87 percentage point. As the value of population growth can reach 17.35%, this result has vital implication on the restriction of population growth in the developing countries.

While I can see positive signs on all the education coefficients and and negative signs on all the trade openness coefficients in the 7 regressions, there is no statistically significant relationship between them and economic growth. Investment rate only has a statistically significant effect on growth when I control for democracy (2.7). A 1 percentage point increase in investment rate leads to a 0.07 percentage point increase in economic growth, which is quite economically significant given that investment rate can reach 93.6%.

There is significant evidence that landlocked countries tend to have higher growth rates in all the 7 regressions. However, if we think about the Steady State theory, we realize that the landlocked countries used to suffer from slow economic growth in the earlier time, so now, when they finally start to increase growth, their growth rates should be faster than that of other countries which had already reached higher levels of growth earlier. The fact that a country is landlocked can lead to its increase in economic growth in the range of 1.25 to 1.8 percentage point, which is quite economically significant. While African countries are likely to have slower economic growth across all the regressions, there are 2 cases (2.2 and 2.4) that show East Asian or Southeast Asian countries tend to have higher growth. A country being in Africa may suffer a reduction in growth in the range of 1.3 to 1.5 percentage point, while a country being in East Asia or Southeast Asia may enjoy an increase of growth in the range of 1.5 to 1.7 percentage point; both of which are economically significant.

My primary concern is whether the natural resource curse exists in my regressions and the role of institutions in countries with abundant natural resources. In the case of voice and accountability and control of corruption, there is no significant relationship between natural resources and economic growth. Their interaction terms with natural resources are not significant either. As a result, I can claim that when we control for the effect of voice and accountability and control of corruption on economic growth, natural resources have no more explanatory power on economic growth.

However, both natural resources and the interaction terms are statistically significant when I control for political stability, government effectiveness, regulatory quality, rule of law, and democracy. At first, it seems contrary to the theory of natural resource curse because all the coefficients of natural resources have positive signs, which means that natural resource abundance actually contributes to growth although the effect is minimal. However, at the same time, all the interaction terms have negative signs. This means that in the resource-rich countries, the improvement of institution quality can lead to slower growth. To investigate the overall

TABLE 2. Natural Resource Effect on Economic Growth for 7 Institutional Quality Indices

Dependent Variable: Economic Growth

Variable	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)	(2.7)
Natural Resources (NR)	0.0002	0.0016*	0.0009*	0.0015*	0.0007*	0.0004	0.0003*
	(0.0001)	(0.0005)	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0001)
Voice and Accountability (VOI)	-3.0585*						
	(1.1502)						
NR•VOI	-0.0002						
	(0.0002)						
Political Stability (POL)		0.6810					
		(1.2945)					
NR•POL		-0.0018*					
		(0.0005)					
Government Effectiveness (GOV)			0.8863				
			(1.7038)				
NR•GOV			-0.0011*				
			(0.0003)				
Regulatory Quality (REG)				1.9155			
				(1.5478)			
NR•REG				-0.0019*			
				(0.0004)			
Rule of Law (RL)					-1.8253		
					(1.5573)		
NR•RL					-0.0008*		
					(0.0004)		
Control of Corruption (CORR)						-2.7787	
						(1.5115)	
NR•CORR						-0.0004	
						(0.0003)	

