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Electricity: A Cursed Resource?

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Abstract

As is well documented in the media, the standard of living in many African countries is extremely low. In fact, in the most recent edition of the Human Development Report, released by the United Nations Development Programme (UNDP), thirty-seven of the forty-one countries classified as “low development” (the lowest ranking on the development scale), are African nations. It is equally well-known that many African nations are ‘blessed’ with valuable natural resource endowments that should bring enormous revenues to these countries. The disparity between theory and reality leads one to wonder, why do these revenues not raise the standard of living for a country’s inhabitants? The natural resource curse hypothesis attempts to explain why the revenues are not allocated efficiently.

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I. INTRODUCTION

As is well documented in the media, the standard of living in many African countries is extremely low. In fact, in the most recent edition of the Human Development Report, released by the United Nations Development Programme (UNDP), thirty-seven of the forty-one countries classified as "low development" (the lowest ranking on the development scale), are African nations. It is equally well-known that many African nations are 'blessed' with valuable natural resource endowments that should bring enormous revenues to these countries. The disparity between theory and reality leads one to wonder, why do these revenues not raise the standard of living for a country's inhabitants? The natural resource curse hypothesis attempts to explain why the revenues are not allocated efficiently.

Kojucharov (2007) clearly explains the theory behind the natural resource curse hypothesis. "Time after time, countries exporting resources such as oil and diamonds have seen enormous amounts of revenue pass through their hands, yet have emerged with fragile economies in which resource wealth has exacerbated the very problems it was envisioned to solve." The curse is essentially broken down in to two categories. Kojucharov calls them the Economic Mechanisms (elsewhere referred to as the Dutch disease) and the Behavioral Mechanisms (also known as the Nigerian disease).

With the Dutch disease, the natural resource export causes a high volume of revenue to flow into the country, raising demand, which drives up prices, causing increased cost of living (assuming that revenues are not evenly distributed). Domestic goods become more expensive than similar goods produced abroad, causing an appreciation of the real exchange rate and reducing the competitiveness of the domestic goods on the world market. The Dutch disease also makes resource exporting countries vulnerable to changes in market prices which can lead to budget deficits if the country does not save "boom" profits to cover "bust" spending (Kojucharov 2007). It is also characterized by an inefficient allocation of resources towards the primary sector, preventing growth of the manufacturing and services sectors (Zenthofer 2011).

In a present-day example of the Dutch disease, Zenthofer (2011) compares Mauritius to Trinidad and Tobago- two countries with very similar histories, ethnic compositions, and resource endowments. He found that Mauritius' decision to diversify has led to a "relatively rich and stable economy," while Trinidad and Tobago, which relies on natural gas revenues, suffers from lower research and development, a less stable government, and low prospect for future growth.

On the other hand, the Nigerian disease deals with fiscal mismanagement of governments. Kojucharov cites a "mountain-top resort in Venezuela and an extravagant new airport in Saudi Arabia" as examples of governments investing resource revenues in high-budget, low-return infrastructure projects that give the impression of growth and development without actually helping the people. This type of project can quickly deplete government funds and lead to deficits. Additionally, the "rentier state theory" explains that, once a government has substantial resource revenues, it has no need to tax its people. In this way, the people who would be taxpayers have less leverage to hold the government accountable, leading to decreased transparency. This sets the stage for corruption and rent-seeking, which takes money away from vital sectors like education and health. The combination of the Dutch and Nigerian diseases often makes the people worse off than before the discovery of the abundant natural resources (Kojucharov 2007). As shown in Section IV of this paper, corruption is a serious problem in African countries. This lends evidence to the hypothesis that, if there is a resource curse in these African nations, it is probably from the Nigerian disease.

In African nations, the electrical grids are often unreliable and not large enough to serve a majority of the population. Especially in underdeveloped nations, this scarcity makes electricity a very valuable resource. A few of the more

developed countries have learned to produce electricity efficiently enough to export it to the surrounding countries. As the export of electricity should bring substantial revenues into a country and as it is derived from natural resources, I wondered if it too could cause a resource curse. This study aims to determine whether, by means of a resource curse, electricity export revenues negatively impact corruption and quality of life in Africa.

