Escaping the Resource Curse?
Lessons from Kentucky Coal Counties

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Presented at the MPSA Annual Conference
(Chicago: April 5, 2008)

Presented at the APSA Annual Conference
(Toronto: September 5, 2009)

May 11, 2010

I would like to thank the following individuals for their generosity and interest in the project: Dennis McCully of the Kentucky Division of Fossil Fuels & Utility Services and John Hiett of the Office of Mine Safety & Licensing for their immense help with locating data; Alexa Mills of the Urban Planning Department at MIT for her insights into post-mining land use and help with literature references from other disciplines; Victor Lapuente of the Quality of Government Institute at Goteborg University for his feedback on corruption issues; Bob Keohane for his ever insightful help with research design and methodological limitations; and Mike Miller and the other members of the Comparative Politics Research Seminar at Princeton University.
Abstract

The paradox of the resource curse is a pressing concern for many of the world’s poorest states. If natural resource abundance, in and of itself, leads to negative economic and political outcomes, then the future looks grim indeed for much of the world. Yet, the oft-cited correlation between natural resources and poor development rests upon troubled empirical foundations. The measure commonly used to capture resource abundance is a complex construction prone to generating spurious results. This paper thus seeks to contribute to our understanding of the resource curse by turning to a new data context where precise and easily interpretable measures for natural resource abundance, production, and rents can be constructed: Kentucky coal counties. Four central hypotheses of the resource curse literature are analyzed: (1) that resource abundance retards growth, that resource rents lead to (2) under-taxation by the government and (3) the diversion of funds away from the provision of public goods, and (4) that resource abundance and/or rents increase corruption. The results encourage hope on the political level while simultaneously suggesting a more intractable economic dilemma. Coal counties do suffer from lower long-term growth rates. Moreover, the evidence suggests that this effect has little to do with typical, more “fixable,” macroeconomic explanations and more to do with the underlying geology of the land or with the nature of resource production processes. Mines inevitably shut down as they exhaust accessible supplies and extraction moves to a new location. Where the land is unsuitable for alternative productive activity, the local economy may simply collapse, leaving no stable base for growth. On the other hand, there is little evidence to support the theoretical mechanisms linking natural resources to poor governance: Kentucky counties benefiting from coal rents not only tax their publics at higher rates, but they also spend more per student on education and are no more vulnerable to corruption than other counties.
1 Introduction

The theoretical paradigm of the resource curse claims that governments with access to large, easily extractable, natural resource bases tend to suffer both slow growth rates and poor governance. Natural resource abundance seems thus doubly cursed: resource rich regions can expect both economic and political struggles to abound. Indeed, poor economic performance can inspire political turmoil while at the same time poor governance can exacerbate economic hardship.

Both case studies and cross-national comparisons have found some evidence of an inverse correlation between political and economic development and resource endowments. Yet, poor data quality, inappropriate measurements, and an abundance of potentially important independent variables at the cross-national level have thus far prevented rigorous testing of the resource curse paradigm, especially of its proposed causal mechanisms. This paper seeks to subject four particular resource curse arguments to such rigorous testing by turning to a region rich in both natural resources and high quality data: the counties of Kentucky. (1) Controlling for standard macro-economic explanations, does natural resource abundance hinder growth? (2) Do resource rents lead governments to tax their publics less, theoretically lowering demands for accountability and public goods provision? (3) Does natural resource wealth tend to lower investment in public goods, specifically in education? (4) Finally, do natural resource abundance and/or resource rents increase corruption and the mismanagement of public funds?

This paper finds that while coal counties have experienced slower growth, higher poverty, and lower overall economic development, the cause of this difference may be one quite literally rooted beneath the soil. Mineral rich areas simply do not lie atop the same kinds of rock formations as do rich agricultural soils. And if agricultural productivity plays a major role in
driving long-term development, and even possibly patterns of urbanization and the growth fostered by cities, then mineral rich areas may just not be, geographically, where the growth game is played. Moreover, mining processes that follow the ore strains, moving from site to site, can further complicate this land story by creating cycles of secondary economy growth and collapse that certainly would not lead to sustained development. They can also damage and pollute the land that they use, making it even less suited for alternative economic activity.