Democracy Index (DEM)							-2.2273*
							(0.7331)
NR•DEM							-0.0003*
							(0.0001)
log(Initial GDP)	-0.0543	-0.4964	-0.5670	-0.7060*	-0.1654	-0.0113	-0.7902*
	(0.2698)	(0.2659)	(0.3487)	(0.3158)	(0.3208)	(0.3304)	(0.2646)
Population Growth	-0.4715*	-0.4218*	-0.5567*	-0.6132*	-0.4235*	-0.4135*	-0.8742*
	(0.2007)	(0.1981)	(0.2014)	(0.2016)	(0.1993)	(0.1998)	(0.2300)
Education	0.0168	0.0143	0.0139	0.0124	0.0156	0.0151	0.0200
	(0.0125)	(0.0126)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0124)
Trade Openness	-0.0023	-0.0029	-0.0020	-0.0019	-0.0023	-0.0024	-0.0003
	(0.0042)	(0.0043)	(0.0043)	(0.0042)	(0.0042)	(0.0043)	(0.0051)
Investment	0.0246	0.0117	0.0119	0.0082	0.0179	0.0196	0.0706*
	(0.0162)	(0.0163)	(0.0158)	(0.0156)	(0.0161)	(0.0160)	(0.0220)
Landlocked	1.6313*	1.8003*	1.6738*	1.6530*	1.7067*	1.6911*	1.2568*
	(0.4771)	(0.4781)	(0.4775)	(0.4758)	(0.4773)	(0.4786)	(0.4684)
Africa	-1.3732*	-1.4115*	-1.4294*	-1.5021*	-1.4301*	-1.3210*	-1.3769*
	(0.5660)	(0.5768)	(0.5677)	(0.5659)	(0.5703)	(0.5759)	(0.6056)
Latin America	-0.6163	-0.5408	-0.6274	-0.6126	-0.8329	-0.7618	-0.5678
	(0.5438)	(0.5434)	(0.5536)	(0.5461)	(0.5629)	(0.5499)	(0.6163)
East Asia or Southeast Asia	1.0305	1.7351*	1.3803	1.5898*	1.2605	1.1632	0.2277
	(0.7261)	(0.7250)	(0.7193)	(0.7176)	(0.7203)	(0.7247)	(0.7711)
Observations	793	793	789	789	793	789	670
R-squared	0.0642	0.0638	0.0656	0.0728	0.0617	0.0616	0.1049

* represents significance at the 5% level. The numbers in parentheses are standard errors.

impact of natural resources on economic growth, I examine the 5 following equations that come from my regressions:

$$\frac{d(growth)}{d(natural\ resources)} = 0.0016182 - 0.0017517(political\ stability)$$

$$\frac{d(growth)}{d(natural\ resources)} = 0.0009045 - 0.0011467(government\ effectiveness)$$

$$\frac{d(growth)}{d(natural\ resources)} = 0.0014861 - 0.0018549(regulatory\ quality)$$

$$\frac{d(growth)}{d(natural\ resources)} = 0.0007085 - 0.0007941(rule\ of\ law)$$

$$\frac{d(growth)}{d(natural\ resources)} = 0.0002742 - 0.0003229(democracy)$$

The above equations show that: if political stability reaches 0.92, government effectiveness 0.79, regulatory quality 0.80, rule of law 0.89, and democracy 0.85, the positive effect of natural resources on economic growth will be 0. Any indices with values above those limits will lead to negative economic growth due to natural resource abundance. As all these indices can reach 1 at most, the negative impact on growth does not seem to be economically significant. However, this outcome still calls for an explanation. It is so ironic, based on my literature review, that better institutional quality can actually lead to slower growth in resource-rich countries. My finding agrees with that of Sachs and Warner (1995) that resource abundance leads to slower economic growth. However, while they find that natural resource abundance directly leads to slower growth, I discover that such a relationship occurs through institutional quality. My finding contradicts all the results by Mehlum et al. (2006), Iimi (2007), and Kolstad (2009) even though my model is based on theirs. As Mehlum et al. and Kolstad use data from 1970 to 1990 (the same data set used by Sachs and Warner), and Iimi uses cross-sectional data although they are more recent, my result can be different because I employ the most updated panel data. This suggests that there could have been some fundamental changes in the economic structure over time.

In order to offer an explanation for my findings, I formulate a hypothesis that in recent years, the countries with better institutional quality tend to reduce their dependence on natural resources and gear their economic development toward other sectors. The resource-abundant countries may have perceived that being too dependent on natural resources may cause problems such as slower economic growth, debt overhang, and other sectors in the economy being less developed. Therefore, they want to diversify their risk by developing other productive sectors in their economies such as manufacturing and services. In fact, the products in those sectors have much lower risk according to Ploeg and Poelhekke (2009). If my hypothesis is true, then although natural resources may help economic growth, their impact will be reduced when the government intervenes. However, this does not mean that the economic growth of the countries

will drop as a whole, because there can be more revenues coming from other sectors in the economy.