II. LITERATURE REVIEW

A number of recent studies have found that the Nigerian disease is present in many of today's economies. In an empirical study, Williams (2010) shows that resource rich countries are less transparent, that reduced transparency stems from resource revenues, and that the revenues have a negative effect on economic growth. Avom (2010) finds that Central and Sub-Saharan African countries who rely heavily on natural resources suffer from larger inequalities, smaller human capital development, and smaller revenue growth.

If the results of my study indicate that a resource curse is negatively impacting the people of Africa, there are a few policies that could combat the curse or prevent it in the future. Several studies have examined how to avoid the natural resource curse. Voigt (2011) points to the "Alaskan solution" in which Alaskan residents receive a portion of oil revenues each year. This holds public officials accountable and has been proposed to ensure that Libya's new government can avoid the corruption that has plagued its predecessors. Kojucharov (2007) describes a World Bank plan that was supposed to prevent a resource curse in Chad. In the Revenue Management Plan (RMP), Chad's oil revenues were kept in an offshore account, introducing them gradually to avoid appreciation of the real exchange rate; surplus revenues were kept in a stabilization fund, to keep suppliers immune to market price changes; a large portion of revenues were given to the health, education, rural development, and water/resource management sectors to ensure that the funds were not misused for public gain; and two programs were initiated to provide the citizens of Chad technical and financial training. Although the RMP failed, due to the Chadian government's unwillingness to allow an outside entity to control its revenues, it provided valuable ideas for avoiding the curse. Avom (2010) suggests government investment in manufacturing to promote diversification of central and Sub-Saharan economies. Pegg (2010) explains that, while Botswana's economy is based on diamond revenues and is unlikely to diversify, its emphasis on saving and investing in infrastructure have led to a stable economy with a relatively high standard of living. Hammond (2011) suggests that Venezuela's decision to use oil revenues to invest in human and physical capital and social welfare is the "cure for the disease."

Oil and mineral revenues are the commonly cited sources of the resource curse. There exists a gap in the literature of alternate sources that have not been examined. Thus, this study adds to existing literature by examining electricity exports, a previously unexplored cause of the curse, one that is derived from natural resources rather than a resource itself. The study also hopes that a solution to poverty may be easier to find from increased knowledge of its causes.

III. DATA

The data set contains information from 25 African countries from 2005-2008, providing 100 observations. The countries were chosen by availability of necessary data, which could have resulted in an unrepresentative sample if, for example, there was incomplete data for the poorest, smallest, or most corrupt countries. However, the existing data set contains a geographically diverse set of countries as seen in Table 1 on the next page. The set also contains six net exporters of electricity, seven net importers, seven countries that neither export nor import, and five that are net exporters in some years but net importers in others.

The data used comes from four separate sources: the Human Development Index from the UNDP (2011), the CIA World Factbook (2011), the World Development Indicators from the World Bank (2011), and the Worldwide Governance Index (2011) from the World Bank. The Human Development Index (HDI) takes a value between 0 and 1, and uses four indicators (life expectancy at birth, mean years of schooling for adults, expected years of schooling for children, and Gross National Income (GNI) per capita, to measure three dimensions of human welfare: health, education, and standard of living. The HDI statistics are all

contained in the UNDP's Human Development Report which "requires the highest standards of data quality, consistency and transparency" (http://hdr.undp.org). In addition to the HDI, values for GNI per capita and mean years of schooling were found through the UNDP's Human Development Report (2011).

The CIA World Factbook (2011) contains detailed country profiles. These profiles contain information about the government, people, geography, and economy of individual countries. The key variables from this source were electricity exports and imports, measured in kilowatt hours per year.

The World Bank's World Development Indicators (2011) contains data from 209 countries for the past fifty years. While there are over one thousand indicators, those used in this project include: life expectancy at birth, electricity production, oil exports, and mineral exports.