Yet, while an economic resource curse may persist at the local level, a political curse may not. Analysis of the data reveals that Kentucky coal counties tax their populations at higher rates than resource-poor counties, invest more in public education, and are no more or less vulnerable to corruption than other counties. Without such mechanisms, it is hard to see how the mere possession of natural resources could cause the degree of political underdevelopment, and tendencies toward non-accountability and authoritarianism, that resource curse scholars claim.

2 The Resource Curse and the Developing World: Economic and Political Ramifications

In its simplest form, the resource curse presents a nagging paradox of global economic and political development: that those countries richest in natural resource abundance have performed worse in both economic and political terms than their resource-poor counterparts. Natural resources appear to hinder both long term economic development as well as the formation and consolidation of strong, accountable government institutions.
2.1 Economic Impact: Depressed Growth Rates

Economists have consistently found a strong, negative correlation between natural resources, as measured by the share of primary commodity exports in GDP, and long-term growth rates.\(^1\) Of particular note are the Sachs and Warner articles of 1995 and 2005 that, together, show this relationship to be statistically robust even given controls for geographical and climactic features as well as for common growth determinants such as initial income, trade policy, investment rates, terms of trade volatility, inequality, and the effectiveness of government bureaucracies.\(^2\)

Yet, although few contest this broad, negative relationship between natural resources and growth, there is little agreement as to why the correlation exists. Explanations run the gamut from the purely economic to the more political in nature. While some argue that commodity exports may suffer from declining terms of trade, price volatility and instability,\(^3\) poor linkage to other sectors of the economy,\(^4\) and "Dutch Disease,"\(^5\) any of which could lead to poor growth, others contest that sound macroeconomic policies would obviate the potential negative impact of any of these factors on the domestic economy. Instead, such scholars focus on the perverse incentives created by the so-called "easy" revenue generated by resource extraction. Resource rents are argued to be quickly and cheaply “capturable” by those in power—inspiring corruption and rent-seeking behavior, introducing inefficiencies

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\(^3\)Khennas, 1993.


\(^5\)This theory argues that when the natural resource sector undergoes a boom in prices, it draws labor and capital away from other sectors of the economy, such as from manufacturing. The domestic economy thus shifts even more towards the export of natural resources and when prices drop, given that the other sectors have shrunk, the domestic economy is hit harder than it would have been had the boom never occurred. See Kim, 2003.
into the economy through over-taxation, waste, and patronage, and thereby slowing growth.\textsuperscript{6} Such rent-seeking may also distract government officials from investing in long-term growth enhancing public goods such as education.\textsuperscript{7}

The evidence supporting or detracting from these explanations is, on the whole, quite mixed. And for our purposes here, does not need full explication.\textsuperscript{8} Rather, each one of these explanations rests on the assumption that the original negative correlation found between natural resources and growth is a valid and reliable inference and not, as it will be argued subsequently, an artifact of measurement construction.

\section*{2.2 Political Impact: Non-Accountable Governance, Corruption and the Provision of Public Goods}

The economists are not the only ones concerned with the impact of natural resource endowments on development. Political scientists have argued that natural resource abundance has negative ramifications for political development as well. Qualitatively observing an apparent relationship between oil and authoritarian tendencies, scholars of the Middle East and North Africa developed the concept of a “rentier state,” defined by its dependence on export revenues from primary resources such as oil.\textsuperscript{9} Building from this case study

\textsuperscript{6}Lane, 1995, and Sachs and Warner, 1995. Indeed, this theory aligns with Robert Bates’ work on African political economies. Bates argues that many African governments used marketing boards to tax primary commodities in order to generate revenue. Since the governments were monopsonistic buyers of the primary goods (and could thus pass their costs along to either producers or consumers), they could afford to be economically inefficient and use their control over prices, export licenses, quotas, and import contracts to build political followings through patronage. Long term vested interests were thus established in an economically inefficient and often corrupt system that slowed or even stalled growth. See especially Bates, 1981, \textit{Markets and States in Tropical Africa}.