To test the hypothesis, I use my second model. However, as I already know that voice and accountability and control of corruption have no significant effect on growth, I can leave them out. Therefore, I have 5 regressions (Table 3).

My output shows that countries with higher initial GDP and higher population growth tend to rely on natural resources more. An increase of 1% in initial GDP may lead to an increase in natural resource dependence in the range of 18.55 to 24.59 points, which is not so economically significant. An increase of 1 percentage point in population growth corresponds to an increase of resource dependence from 1831 to 1889 points, which is quite large because population growth can reach 17.35%. These relationships possibly exist because countries at higher stages of economic development or larger populations need more energy.

Countries in Africa and Latin America, in the time period of my data, seem to become less dependent on natural resources. The fact that a country is in either Africa or Latin America reduces its dependence on natural resources in the range of 963 to 1623 points. Although these numbers are not economically large, they show a start of the countries in these continents to navigate away from natural resources. This claim of mine is actually supported by evidence found in Meller (2009). This article explores the changes in Latin America trade regime. Since the 1990s, there has been an emphasis of the Latin American economies on information and communication technologies despite their comparative advantages in natural resources. They view information and communication technologies as the crucial driving forces for a thriving economy in the twenty-first century. Data show that "In 1965, natural resources accounted for almost 80% of total Latin American foreign sales; but this proportion had fallen to 53% in 1980 and 46% in 1990. Manufactured goods accounted for less than 4% of the region's exports in 1965, but had risen to almost 30% by 1990." This trend of changes in economic orientation supports my argument on the effort of the countries in Latin America to become less dependent on natural resources. However, this is the only article that I could find in the literature that elaborates on the economic structural changes in resource-rich countries. Although there is common speculation that countries in Africa and the Middle East are improving on their manufacturing industries and technology, there should be more scholarly works to study their current views on natural resources.

Except for political stability, there is significant evidence that better government effectiveness, regulatory quality, rule of law, and democracy lead to less dependence on natural resources. An increase of 0.1 point in the index of any of these institutional quality measures is associated with a decrease of natural resource dependence in the range of 235.65 to 480.22 points. As an index can only take values up to 1, whereas natural resources can reach 46424.39 points, the reduction in natural resource dependence is not economically large. This explains why the negative impact of natural resources through institutions is not economically significant either as I claim above.

Therefore, I find evidence that natural resources may lead to slower growth through higher quality of government effectiveness, regulatory quality, rule of law, and democracy.

TABLE 3. Institutional Effect on Natural Resources

Dependent Variable: Natural Resources

Variable	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
Political Stability	-563.59				
	(617.38)				
Government Effectiveness		-4802.24*			
		(788.36)			
Regulatory Quality			-3755.97*		
			(740.83)		
Rule of Law				-4095.45*	
				(712.41)	
Democracy Index					-2356.52*
					(368.39)
log(Initial GDP)	1855.03*	2459.39*	2267.87*	2331.04*	1937.34*
	(125.52)	(150.60)	(140.13)	(139.78)	(117.65)
Population Growth	1889.39*	1831.90*	1850.88*	1869.22*	1843.28*
	(82.77)	(81.75)	(82.12)	(80.99)	(88.79)
Education	6.24	5.15	4.90	6.91	8.67
	(6.77)	(6.60)	(6.64)	(6.61)	(6.70)
Landlocked	343.93	309.80	343.24	287.22	301.10
	(253.89)	(248.77)	(250.48)	(248.97)	(252.30)
Africa	-963.27*	-982.97*	-1029.65*	-1023.03*	-1323.63*
	(291.22)	(284.32)	(286.41)	(284.56)	(311.56)
Latin America	-1277.36*	-1517.20*	-1406.32*	-1623.59*	-1034.17*
	(288.63)	(285.59)	(285.98)	(289.39)	(329.27)
East Asia or Southeast Asia	-495.35	-456.16	-479.03	-653.63	-1143.14*
	(383.12)	(375.35)	(377.96)	(376.52)	(413.06)
Observations	793	789	789	793	670
R-squared	0.5053	0.528	0.5213	0.5248	0.5871

* represents significance at the 5% level. The numbers in parentheses are standard errors.

