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Growth, Development, and the Natural Resource Curse: Understanding the Asymmetric Gains of Trade

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1. Introduction

Trade is an essential component of a country's economy. The flow of goods and services across national boundaries has become emblematic of the modern global economy. Yet, the effects of trade are not constant across countries. Instead, gains from trade have been observed to be asymmetric across the diverse landscape of political economies. Sharma and Morrissey (2005) for example, suggest that while trade liberalization is generally desirable, it does not guarantee growth.[1] Instead, any impact of trade on an economy is conditional upon the initial economic structure and prevailing policy. This makes sense since countries often differ in terms of structure and what goes into its trade balance. Cross-sectional studies have been divided with regards to trade's ability to alleviate poverty.[2] Yet they have been scant as to what factors cause such differences. This study intends to bridge that gap. Specifically, it seeks to discover what features of an economy determine its relative gains from trade, and consequently, its impact on development.

First, I ask if the marginal impact of trade on growth is conditional upon an economy's relative dependency on natural resources, its governance practices, and its level of development. This will be important to determine the general effects of trade on economic performance. Economic growth however, fails to present a complete picture of development. In assessing the benefits of international trade, one must also be interested in a country's overall wellbeing. As such, the second part of this study will look at a country's overall level of development as measured by the United Nation's Human Development Index (HDI). I ask how economic growth, international trade, and a country's natural resource endowments impact HDI score. Such a move provides greater traction than classical models focused on traditional measures of wealth or income allow. The results of this study will inform the way policy makers and theorists

[1] Kishor Sharma and Oliver Morrissey, *Trade, Growth and Inequality in the Era of Globalization* (London: Routledge, 2005), 4.
[2] ibid.

think about the relationship between trade and development. It will also have important implications for international institutions in understanding how best address economic dependency in the developing world, thereby alleviating hardship and promoting healthy growth.

We find strong evidence for the presence of a natural resource curse. A growing body of literature suggests the existence of a natural resource curse—that natural resource abundant countries tend to grow slower than resource scarce countries.[3] Most studies have looked directly at the impact of the commodity boom that began in the early 2000s on growth.[4] Collier and Goderis (2007) provide compelling evidence for the resource curse, taking into account both short and long run effects. In short, they propose that while in the short run resource revenues raises growth, in the long run it is substantially reduced.[5] Our study builds on such results, asking explicitly if a country's relative dependence on natural resources substantially reduce an economy's gains from trade. The evidence suggests that it does. We also find, as Collier and Goderis do, that countries are able to avoid the resource curse by way of good governance.[6] This is true in terms of contribution to a country's economic growth and human development index. This suggests that the transmission channels of the resource curse are through a country's political institutions. Assuming this diagnosis of the cause of the curse is correct, it would imply that gains to trade, particularly from the extraction of natural resources, could be avoided by rooting out government corruption.

The rest of this paper will be organized as follows. Section 2 describes the empirical model and methodology. Section 3 reports and interprets the estimation results. Section 4 tests

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[3] See for example: Paul Collier, "The Political Economy of Natural Resources." (New School University, 2010).
[4] See Angus Deaton, *International Commodity Prices, Macroeconomic Performance, and Politics in Sub-saharan Africa* (Princeton, NJ International Finance Section, Department of Economics, Princeton University, 1995). & Claudio E. Raddatz, *Are External Shocks Responsible for the Instability of Output in Low Income Countries?* (Washington, DC World Bank, Development Research Group, Growth and Investment Team, 2005).
[5] Paul Collier and Benedikt Goderis, "Commodity Prices, Growth, and the Natural Resource Curse: Reconciling a Conundrum," 2007.
[6] Measured in this context as the control of corruption.

the statistical validity and reliability of the model, acknowledges limitations and suggests potential avenues for improvement. Section 5 concludes.