\textsuperscript{8}In his 1999 article, Ross includes an interesting discussion of the "Dutch Disease model.. Cuddington, 1992, analyzes patterns in the terms of trade of commodities over the course of the 20th century.. Sachs and Warner, 1995, analyze commodity market volatility and trade policy, among other factors.

literature, political scientists have developed a set of core tenets and mechanisms comprising what amounts to resource curse theory of politics, connecting the possession of natural resource to many persistent ills of the developing world: faulty public goods provision,\textsuperscript{10} corruption,\textsuperscript{11} low tax effort,\textsuperscript{12} repression,\textsuperscript{13} non-accountable governance,\textsuperscript{14} and even conflict and civil war.\textsuperscript{15}

The core logic underpinning most of these claims\textsuperscript{16} is well-articulated in a pair of articles by Michael L. Ross: “The Political Economy of the Resource Curse” (1999) and “Does Oil Hinder Democracy?” (2001). In natural resource abundant states, taxes on resource extraction and their export abroad (resource rents) provide a significant source of revenue for the government. This allows the state to fulfill its fiscal needs without relying on the direct taxation of the population. The public will then presumably demand less accountability and representation from its government, making politics more administrative and authoritarian and less democratic and participatory.\textsuperscript{17} Moreover, resource rents provide a source of fiscal funds not reliant on the general welfare of the population that, when not simply stolen for private consumption, can be used to build extensive patronage networks, block competitors from entering the political arena, or directly fund repression. Investment in public goods, and especially in education, may also suffer in resource rich countries as employment in this sector of the economy does not usually require much education, discouraging both

\textsuperscript{11}Schleifer and Vishney, 1993.
\textsuperscript{13}Ibid.
\textsuperscript{16}Alas, we must henceforth leave aside the growing debate over the role of natural resources in the outbreak and continuation of violence, as the empirical analysis of this study cannot contribute to it.
\textsuperscript{17}An hypothesis based largely on the history of Western political development, especially that of Great Britain and the United States, wherein greater taxation by sovereigns presumably led to greater demands for representation by the people.
government and individual investment in advanced schooling.\textsuperscript{18} Also, if resource rents do indeed result in greater political corruption, then this too may inhibit the provision of public goods as, theoretically, patronage of any sort should favor the provision of divisible, private goods: in order for patronage to work, for it to help politicians develop loyal followings, patronage must be individual-specific and not available to all regardless of their degree of support.\textsuperscript{19}

Yet, despite their theoretical promise, such political dimensions of the resource curse have, to date, been subject to scant, systematic empirical testing. In his 2001 article, “Does Oil Hinder Democracy,” Ross conducts the first such attempt using cross-national data. He finds robust statistical evidence that oil and mineral dependence (as measured by the share of their exports in GDP) are negatively correlated with levels of democracy, public taxation, and government spending as a percentage of GDP (an indirect test of the extent of patronage and/or repression).\textsuperscript{20} Nevertheless, as Goldberg, et al, point out in their 2008 article, “Lessons from Strange Cases: Democracy, Development, and the Resource Curse in the U.S. States,” Ross’ cross-national data is subject to considerable non-random missing observations,\textsuperscript{21} short historical coverage (most importantly the complete exclusion of the west’s developmental period), and indirect and noisy measures.\textsuperscript{22} To move beyond such data constraints, Goldberg et al turn to the sub-national U.S. context and its rich data

\textsuperscript{19}Indeed, in their 1993 study of corruption and growth, ”Corruption,” Shleifer and Vishney found that due to its illegality, corruption influences the project choices of public officials: in order to avoid detection they tend to support projects where it is easier to collect and distribute bribes and hence prefer infrastructure and defense projects over health and education projects.
\textsuperscript{20}Ross, 2001.
\textsuperscript{21}Non-random missing data introduces an unknown selection effect that undermines the basic assumptions of the applied statistical model. Indeed, missing data is more common where civil wars, resource looting, poverty, and other hindrances to accurate record keeping are frequent. This should thus deeply concern us in cross-national comparisons.
\textsuperscript{22}Goldberg et al, 2008.
and diversity of resource endowments, historical experiences, and political and economic outcomes. They find robust statistical evidence that natural resource dependence (measured as the value of annual oil and coal production as a share of state income) is negatively correlated with growth rates, political competitiveness (margin of victory in gubernatorial elections), and tax effort (a weighted and normalized scale of tax rates).23

While their work is a solid contribution to a progressive and cumulative research agenda focused on a pressing international development concern, and employs some excellent measures for outcome variables, Goldberg et al’s analysis is still subject to the same fundamental data problem as the cross-national analyses. Like Ross and the economists, Goldberg et al did not find a better measure for natural resource endowments than the value of resource production as a fraction of overall wealth.24