However, I am skeptical in claiming that the natural resource curse exists, because the government in the resource-rich countries may have shifted their economy toward other sectors such as manufacturing or services. Nevertheless, I want to test if there is a difference in the effect of natural resources on economic growth between developed and developing countries. In order to do this, I use the Chow Test for the 4 relevant cases of institutional quality, and the result suggests that I should split my sample into developed and developing countries (Table 4).

My result shows that there is no relationship between natural resources and economic growth in the developed countries. In the developing countries, natural resources have impact on

TABLE 4. Natural Resource Effect on Economic Growth by Development Status

Dependent Variable: Economic Growth

	(4.1)		(4.2)		(4.3)		(4.4)	
Variable	Developed	Developing	Developed	Developing	Developed	Developing	Developed	Developing
Natural Resources (NR)	0.0004	0.0010*	-0.0002	0.0014*	-0.0001	0.0006	-0.0012	0.0001
	(0.0011)	(0.0003)	(0.0016)	(0.0004)	(0.0009)	(0.0004)	(0.0022)	(0.0001)
Government Effectiveness (GOV)	1.2242	6.6461*						
	(1.6844)	(2.1550)						
NR•GOV	-0.0004	-0.0016*						
	(0.0012)	(0.0005)						
Regulatory Quality (REG)			1.9791	5.5455*				
			(3.0991)	(1.8254)				
NR•REG			0.0003	-0.0021*				
			(0.0018)	(0.0006)				
Rule of Law (RL)					-0.6194	1.6200		
					(1.7869)	(1.8934)		
NR•RL					0.0001	-0.0008		
					(0.0009)	(0.0006)		
Democracy Index (DEM)							1.2709	-0.8572
							(5.4120)	(0.8389)
NR•DEM							0.0012	0.0000
							(0.0022)	(0.0004)
log(Initial GDP)	-2.6575*	0.1343	-2.7888*	0.2169	-2.3765*	0.6251	-2.8600*	0.4615
	(0.5227)	(0.4075)	(0.5223)	(0.3863)	(0.5368)	(0.3913)	(0.4982)	(0.3820)
Population Growth	0.2397	-0.2447	0.2436	-0.3471	0.2548	-0.2219	0.4488*	-0.4464
	(0.2365)	(0.2424)	(0.2382)	(0.2428)	(0.2308)	(0.2479)	(0.2044)	(0.2883)
Education	-0.1367*	0.0168	-0.1342*	0.0157	-0.1377*	0.0172	-0.1478*	0.0243
	(0.0276)	(0.0136)	(0.0270)	(0.0136)	(0.0276)	(0.0137)	(0.0234)	(0.0136)
Trade Openness	0.0111*	-0.0156*	0.0108*	-0.0162*	0.0111*	-0.0160*	0.0131*	-0.0135*
	(0.0020)	(0.0062)	(0.0020)	(0.0062)	(0.0020)	(0.0062)	(0.0031)	(0.0065)

Investment	0.0679*	0.0234	0.0717*	0.0226	0.0634*	0.0262	0.0564*	0.1018*
	(0.0257)	(0.0178)	(0.0282)	(0.0178)	(0.0258)	(0.0184)	(0.0257)	(0.0252)
Landlocked	0.5945	2.3716*	0.5911	2.2705*	0.5570	2.3084*	0.4602	1.8039*
	(0.3362)	(0.5709)	(0.3350)	(0.5689)	(0.3420)	(0.5759)	(0.3197)	(0.5527)
Africa		-1.8860*		-1.8020*		-1.7209*		-1.4949*
		(0.6317)		(0.6267)		(0.6458)		(0.6773)
Latin America	1.7828*	-2.1219*	1.7470*	-2.1018*	1.4256	-1.9781*		-2.2525*
	(0.8014)	(0.6607)	(0.7526)	(0.6597)	(0.8048)	(0.6671)		(0.7490)
East Asia or Southeast Asia	-0.0636	1.0241	-0.0355	1.4575	-0.1085	1.2423	-0.0901	0.3768
	(0.4627)	(0.8983)	(0.4624)	(0.8984)	(0.4651)	(0.8971)	(0.5090)	(0.9687)
Observations	154	634	154	634	154	638	133	537
R-squared	0.4514	0.1061	0.4514	0.1061	0.4498	0.0875	0.5663	0.1341