2. Empirical Model and Methodology

This section describes the econometric model and the variables used in estimation. Data descriptions and sources can be found in Appendix B. Our model takes the form of the classical linear regression model (CLRM) and is estimated by way of ordinary least squares (OLS). The basic linear form of the regression model is given as follows:

$$Y_i = B_i X_i + e_i \tag{1}$$

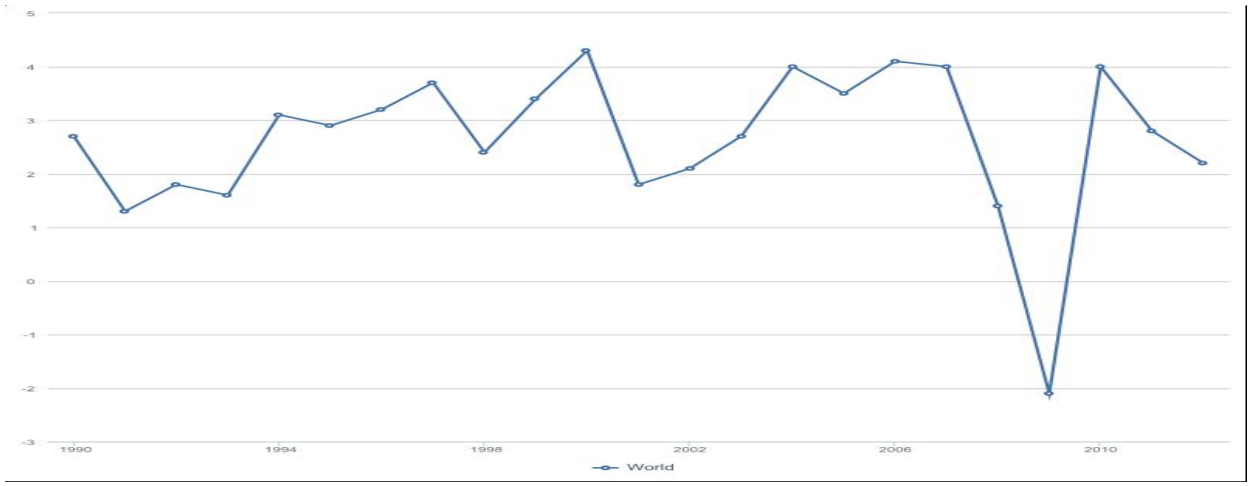
For $i = 1, \ldots N,$ where Y_i is the dependent variable. $B_i X_i$ makes up the deterministic component with B_i representing the regression parameters and X_i representing the non-random regressors. The stochastic random component is given as the error term, e_i, whose expected value is equal to zero following assumptions to the CLRM.

The study includes two base models (hereafter referred to as the growth model and the development model). In the growth model, GDP growth is measured as a function of GDP per capita, trade (% of GDP), natural resources (% of GDP), control of corruption and HDI score. In the development model, HDI is measured as a function of GDP growth, trade (% of GDP), Natural Resources (% of GDP) and control of corruption. The regression equations are given as follows:

$$Growth = B_i\ gdp\ per\ capita\ + B_2\, tradeshare + B_3\, natural\ resource\ rents + B_4\ control\ of\ corruption + B_5\, HDI \tag{2}$$

$$HDI\ = B_i\ gdp\ growth\ + B_2\, tradeshare + B_3\, natural\ resource\ rents + B_4\, control\ of\ corruption \tag{3}$$

Average data from 1995 – 2007 is used to estimate the models, except HDI score, which uses latest available figures from the United Nations Development Programme Human Development Reports. The specific time period was chosen to account for breaks in the data. Between the years 1995 to 2007 the data is relatively stable as shown in the following graph for Gdp Growth.



Aggregate trade share of global GDP. World Bank, WDIs. 2013

For summary statistics see Appendix A. Table 1 summarizes the variables featured in the models.

Table 1

Variables	**Explanation**	**Unit**	**Source**
Growth	Average annual gdp growth	Percentage	World Bank: World Development Indicators
Gdp per capita	Average annual gdp per capita	Current US dollars	World Bank: World Development Indicators
Trade share	Average annual trade share of gdp	Percentage	World Bank: World Development Indicators
Natural resource rents	Average annual natural resource rents as a share of gdp	Percentage	World Bank: World Development Indicators
Control of Corruption	Perception of a country's level of control over corruption	Units on a scale of -2.5 to 2.5 with higher numbers corresponding to better outcomes	World Bank: World Governance Indicators
HDI	Measure of a country's overall wellbeing	Units. Scored between 0 and 1, with higher scores corresponding to better outcomes.	UNDP Human Development Reports

Each model is controlled for heteroskedastic error terms and does not suffer from autocorrelation given the cross-sectional nature of the data.