3 The Fundamental Problem with How Natural Resources Have Been Measured

Studies of the natural resource curse, in both economics and political science, almost always measure a country’s endowment of natural resources as some type of proportion of state GDP.25 The most widespread measure used is the ratio of the value of natural resource exports in a given year over the national GDP:

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23 Ibid.
24 Although, unlike the others, they do include production for domestic markets as well as for export markets.
25 An important exception, and the only one that I could find, is Macartan Humphrey’s work on natural resources and civil wars. In the methodological discussion of his 2005 article, “Natural Resources, Conflict, and Conflict Resolution,” he argues that the standard natural resource measure discussed here cannot distinguish between the various causal mechanisms linking natural resources to conflict. Instead, he collects data on the total production of both oil and diamonds as well as on known oil reserves. Indeed, this is the type of effort that will be strongly advocated here.
Measure of Natural Resources = \frac{abundance \cdot \gamma \cdot \epsilon \cdot P_w}{GDP}

where:
\[\gamma = \text{the proportion of the resource endowment extracted}\]
\[\epsilon = \text{the proportion of what is extracted that is then exported}\]
\[P_w = \text{the prevailing world price of the resource}\]

This particular measurement specification leads the researcher into a quagmire of potentially false inferences: from spurious accounts of causality to hidden endogeneity issues. Take, for example, the following plausible, and indeed historically relevant, economic story: say a set of countries at some point in the past \(T_0\) choose to follow the same general development policy—such as Import Substitution Industrialization (ISI). Let us assume that this general policy fails to promote GDP growth across the entire set of countries that choose it. Then, if we measure natural resource “abundance” as is typically done at a subsequent time interval \(T_1\), all of the countries following ISI will have a lowered GDP compared to those who chose a better policy path and, since GDP is in the denominator, also a higher measure for natural resource “abundance.” If we then measure GDP (again) at an even later time \(T_2\) and compare the natural resource measures from \(T_1\) across countries to their GDPs at \(T_2\), we will automatically find a negative correlation between natural resource “abundance” and GDP. And this correlation is, in this case, nothing more than an artifact of the measurement’s very construction:
Thus, states with similar resource endowments that make different investment and infrastructure choices may falsely appear different with regard to resources, thereby generating spurious results with regard to outcome variables. In other words, human choices and institutions that may have nothing to do with the presence of natural resources could systematically bias the data.

Likewise, the inclusion of GDP in the measure of natural resource “abundance,” as well as choices in the rate of extraction and the proportion of extracted resources to allocate to external versus internal markets, creates inference challenges for research on political development. As one example, consider the relationship between poverty and taxation: we could plausibly argue that low GDP, because it logically implies a smaller income tax base, forces governments in poor countries to increase the volume of resource extraction, and perhaps also its direction toward international markets, in order to raise basic operating revenues. In these circumstances, low GDP automatically increases the natural resource measure of poor countries in relation to rich countries. Moreover, low GDP causes increases in $\gamma$ and $\epsilon$ which further increase the natural resource measure in comparison to wealthier countries. Thus we observe a negative correlation between natural resource “abundance” and both poverty and
low levels of taxation. But here the causal pathway runs in the opposite direction from the resource curse hypothesis:

These are just two of the many possible ways in which the complex construction of the natural resource measure can introduce bias into statistical analyses and thereby create substantial threats to both causal and correlational inference. There is simply too much going on in the measurement itself, involving an array of variables whose own relationships to each other are not fully understood, to draw valid statistical inferences from existing studies. A better measurement is needed.

4 Kentucky Coal: The Promises of Data

We are thus left with an array of theories as to how and why the possession of natural resources may negatively affect both political and economic development, and yet no reliable statistical evaluations of these theories. The ideal solution would be to construct better cross-national measures for natural resources, based on simple and easily interpretable concepts such as known reserves, original endowments, and production levels. One could then, assuming that fine-grained measures for outcome variables were also available, re-do the original tests and evaluate whether the results still held. Unfortunately, the large number of
natural resources in the world, as well as the poor quality of record keeping in many places, times, and industries, makes such a solution near impossible.