* represents significance at the 5% level. The numbers in parentheses are standard errors.

economic growth through government effectiveness and regulatory quality only; rule of law and democracy become insignificant. To determine whether institutional quality still creates a negative effect of natural resources on growth in the developing countries, I examine the 2 equations:

$$\frac{d(growth)}{d(natural\ resources)} = 0.001007 - 0.0016368(government\ effectiveness)$$

$$\frac{d(growth)}{d(natural\ resources)} = 0.001429 - 0.0020505(regulatory\ quality)$$

This shows that when government effectiveness reaches 0.61 and regulatory 0.69, the effect of natural resources on economic growth will be 0. Higher levels of those two indices will lead to slower growth. Here, the limits that institutional quality can offset the positive effect of natural resources seem to be much lower.

It is surprising to see that while education has no impact on growth in the developing countries, it has significant negative effect on growth in the developed countries in all four cases. This effect may exist because in the developed countries when life is more stable, more people will spend more time in school, which leads to a reduction in the number of people in the productive activities in the economy. In all four cases, the investment rate seems to improve growth of the developed countries, while it only helps the developing countries when I control for democracy. The most interesting result is on trade openness. While trade openness significantly promotes economic growth in the developed countries, it significantly reduces growth in the developing countries in all of the regressions. This may be related to the finding by Falkinger and Grossman (2002) and Butkiewicz and Yanikkaya (2010) that trade openness may lead to slower growth in the developing countries when we control for natural resources.

As I use panel data for my model, there can possibly be unobserved factors across countries that do not change over time and may cause bias in my model. Moreover, as the time frame is 5 consecutive years with the purpose of avoiding changes in economic structure, it is very likely that those factors exist. If the countries' economic structures stay the same during this period, their economic growth patterns may differ due to this indigenous unobserved factor. In addition, it is likely to determine how each country depends on their natural resources, which is a correlation between an unobserved factor and my main explanatory variable: natural resources abundance, leading to bias. Other unseen time-constant factors that may affect the economic growth and natural resource abundance of each country individually include their history of dependence on natural resources, the availability of other economic sectors, the types of economic zones they belong to, geographical locations, infrastructure, etc. However, while all of the issues above are expected to influence the economic growth of the countries, I cannot be certain whether they are really correlated with natural resource abundance. Their relationship with natural resources may be a random one rather than one that follows recognizable patterns. Therefore, I need to test for their effect on my primary model and their behaviors using a fixed effect model: if those factors are correlated with natural resource abundance, and a random effect model: if those factors are not correlated with natural resource abundance. I also need to apply the Hausman test to know which model I should use in each case of the 7 institutional quality

indices. The purpose of these models is to remove the time-constant unobserved factors from my primary model to form new regressions that better reflect the time-varying characteristic of my panel data.