Finally, the Worldwide Governance Index (2011) contains a Control of Corruption Indicator that will be used to determine whether electricity exports cause increased corruption. The index "captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption as well as 'capture' of the state by elites and private interests" (http://info.worldbank.org). Each country is given a governance rating between -2.5 and 2.5, with the highest scores indicating the least corrupt governments. The rating for each country comes from a specific set of sources. For example, Angola was rated by twelve sources, including The African Development Bank Country Policy and Institutional Assessments, Global Integrity Index, Economist Intelligence Unit, and nine other expert sources.

Table 1: Description of countries included in data set

Countries by region		Electricity Net Export/ Import	Control of Corruption Index	Human Development Index
Northern Africa				
	Algeria	Importer 2 years, Exporter 2 years	-0.44 to -0.4	0.65 to 0.67
	Egypt	Exporter	-0.68 to -0.55	0.59 to 0.61
	Libya	Neither	-0.91 to -0.8	0.73 to 0.74
	Morocco	Importer	-0.31 to -0.21	0.54 to 0.56
	Sudan	Neither	-1.47 to -1.13	0.36 to 0.37
	Tunisia	Importer 1 year, Exporter 3 years	-0.04 to 0.03	0.65 to 0.67
Western Africa				
	Benin	Importer	-0.94 to -0.35	0.42 to 0.43
	Côte d'Ivoire	Exporter	-1.3 to -1.14	0.38 to 0.40
	Nigeria	Exporter	-1.28 to-0.84	0.40 to 0.42
	Senegal	Neither	-0.47 to 0	0.39 to 0.41
	Togo	Importer	-1.13 to -0.75	0.39 to 0.42
Central Africa				
	Angola	Neither	-1.36 to -1.24	0.38 to 0.40
	Cameroon	Neither	-1.2 to -0.91	0.44 to 0.45
	Democratic Republic of the Congo	Exporter	-1.54 to -1.27	0.22 to 0.24
	Gabon	Neither	-0.98 to -0.51	0.63 to 0.64
	Republic of the Congo	Importer 3 years, Exporter 1 year	-1.11 to -1.07	0.47 to 0.48
Eastern Africa				
	Ethiopia	Neither	-0.77 to -0.62	0.29 to 0.32
	Kenya	Importer 3 years, Exporter 1 year	-1.02 to -0.88	0.44 to 0.46
	Mozambique	Exporter	-0.61 to -0.47	0.26 to 0.28
	Tanzania	Importer	-0.78 to -0.28	0.37 to 0.39
	Zambia	Exporter	-0.81 to -0.45	0.36 to 0.38
	Zimbabwe	Importer	-1.37 to -1.34	0.12 to 0.16
Southern Africa				
	Botswana	Importer	0.88 to 1.07	0.60 to 0.62
	Namibia	Importer	0.17 to 0.54	0.58 to 0.60
	South Africa	Importer 1 year, Exporter 3 years	0.22 to 0.58	.058 to .059

The following table, Table 1, contains descriptions of the twenty-five countries included in this study. Attributes included are: geographic region, whether the country is a net exporter or importer of electricity, the country's highest and lowest values for CCI, and the highest and lowest values for HDI. Table 1 shows that there is likely a connection between standard of living and

geographic location. For example, all of the Western African countries have nearly identical values for HDI. Additionally, the data for Southern Africa suggests a correlation between corruption and standard of living. Southern Africa is the only region with consistently positive CCI values and the only region in which each country has an HDI greater than 0.50.

IV. EMPIRICAL DESIGN

Of the twenty-five countries in this sample, ten are considered to be "very corrupt," with CCIs lower than negative one, for at least two years. Only three of the twenty-five countries have CCIs greater than one. Clearly, corruption is widespread in African countries. Two separate Ordinary Least Squares (OLS) regressions will be used to test this study's hypotheses about the Nigerian disease. The first regression tests the hypothesis that electricity exports increase corruption in Africa, and the second regression tests the hypothesis that this corruption leads to decreased quality of life.