Yet, if natural resources do contribute to both economic and political underdevelopment, as theory suggests, then it is important to understand why and how they do so. Only then could intelligent policy be designed and implemented, allowing those afflicted to escape from the resource curse. Throwing our hands up in the face of poor national-level data is simply not an option. Rather, the alternative is to turn to sub-national and local units, where the number of resources is limited and where quality data can be found (as indeed Goldberg et al have already advocated).26 While the results obtained in such settings must be generalized with caution, always taking into account the larger institutional contexts in which they are embedded, they can still provide valuable insights into puzzling phenomenon. Local development is, moreover, important in its own right. A great many people, even in today's high-tech world, live locally centered lives that depend upon local good governance and local economic growth.

It is in this vein that I turn to the counties of coal-rich Kentucky. In this very localized context the data is available to conduct solid statistical analyses, and therefore to draw reliable inferences, about the impact of natural resources on local political and economic development. Kentucky is a state rich in one particular natural resource: coal.27 Yet, this resource is spread unevenly across the state’s 120 counties, providing large variability in both coal abundance and extraction (35 counties lie across the eastern coal belt, 17 across the western coal belt, and 68 counties have no coal whatsoever).28 Kentucky is also a state rich

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27Although some oil production has taken place in the state, at no time did Kentucky become a major oil producer (Harrison and Klotter, 1997, p.311).
in data: the coal industry has kept extensive records on mining activities, including initial coal reserves and annual production. The state government has also made information on county incomes, growth rates, poverty, unemployment, education, taxes, and financial audits, among other important data, publicly available.

Nonetheless, although historical data from the coal industry is readily available, matching county-level measures for outcome variables prior to the late 20th century are not. The statistical analysis is thus confined temporally to a quite modern period, a limitation that deserves careful consideration. In the following section, I give a brief overview of the history of coal mining in Kentucky up until the introduction of the severance tax in the early 1970s (the first time any government unit received rents from coal mining). Later, statistical results will also be placed in context, using qualitative historical accounts to compare the “modern” findings with what was thought to be happening in earlier periods.

5 Historical Background

Indeed, although historical data from the coal industry is readily available, matching county-level measures for outcome variables prior to the late 20th century are not.

Commercial coal mining in Kentucky was born into a war-torn environment almost completely devoid of law and order and plagued by widespread disputes over land rights dating back to the settlement era. Although knowledge of the vast coal deposits under Kentucky soil predated the U.S. Civil War, a poor transportation infrastructure and the wide availability of timber slowed its extraction.\textsuperscript{29} The late 1850s finally brought extensive railroads to Kentucky, opening up the possibility of profitable commercial coal mining, only to be

\textsuperscript{29}\textit{Harrison and Klotter, 1997, p.142 and p.307.}
interrupted by the onset of war in 1861, when both Union and Confederate armies violated Kentucky neutrality. Although Union forces quickly drove the Confederate Army south to Tennessee, northern military occupation led to large-scale guerrilla warfare carried out largely by southern sympathizers (only loosely associated with the Confederate chain of command, which itself sent frequent raiding parties into Kentucky). The lawlessness engendered by war only escalated after the surrender of the Confederacy: in addition to the armed bands of former guerrillas, outcasts and outlaws from both armies roved the countryside ambushing returning soldiers, seeking revenge for the theft of property and loss of homes and crops during the war, punishing neighbors for their errant political sympathies, and lynching freed slaves with impunity.30 From this milieu evolved the institution of the feud as well as “the regulators”—both of which continued well into the 20th century. “The regulators” were bands of armed vigilantes who predominated over a local area (usually the county but sometimes smaller precincts) and implemented their own interpretation of justice throughout the state, inflicting punishment on those they deemed guilty without trial, evidence, or appeal.31