My regression result and the Hausman test show that there is fixed effect in the cases of regulatory quality, rule of law, and democracy index and there is random effect in the cases of voice and accountability, political stability, government effectiveness, and control of corruption. This suggests that the time-constant unobserved factors are related to natural resource abundance in the group of regressions involving the first 3 institutional quality indices, while they do not cause significant effect on the rest four. In the cases of fixed effect (Table 5), the most noticeable thing is that natural resource abundance in all the three regressions become insignificant, which is not the case in my original model. This result actually shows that natural resources do not create any impact on economic growth at all when I control for regulatory quality, rule of law, and democracy index. This suggests that there can be bias in my primary model due to time-constant unobserved factors. Therefore, its explanatory power in the context of these 3 institutional quality indices is reduced. Furthermore, most of the other variables that used to be significant in my primary model turn out to not to be when fixed effect is taken into account. For regulatory quality, all of the independent variables are insignificant. For rule of law and democracy index, although population growth is still significant, its sign surprisingly changes from being negative to positive in both cases. While earlier I explained that population growth is especially harmful for economic growth, it is the opposite case here: population growth has a positive relationship with economic growth. In addition, by examining their coefficients, I find evidence that their positive effect on the economy here is even stronger than in my original model. Disregarding the constant indigenous difference across countries, an increase of 1 percentage point in population growth corresponds to a 1.63 and 1.72 percentage point increase in economic growth when rule of law and democracy index are controlled for respectively. Again, given that population growth can reach 17.35%, this result is quite economically significant. On the other hand, although trade openness is not significant in any cases in my primary model, it becomes significant here when I control for democracy index. I find evidence that trade openness can improve economic growth. Even though some countries with abundant natural resources may make way for trade openness through the suppression of the population, the majority of the countries must be applying it in the right way to improve their economies. After all, we rarely see a country thrive with a more closed economy regardless of their social and political backgrounds. The investment rate is only significant when democracy is controlled for, which is similar to the result in my original model. However, the effects in the two models contradict each other: while investment has a positive effect on economic growth in my original model, it has a negative effect in the fixed effect model. There might have been a strong correlation between the time-constant unobserved factors and the investment rate in my original model, which causes bias in the model and leads to such a contradictory result. If the result in the fixed effect model has better predictive power, one possible explanation is the investment rate may suffer from the diminishing return effect as I notice that many countries are investing excessively as the investment rate can reach 93.60% of their GDPs. Such amounts of investment seem too large for the economy to be sustainable, and it may cause the rate of growth to decrease.

TABLE 5. Fixed Effect Model

Dependent Variable: Economic Growth

Variable	(5.1)	(5.2)	(5.3)
Natural Resources (NR)	-0.0004	0.0001	-0.0002
	(0.0007)	(0.0006)	(0.0002)
Regulatory Quality (REG)	5.1534		
	(5.6630)		
NR•REG	0.0005		
	(0.0010)		
Rule of Law (RL)		10.0015	
		(6.6178)	
NR•RL		-0.0003	
		(0.0009)	
Democracy Index (DEM)			-1.0943
			(3.0730)
NR•DEM			0.0002
			(0.0004)
Population Growth	1.4267**	1.6269*	1.7701*
	(0.7525)	(0.7541)	(0.8248)
Education	0.0165	0.0131	-0.0055
	(0.0434)	(0.0431)	(0.0432)
Trade Openness	-0.0016	-0.0039	0.0462*
	(0.0193)	(0.0193)	(0.0213)
Investment	-0.0494	-0.0355	-0.1426*
	(0.0600)	(0.0596)	(0.0698)
Observations	789	793	670
R-squared	0.0111	0.0122	0.0084

* represents significance at the 5% level. ** represents significance at the 10% level. The numbers in parentheses are standard errors.

For the random effect model in four other cases of institutional quality indices (Table 6), I do not see much change in the significance of the explanatory variables compared to my original model. Almost all of them maintain their significance at the 5% significance level, and all of them except for population growth maintain their significance at the 10% level. None of the ones that are not significant in my original model become significant in this model either. I still find evidence that natural resources improve economic growth when I control for political stability and government effectiveness while there is no relationship between natural resources and economic growth when voice and accountability and control of corruption are controlled for. For the coefficients of the explanatory variables that are still significant, there is no change in their signs and only minimal change in their values. Only population growth displays the most drastic change in all the four cases because it shows no relationship with economic growth at all. Actually population growth seems to be the most erratic variable across my three types of