For each model, a base regression is first estimated, followed by subsequent modifications to test for various relationships. Our interest is in the underlying relationship between trade and the other variables included in the model. As such, we make use of interaction terms to determine if the impact of trade on growth and HDI is dependent upon other factors present in the model. Of particular interest is the interaction between control of corruption (our governance indicator) and the other factors in order to test if governance can affect the way other variables relate to the dependent variables (growth & HDI).

3. Results and discussion

Using average data facilitates identification of the aggregate impact of specified variables on growth and development while keeping it within the linear cross-sectional framework of OLS. Model estimations suggest that while growth and development are intricately linked, growth alone does not lead to greater levels of overall wellbeing. In the same vein, the impact of trade on growth and HDI is highly dependent on other variables specified in the model, in particular on a country's dependence on natural resources. Corruption's impact on growth and HDI tell two quite different stories, calling into question traditional measures of wealth, as we shall soon see.

3.1 Determinants of growth

Table 2 reports the results of estimating equation (2). The first specification is the base model and each subsequent specification includes an interaction term. Specification 2, 3, and 4 account for the factors that influence trade's impact on growth. Specification 5 interacts the role of governance with returns to natural resource rents.

All base model parameters exhibited expected signs. The initial marginal impact of trade, natural resource rents, and human development index score holding all other variables constant, is positive. The coefficients are statistically significant at 1 percent. The coefficient for control of corruption is negative and also significant at 1 percent. Though alarming at first look, it makes theoretical sense that countries with higher levels of corruption grow faster than country's with less corruption. This is consistent with the data, which suggests that corruption (at least conspicuous corruption) is more present in developing economies than rich economies. Consequently, slower growth rates in countries that have controlled corruption are not surprising. The negative coefficient associated with control of corruption is therefore expected.

Table 2, column (2) includes the impact of trade on growth, given a country's level of natural resource rents. The interaction term *trade share*natural resource* rents tracks returns to marginal increases in trade share while simultaneously accounting for relative levels of natural resource rents in an economy. The coefficient is negative and statistically significant at 5 percent. This suggests that gains to trade are undercut by marginal increases in natural resource rents, confirming the resource curse hypothesis. In the same vein, benefits from natural resources are offset by marginal increases in the level of trade in an economy. Given this interaction, impact on growth given a marginal change in trade share can be demonstrated formally by the partial derivative (Summary of the thresholds are shown in Table 2.1) :

$$\frac{\partial Growth}{\partial Tradeshare} = 0.011 - 0.004(NR) \tag{4}$$

Where *NR* is natural resource rents. At mean value of 8.48 percent, the partial equals -0.023 percent, a substantial penalty on GDP growth. Setting the partial equal to zero, we can find the maximum level of natural resource rents as percentage of GDP before the marginal impact of trade on growth falls below zero. We find that the marginal impact of trade equals zero when

natural resource rents makes up 2.75% of Gdp. Thus: when $NR > 2.75$, $\frac{\partial Growth}{\partial Tradeshare}$ is negative; when $NR < 2.75$, $\frac{\partial Growth}{\partial Tradeshare}$ is positive. Given the median value in the sample is 2.11% about half the sample – i.e. half of the world's countries – are susceptible to losses from increased trade associated with natural resource extraction.

We can estimate a similar threshold for the marginal impact of natural resources on growth given relative levels of trade. The partial is demonstrated by the following equation:

$$\frac{\partial Growth}{\partial NR} = 0.09 - 0.004(Trade) \tag{5}$$

At mean value of 87.1 percent, the partial equals -0.258 percent, indeed a very substantial penalty. The marginal impact of natural resource rents equals zero when trade is 22.5%. Thus: when $Trade > 22.5$ percent, $\frac{\partial Growth}{\partial NR}$ is negative; when $Trade < 22.5$ percent, $\frac{\partial Growth}{\partial NR}$ is positive. The implication is that much of the wealth associated with natural resource rents in lost as a result of trade. This highlights one of the transmission channels of the natural resource curse, suggesting that much of a country's natural wealth is lost when being siphoned out of the economy. In specification (5) however, we find that such losses are avoided with marginal improvements in the control of corruption.

Table 2, columns (3) and (4) interact trade with corruption and HDI respectively. The coefficient for *Trade Share*Control of Corruption* is negative and significant at 10 percent. This interaction variable is tricky to interpret given the relationship between corruption and growth as presented earlier. There are potential simultaneity issues that might be present, rendering the result meaningless at best. *Trade Share*HDI* shows up in specification (4) and is more interesting. The coefficient is negative and statistically significant at 1 percent. The HDI

coefficient is positive and also significant at 1 percent. The results suggest diminishing returns to trade as a country develops with respect to GDP growth.