H1: Electricity exports cause increased corruption in Africa.
H2: Increased corruption reduces standard of living in Africa.

Model 1 will determine whether electricity exports cause corruption, while controlling for human development. The dependent variable is CCI. The effects of electricity exports are measured by ELEC, which is the ratio of net electricity exports to total electricity produced. ELEC, OIL, and MINE are dummy variables that take the value of one if a country exports oil or minerals. ELEC, OIL, and MINE test for the resource curse. Controls for the level of human development, life expectancy (LIFEEXPEC), GNI per capita (GNIPC), and mean years of schooling (YSCHOOL) are also included in the regression. The equation for Model 1 follows, and its key variables are explained in Table 2.

$$CCI = \alpha + \beta_1 LE + \beta_2 YSCHOOL + \beta_3 GNIPC + \beta_4 ELEC + \beta_5 OIL + \beta_6 MINE$$

Model 2 will test whether corruption negatively impacts quality of life for the people of Africa. The dependent variable is HDI, and the independent variable is CCI. If Model 1 shows that electricity exports cause increased corruption, and Model 2 demonstrates that corruption negatively impacts the standard of living, then by the transitive property one can say that electricity exports cause a reduced standard of living. If this is the case, a resource curse may be to blame. The equation for Model 2 is given below and is summarized in Table 3.

$$HDI = \alpha + \beta_1 CCI$$

Table 2: Key variables for Model 1

Variable	Description (Unit of measurement)	Expected Sign
Dependent Variables		
CCI	Measure of corruption	N/A
Independent Variables		
LE	Life expectancy at birth (years)	+
YSCHOOL	Mean years of schooling (years)	+
GNIPC	GNI Per Capita (2008 dollars)	+
ELEC	Net Electricity Exports/ Total Electricity Production (kilowatt hours)	-
OIL	Takes value of 1 if country exports oil, 0 if not	-
MINE	Takes value of 1 if country exports minerals, 0 if not	-

Table 3: Key Variables for Model 2

Variable	Description	Expected Sign
Dependent Variable: HDI	A measure of human development, accounting for income, schooling, and life expectancy	N/A
Independent Variable: CCI	A measure of corruption, with positive values associated with low levels of corruption	-

V. RESULTS

The results for Model 1, which predicts corruption as a function of resource exports and a control set of variables, are presented in Table 4. It is important to remember, when reading the results, that CCI values for very corrupt nations are negative. Therefore, a negative coefficient in the regression results indicates an increase in corruption. Interestingly, two of the variables that control for human development (LIFEEXPEC and YSCHOOL), are insignificant; however, the third (GNIPC), is positive and highly significant.

The remaining three variables (ELEC, OIL, and MINE) test for the resource curse and each is significant. Interestingly, MINE has the only positive coefficient. This is consistent with the findings of Pegg (2010), who concludes that Botswana's diamond revenues have not caused a resource curse, thanks to careful government planning

and a willingness to invest the revenues into the vital sectors of health, education, and infrastructure. Perhaps the countries with large mineral deposits, such as Botswana and South Africa are more equipped to appropriately manage the revenues, and have turned their resources into a blessing.

The coefficient for OIL is negative and significant, supporting the natural resource curse hypothesis. This is consistent with the findings of Williams (2010) and Avom (2010) who find that oil revenues cause decreased government transparency, allowing funds to be mismanaged. This finding is also supported by Kojucharov (2007), who reports that, despite the World Bank's best efforts to prevent a resource curse, the Chadian government misused revenues, preventing economic and human development growth.

The most important result of this study is that the coefficient for ELEC is negative and significant. This demonstrates that if a country increases electricity exports, it also increases corruption, and supports the resource hypothesis that electricity exports, which can bring large revenues thanks to power shortages in Africa, can increase corruption, consistent with the Nigerian disease.