It was in this general environment that commercial coal mining developed, first in the western coalfields and then later (beginning in the 1890s) in the eastern coalfields. Outside of encouraging railroad development and other improvements to the transportation infrastructure, neither the federal nor the state government had much of a hand in the coal industry, or even in the areas where it operated, until well into the 20th century. Neither the U.S. federal government nor the Commonwealth of Kentucky collected any money from coal production until the early 1970s, when the state established a coal severance tax.32 Rather than government involvement, private companies and their representatives purchased “broad form

deeds,” which conferred mineral rights but not ownership over land, from existing landowners (usually farmers) for small amounts of what was then very scarce hard currency.\textsuperscript{33} These companies, backed by private investors, then opened mines, employed workers (sometimes even developing company towns), and reaped any profits they could. During this time, most important powers of government rested in the only place where the majority of Kentucky citizens had any contact with their government—in the county seats, which operated as semiautonomous units: county governments dispensed all poor relief, county sheriffs gathered taxes, county clerks recorded and stored legal documents, county assessors surveyed and evaluated property, and county courts heard most legal cases.\textsuperscript{34} Moreover, federal and state governments rarely intervened in their affairs. As late as the year 1900, the U.S. Supreme Court ruled that they had no jurisdiction to hear cases of electoral fraud in non-federal elections.\textsuperscript{35}

Only during the Great Depression did federal power begin its vast expansion over previously sanctified states’ rights and, thus, only then did it begin to exert any influence over coal mining in Kentucky. Particularly of note was the 1935 passage of the Wagner Act and the creation of a National Labor Relations Board. For the first time, and in the face of continued state and local government hostility, miners’ unions began to have some success in their struggles.\textsuperscript{36} Yet, those small strides were soon reversed by the mechanization of the industry in the 1940s and the associated plummet in labor demand.\textsuperscript{37} Between 1950-

\textsuperscript{33}Ibid, p.284.
\textsuperscript{34}Ibid, p.250.
\textsuperscript{35}The case involved the Kentucky Governor’s race of that year: the Democratic majority in the Kentucky legislature had, in a secret session held in a hotel while Republican-controlled gatling guns faced down a Democratic-controlled militia outside the state capital building, nullified enough Republican votes to hand their candidate a narrow victory. The episode ended in the only assassination of a State Governor in the history of the United States.
\textsuperscript{36}Ibid, p.365.
1965, mining employment in Kentucky fell by roughly 70% while the volume of production continued to increase.\textsuperscript{38}

6 Hypotheses and Models

Although the theories of the resource curse, in both economics and political science, attempt to explain effects at the national level, they can still be used as a jumping-off point for considering sub-national effects. There is no \textit{a priori} reason to think that the causal mechanisms do not operate at a more local level as well. If natural resource abundance depresses growth nationally, it would make sense that it particularly effects economic development in the sub-national regions where those resources dominate the local economy. If natural resource rents free national governments from taxing their populations, then local windfalls of resource rents should free local governments from taxing their residents. If national governments attempt to secure political followings by directing public projects into sectors where patronage and corruption are easy, and away from the provision of public goods, then so should local politicians. If natural resources dampen the pressures for democratic accountability and public participation within a nation, then why shouldn’t the same effect appear at the local level? And if easily lootable resources predispose a country to civil wars, then violence should be particularly fierce in the very locations where those resources lie.

Unfortunately, the data I have collected from Kentucky still does not permit the examination of every hypothesis associated with the resource curse. In particular, questions of violence and political competitiveness must be left aside. While Kentucky certainly suffered

\textsuperscript{38}Harrison and Klotter, 1997, p.367).
a range of negative experiences during the American Civil War, data on local participation in (and targets of) the guerrilla campaigns are unavailable. Neither have I been able, thus far, to locate county-level election data on turnover rates and the margins of victory for local office. This study thus focuses on the relationships between natural resources and (1) economic development, (2) government taxation, (3) investment in public goods (here education), and (4) corruption.

**H1: Greater natural resource abundance inhibits economic development and growth.**

Does resource abundance and/or extraction lead to lower growth rates and levels of economic development? Here, standard macro-economic explanations are easy to control for as Kentucky counties are all subject to the same state and national political and economic policies. If major failures occur in controlling national/state savings rates or international exchange rates, all counties experience the same adverse effects. Thus, the data-context itself permits the exclusion of the majority of control variables included in typical cross-national studies (most importantly trade openness, savings and investment rates, and terms of trade). Moreover, the quality of available mineral data allows for the use of direct measures of resource reserves and extraction. I am therefore able to construct three, quite simple OLS models with easily interpretable variables.