3.2 The resource curse conditional on governance

The discussion thus far suggests that returns to trade are highly dependent on levels of natural resource rents- a manifestation of the resource curse by its impact on trade. Specification (5) tests the effect of governance on returns to natural resource rents. Table 2, column (5) interacts governance with natural resource rents with the following variable: *Natural Resources*Control of Corruption*. The estimated coefficient is positive and significant at 5 percent. The coefficient for *Trade Share*Natural Resource Rents* is still negative but not significant at conventional confidence levels, confirming that the natural resource curse can be avoided by improvements in governance. This suggests that corruption is in fact a major transmission channel through which gains from trade and natural resources are often lost. The development model further strengthens this argument, as we will now show.

Table 2 Estimation Results: Determinants of Growth

Dependent Variable: Average GDP Growth	(1)	(2)	(3)	(4)	(5)
Average GDP Per Capita	0.894*** (0.055)	0.966*** (0.049)	0.953*** (0.047)	0.916*** (0.049)	0.973*** (0.045)
Average Trade Share of GDP (%)	0.0065*** (0.0016)	0.011*** (0.002)	0.017*** (0.002)	0.047*** (0.005)	0.012*** (0.0015)
Average Natural Resource Rents Share of GDP (%)	0.0033*** (0.011)	0.09*** (0.023)			0.076*** (0.020)
Control of Corruption	-0.45*** (0.12)		-0.309* (0.18)		-0.540*** (0.099)
HDI	1.33*** (0.289)			1.545*** (0.356)	
Trade Share*Natural Resource Rents		-0.0004** (0.0002)			-0.0001 (0.00018)
Trade Share*Control of Corruption			-0.0027* (0.0016)		
Trade Share*HDI				-0.055*** (0.0073)	
Natural Resources*Control of Corruption					0.043** (0.187)
Model: OLS	YES	YES	YES	YES	YES
Number of observations	179	184	185	180	184
Adjusted R-Squared	0.93	0.92	0.92	0.94	0.94

Notes: Robust Standard Errors are shown in parenthesis. ***, **, * denote significance levels at the 1%, 5%, and 10% levels respectively.

Table 2.1 Signs and Thresholds

Equation	(–)	0	(+)
$\frac{\partial Growth}{\partial Tradeshare} = 0.011 - 0.004(NR)$	NR > 2.75%	NR = 2.75%	NR < 2.75%
$\frac{\partial Growth}{\partial NR} = 0.09 - 0.004(Trade)$	Trade > 22.5%	Trade = 22.5%	Trade < 22.5%

Where NR is Natural Resource Rents, Trade is Trade share of GDP

3.3 Determinants of wellbeing

Table 3 reports the results of estimating equation (3). As with table (2) the first specification is the base model and each subsequent specification includes an interaction term. The asymmetric impacts of trade cannot be understood by growth rates alone. The HDI provides us with a more complete account of a country's overall wellbeing by taking into account three non-monetary dimensions of development: health, education, and living standards.

The base model parameters exhibit expected signs. Marginal increases in GDP growth, trade share, and control of corruption correspond with higher HDI scores and are statistically significant at 1 percent. The coefficient for natural resource rents is positive but is not statistically significant. The positive sign associated with control of corruption is revealing. Recall that in the growth model, the sign was negative. This suggests that while control of corruption may not directly contribute to higher GDP growth rates, it most certainly leads to improvements in welfare. This is particularly important in light of almost exclusive attention that is paid to GDP growth in much developmental discourse. Granted, GDP growth does contribute significantly to better HDI outcomes as shown in the results, but one might be careful so as to not place too much emphasis on growth at the expense of other elements of development.

The results reveal that wellbeing, along with growth, is adversely affected by the natural resource curse. Table 3, Column (2) includes the interaction term *Trade Share*Natural Resource Rents*. The coefficient for natural resource rents is positive and now statistically significant at 1 percent, suggesting positive returns to marginal increases in resource rents. The coefficient of the interaction term however is negative, and also significant at 1 percent. Relevant thresholds for the marginal impact of natural resources on HDI score are given in Table 3.1.