Table 4: Regression Results for Model 1

Variable	Coefficient
Constant	-1.396*** (-3.914)
ELEC	-.086* (-2.065)
OIL	-.472*** (-4.338)
MINE	.488*** (3.941)
LIFEEXPEC	.006 (.931)
GNIPC	8.746E-5*** (5.462)
YSCHOOL	-.016 (-.508)

***significant at the .001 level
*significant at the .02 level
Dependent Variable: CCI
R-Square: .539
Observations: 100
Numbers in parenthesis are T-values

Table 5 presents the results of Model 2, which tests whether corruption negatively impacts standard of living. It is important to note that corrupt countries have negative values for CCI, while benevolent countries have positive values. The coefficient for CCI is positive and significant, indicating that an increase in "goodness" causes an increase in HDI. Conversely, increasing corruption negatively impacts HDI. It is interesting to note that the R-squared value for Model 2 is .290, suggesting that nearly thirty percent of the variation of standard of living is explained by the model.

Table 5: Regression Results for Model 2

Variable	Coefficient
Constant	.544*** (29.691)
CCI	.132*** (6.319)

***significant at the .001 level
Dependent Variable: HDI
R-Squared: .290
Observations:100
Numbers in parenthesis are T- values

The results of Model 2 intuitively make sense. If a government official is corrupt, and is diverting funds for personal gain, those funds cannot be used to promote health, education, or infrastructure. They are also consistent with the findings of Avom (2010), who determines that corruption that is caused by resource dependency reduces human capital development and revenue growth. Williams (2010), finds that corruption prevents economic growth, further supporting the findings of Model 2.

Combining the findings of Models 1 and 2 demonstrates that electricity exports increase corruption, and therefore reduce quality of life in Africa. Model 1 finds that an increase in electricity exports in Africa causes an increase in corruption. Model 2 finds that corruption decreases standard of living. Thus, by transitive property, electricity exports decrease standard of living, supportive of the resource curse hypothesis.

VI. CONCLUSION

There exists an electricity shortage throughout most of Africa. Grids are unreliable, causing frequent blackouts. Villages without access to power grids are common, and this greatly lowers quality of life. This shortage causes electricity to be very valuable. Intuitively, the countries that have learned to produce electricity efficiently enough to export it to neighboring nations should be better off than those who haven't. That is, electricity exports should be a 'blessing' to the

people of Africa.

The natural resource curse attempts to explain why the people of resource rich countries often do not receive any benefit from resource revenues. Specifically, in countries affected by the Nigerian disease, corrupt officials misuse revenues for personal gain, diverting funds away from the vital sectors of health, education, and infrastructure. This project helps to determine whether revenues from electricity exports can actually reduce quality of life in African countries, by means of a resource curse. It fills a gap in the literature by testing for a previously unexamined cause of the resource curse.

Two separate OLS regressions are used to test the hypothesis that electricity exports can cause a corruption driven resource curse (the Nigerian disease), and that this harms standard of living in Africa. Model 1 measures whether resource exports increase corruption, while controlling for human development. The model finds that oil and electricity exports do increase corruption, providing evidence of a Nigerian disease. Model 2 attempts to determine whether corruption has a negative impact on quality of life. Unsurprisingly, the model finds that corruption does reduce standard of living. By the transitive property, if electricity exports cause corruption, and corruption reduces standard of living, then electricity exports reduce standard of living. These conclusions support this project's hypothesis that electricity exports cause a Nigerian disease, that negatively impacts the quality of life for the people of Africa. This research could be expanded by compiling a larger data set. If more countries were included over a longer time period, the sample would become a better representative of the African continent. Additionally, a model developed to test for the Dutch disease could provide increased understanding of how this particular instance of the curse operates.

The findings of this study imply that poverty may be a more complex problem than previously imagined, and that there are additional potential causes that must be explored. It also stresses the importance of efficient revenue management for governments, as corruption is a significant determinant of standard of living. Finally, it demonstrates that a natural resource curse is not inevitable, as mineral exports were shown to decrease corruption, thereby promoting quality of life.

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