TABLE 6. Random Effect Model

Dependent Variable: Economic Growth

Variable	(6.1)	(6.2)	(6.3)	(6.4)
Natural Resources (NR)	0.0001	0.0014*	0.0007*	0.0003
	(0.0002)	(0.0006)	(0.0003)	(0.0003)
Voice and Accountability (VOI)	-2.8790*			
	(1.5423)			
NR•VOI	-0.0002			
	(0.0003)			
Political Stability (POL)		0.9710		
		(1.6880)		
NR•POL		-0.0016*		
		(0.0007)		
Government Effectiveness (GOV)			1.4433	
			(2.1967)	
NR•GOV			-0.0009*	
			(0.0004)	
Control of Corruption (CORR)				-1.9655
				(1.9702)
NR•CORR				-0.0003
				(0.0004)
log(Initial GDP)	0.0462	-0.3909	-0.5102	-0.0081
	(0.3601)	(0.3588)	(0.4546)	(0.4377)
Population Growth	-0.2804	-0.2322	-0.3616	-0.2521
	(0.2641)	(0.2627)	(0.2648)	(0.2662)
Education	0.0212	0.0179	0.0183	0.0194
	(0.0165)	(0.0166)	(0.0164)	(0.0165)
Trade Openess	-0.0032	-0.0040	-0.0027	-0.0030
	(0.0057)	(0.0058)	(0.0057)	(0.0057)
Investment	0.0220	0.0099	0.0098	0.0157
	(0.0212)	(0.0214)	(0.0206)	(0.0210)
Landlocked	1.7647*	1.9272*	1.8007*	1.8281*
	(0.6705)	(0.6715)	(0.6672)	(0.6735)
Africa	-1.5109*	-1.5720*	-1.5399*	-1.4554**
	(0.7810)	(0.7931)	(0.7790)	(0.7951)
Latin America	-0.6570	-0.5928	-0.6397	-0.7512
	(0.7612)	(0.7602)	(0.7676)	(0.7694)
East Asia or Southeast Asia	1.1826	1.8447**	1.4991	1.3772
	(1.0260)	(1.0227)	(1.0108)	(1.0240)
Observations	793	793	789	789
R-squared	0.0627	0.062	0.0629	0.0141

* represents significance at the 5% level. ** represents significance at the 10% level. The numbers in parentheses are standard errors.

models: it exhibits negative effect on economic growth in the original model, positive impact on economic growth in the fixed effect model, and no relationship with economic growth in the random effect model. In general, the random effect model, where the time-constant unobserved factors are not correlated with natural resource abundance, reinforces the explanatory power of my primary model in the 4 cases of institutional quality indices except for the variability of population growth.

III. Conclusion

My first set of regressions show that natural resources have positive effect on economic growth when I control for political stability, government effectiveness, regulatory quality, rule of law and democracy. However, when I take into account the interaction terms between natural resources and each of the institutional quality indices, I discover that if the institutional quality indices reach certain limits, natural resources will start to create negative impact on growth. This result seems to confirm the theory of the natural resource curse. However, by using my second set of equations, I find evidence that higher quality of government effectiveness, regulatory quality, rule of law, and democracy leads to less dependence on natural resources. That explains why although natural resources can promote economic growth, the government may intervene to reduce its effect. They probably realize that depending solely on natural resources brings in too much risk, especially all commodities are highly volatile. Therefore, they must have introduced new economic policy to diversify their risk. The most reasonable method is to shift the workforce from the extractive industry to the manufacturing industry and services. Those two sectors are the basis for the development of most the developed countries.

I actually find evidence of such a change in the economic structure in the countries that used to depend a lot on resources: African and Latin American countries are shifting their economy away from natural resources. Therefore, the fact that natural resources have negative effect on economic growth at higher levels of institutional quality does not mean that those countries are suffering from the resource curse. There can be more income from other sectors of the economy. The government in those countries should maintain such a change in economic policies to ensure that their development strategy is a portfolio of different types of technical risk.

By separating my sample into developed and developing countries, I find evidence that there is no relationship between natural resources and economic growth in the developed countries, while the negative impact of natural resources on economic growth through government effectiveness and regulatory quality still exists in the developing countries. By employing a fixed effect and a random effect model to test for possible bias in my primary model due to the time-constant unobserved factors, I find that there may be bias in the model in the cases of regulatory quality, rule of law, and democracy index. Their explanatory power is not maintained. However, in the cases of voice and accountability, political stability, government effectiveness, and control of corruption, the significance of the model is preserved. Therefore, my primary model sustains its explanatory power in these cases. The finding of my study suggests that there should be more research in the future about how the economic structures of the resource-rich countries are changing.

IV. References

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