It should be pointed out at this point that the marginal impact of control of corruption is now 0.115, a substantial jump given the HDI is scaled between 0 and 1. An important caveat however, is that marginal changes in control of corruption score represents drastic improvements as it is scored between -2.5 to 2.5. Thus marginal changes involve a 1-point improvement in score, which is a palpably large jump and typically only takes place over long periods of institutional reform. Nevertheless, the results still suggest that corruption is a significant determinant of a country's wellbeing. The adverse impact of corruption is only exacerbated by the presence of the resource curse, as suggested by the interaction term.

3.4 Governance and wellbeing

Table 3, Column (3) interacts natural resource rents with control of corruption. The coefficient for *Natural Resources*Control of Corruption* is positive and significant at 10 percent. This confirms the story that improvements in governance ameliorate the effects of the resource curse. What is more revealing however is that corruptions impact on HDI is greatly amplified merely by the presence of natural resources. Corruption already imposes a big penalty on a country's wellbeing as shown in all three specifications. The interaction term *Natural Resources*Control of Corruption* reveal that a country's reliance on natural resources imposes a further penalty. This suggests that a major channel for corruption is through a country's natural wealth. This can be seen in the difference between a country like Equatorial Guinea and China. Both countries are notorious for government corruption but while natural resources only make up 4% of China's Gdp, it accounts for 68% of Equatorial Guinea's. Consequently, it is no surprise that China's HDI score is significantly higher than that of Equatorial Guinea's even though on average, Equatorial Guinea has been growing at an average rate of 26% annually.

Table 3 Estimation Results: Determinants of Wellbeing

Dependent Variable: HDI	(1)	(2)	(3)
Average GDP Growth	0.041*** (0.013)	0.043*** (0.0098)	0.041*** (0.012)
Average Trade Share of GDP (%)	0.0042*** (0.001)	0.0042*** (0.001)	0.0042*** (0.0007)
Average Natural Resource Rents Share of GDP (%)	0.0014 (0.0018)	0.025*** (0.0024)	0.005** (0.002)
Control of Corruption	0.0104*** (0.024)	0.115*** (0.115)	0.078** (0.030)
Trade Share*Natural Resource Rents		-0.0002*** (0.000)	
Natural Resources*Control of Corruption			0.005* (0.003)
Model: OLS	YES	YES	YES
Number of observations	179	179	179
Adjusted R-Squared	0.82	0.87	0.83

Notes: Robust Standard Errors are shown in parenthesis. ***, **, * denote significance levels at the 1%, 5%, and 10% levels respectively.

Table 3.1 Thresholds for values of the partial derivative

Equation	(–)	0	(+)
$\frac{\partial HDI}{\partial Tradeshare} = 0.0042 - 0.0002(NR)$	NR > 21%	NR = 21%	NR < 21%
$\frac{\partial HDI}{\partial NR} = 0.025 - 0.0002(Trade)$	Trade > 125%	Trade = 125%	Trade < 125%
$\frac{\partial HDI}{\partial NR} = 0.005 + 0.005(C)$	C > -1	C = -1	C < -1

Where NR is Natural Resource Rents, Trade is Trade share of GDP, and C is Control of Corruption score

4. Statistical validity, limitations and avenues for improvement

Both the growth model and the development model were controlled for heteroskedastic error terms. Using the averages of data from 1995 – 2007 would have also accounted for any autocorrelation between within the time-period. This is important since growth and trade figures exhibit an upward trend. Keeping it within a cross-sectional framework also meant not having to make first difference modifications in order to keep the data unbiased and consistent. The adjusted R-squared on each model specification is given in the above tables. Restricted F-tests exhibited high F-statistics and correspondingly low p-values for all specifications. High R-squares suggest that the model is well "fitted".

The models are good starting points to discover patterns in trade, growth, and development. But they do have several limitations. The cross-sectional framework and using average data limit our ability to test such relationships across time. Averages also suffer from potential existence of outliers within the data that might distort the results. Nonetheless, short of employing panel methodology, the cross-sectional method using averages is a good start. For one, this method gains some mileage in terms of simplicity and being representative of the entire time period.

Potential improvements include allowing the data to vary with time. Using panel data will allow us to do so with some degree of success. Fixed effects panel analysis also has the advantage of allowing each cross-section to have its own intercept thus taking into account characteristics unique to each country. Future versions of the study might also consider including regional dummies. They were not included in this study because given the number of observations available they would rapidly eat up degrees of freedom. Panel data would avoid that issue

5. Conclusions

We find strong evidence that natural resource rents and levels of development are strong determinants of the impact of trade on an economy. In particular, we find that the resource curse is alive and well, and one of the major transmission channels of the curse is through an economy's trade. Its impact on development is even more telling. This suggests that growth figures, though a good indicator of development, is insufficient to generate healthy development. Encouragingly, or otherwise, we find that returns to trade and natural resources can be protected by improvements in governance, specifically control of corruption.

Our findings have important implications for resource dependent economies with weak institutions. A country's wealth is squandered if corruption is not brought under control. Likewise, growth figures do not translate into real development. As the development model reveals, more attention needs to be paid to other dimensions of human development if the wealth of a nation is not to be completely lost to the global economy.

Appendix A Summary Statistics

	Obs.	Mean	Std. Dev	Min	Max
Average GDP Growth (%)	201	4.45	2.943	-2.38	26.20
Average GDP Per Capita (Current US dollars)	198	2.913	2.86	-3.22	22.35
Average Trade Share of GDP (%)	188	87.091	46.876	1.25	372.27
Average Natural Resource Rents Share of GDP (%)	202	8.48	15.809	0	93.412
World Governance Indicators: Control of Corruption	205	-0.018	0.983	-1.724	2.45
UN Human Development Index (HDI)	185	0.67	0.172	0.295	0.95

Appendix B Data Description and Sources

Average GDP Growth (1995 – 2007) Average GDP is measured as an annual percentage growth rate of GDP at market prices based on constant local currency. GDP is measured as the sum of gross value added by all resident producers in the economy, plus product taxes and minus subsidies. It is calculated without making deductions for depreciation of fabricated assets or the depletion or degradation of natural resources. The World Bank sources its data from various national accounts as well as OECD national accounts data.

Average GDP per capita (1995 – 2007) GDP per capita is simply GDP divided by the mid-year population. GDP is measured as the sum of gross value added of all production within a country plus taxes and minus subsidies not included in the value of a product. It does not include calculations for depreciation of capital and assets or the degradation of natural resources.

Average Trade Share of GDP (%) Trade share of GDP is simply the sum of all exports and imports of goods and services measured as a share of gross domestic product.

Average Natural Resource Rents share of GDP (%) This measures the share of a country's GDP made up of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. Estimates are based on the sources and methods described in "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium" (World Bank, 2011) It is measured as a percentage of GDP.

Control of Corruption Estimate The control of corruption estimate 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 interest. (WGI database) It is scored on a scale of -2.5 and 2.5, with higher values corresponding to better outcomes.

** The WGIs are aggregate measures of 31 different data sources compiled from large number of survey institutes, think tanks, NGOs, international organizations, and private sector firms. The 31 data sets reflect four different types of source data, i.e. Surveys of households and firms (9 data sources), Commercial business information providers (4 data sources), Non-governmental organizations (10 data sources), and Public sector organizations (8 data sources). Each indicator is constructed by averaging data from the underlying sources that correspond to the feature of governance being measured. Each indicator is then scaled in units of a standard normal distribution, with a mean of zero and a standard deviation of 1.

Human Development Index score The HDI is a composite index of life expectancy, education, and income. It was developed as a single statistic to serve as a frame of reference for both social and economic development. The HDI sets a minimum and a maximum for each dimension, called goalposts, and then shows where each country stands in relation to these goalposts, expressed as a value between 0 and 1. HDI values and rankings in the global Human Development Report are calculated using the latest internationally comparable data from mandated international data providers. The composite index is scored between 0 and 1.

References:

Collier, Paul. "The Political Economy of Natural Resources." New School University, 2010.

Collier, Paul, and Benedikt Goderis. *Commodity Prices, Growth, and the Natural Resource Curse: Reconciling a Conundrum,* Center for the study of African Economies, University of Oxford, 2007.

Deaton, Angus. *International Commodity Prices, Macroeconomic Performance, and Politics in Sub-saharan Africa*. Princeton, NJ, International Finance Section, Department of Economics, Princeton University, 1995.

Raddatz, Claudio E. *Are External Shocks Responsible for the Instability of Output in Low Income Countries?* Washington, DC, World Bank, Development Research Group, Growth and Investment Team, 2005.

Sharma, Kishor, and Oliver Morrissey. *Trade, Growth and Inequality in the Era of Globalization*. London, Routledge, 2005.