**Model 1.1:**

\[
\log P_{I(1980)i} = \beta_0 + \beta_1 \log \text{coal.abundance}_{(original) i} + \beta_2 \log \text{coal.mined}_{(1980) i} + \beta_3 \text{one.river}_{i} + \beta_4 \text{two.river}_{i} + \beta_5 \text{inner.bluegrass}_{i} + \beta_6 \text{outer.bluegrass}_{i} + \beta_7 \text{east.coalfield}_{i} + \epsilon_i
\]

The first model focuses on long-term economic development and examines the effects of pre-settlement geographic variables, including coal reserves, and commercial coal production...
on contemporary income levels. The unique availability of measurements for both the original, pre-mining volume of coal in Kentucky and the total coal extracted up until 1980, by county, provides a unique opportunity to separate resource abundance (understood here as the mere presence of a resource) from its actual production. No controls for “initial” per capita income and inequality are included because coal abundance estimates and all other geographic variables precede the white settlement of Kentucky.\textsuperscript{39} Initially, just coal abundance and coal extraction are regressed on 1980 per capita personal income. Then, two dummy variables are incorporated to account for the effects of riverine networks on development. Prior to the advent of railroads, navigable rivers were the only way to transport products that could not walk themselves to market.\textsuperscript{40} For each county: \textit{one.river} is coded 1 if at least one navigable river borders or runs through the county and 0 otherwise; \textit{two.river} is similarly coded but for two navigable rivers.\textsuperscript{41} Then, two additional dummy variables are incorporated to measure agricultural soil quality as this too is likely to affect both early urban development as well as long-term growth. The Kentucky Bluegrass region, named after the lush grass that grows there, sits atop ordovician limestone deposits that generate particularly good soil for agriculture.\textsuperscript{42} The inner bluegrass subregion has marginally better soil quality than the outer bluegrass; but together they comprise the best agricultural land in the state. Each variable (\textit{inner.bluegrass} and \textit{outer.bluegrass}) is coded 1 if a significant portion of the county lies on that geological zone and 0 otherwise. Finally, a dummy variable

\textsuperscript{39}White settlement in Kentucky began with Daniel Boone’s 1775 expeditionary party. Native American settlement patterns are not considered as they were all eventually forced westward after a series of wars with the British and then the early American states.

\textsuperscript{40}The first major railroad line in Kentucky, connecting Louisville to Nashville, Tennessee was completed in 1859. Yet, Kentucky’s more than 1000 miles of navigable waterways remained the state’s most extensive transportation network for another decade, until railroad mileage surpassed it in 1870. (Harrison and Klotter, 1997, p.135 and p.313).

\textsuperscript{41}There is only one county in all of Kentucky (Livingston) that has access to 3 navigable rivers.

\textsuperscript{42}McDowell, 2001.
is added for the Eastern Coalfield, which has much poorer soil quality than even the Western Coalfield (coded 1 if the county lies in the Eastern Coalfield and 0 otherwise).  

**Model 1.2:**  
\[
\log PI(2005)_{i} = \beta_0 + \beta_1 \log coal.abundance(1980)_{i} + \beta_2 \log coal.mined(1980-2004)_{i} + \beta_3 \log PI(1980)_{i} + \beta_4 poverty(2004)_{i} + \epsilon_{i} 
\]

The second model examines the effect of coal abundance and production on medium-term economic development. A measure for coal abundance in 1980 is constructed by subtracting the volume of coal extracted up until 1980 from the estimates of original county coal endowments. This abundance variable, along with total coal production from 1980-2004, are then regressed on 2005 per capita personal income. Following Sachs and Warner, controls are added for initial income (here, 1980 per capita personal income) and inequality (here, the percentage of residents living below the poverty line in 2004). 2004 was the only year county poverty levels were available. The direction of bias, however, can be accounted for and thus compensated for: poverty levels from one year prior to the dependent variable should predict average income better than those from several years prior (its estimate will be biased in an upward direction, potentially reducing the impact of other variables). Controlling for 1980 income levels also controls for the effects of resource abundance and the other geographical variables prior to that year.  

**Model 1.3:**  
\[
\text{Growth}_{i} = \beta_0 + \beta_1 \log PI(1980)_{i} + \beta_2 \log coal.abundance(1980)_{i} + \beta_3 \log coal.mined(1980-2004)_{i} + \beta_4 poverty(2004)_{i} + \epsilon_{i} 
\]

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44Some of the smallest coal producing counties were estimated from geological survey data as they were lumped together as an “other” category in the original production data. See the appendix for further information on data sources.  
The third model follows the second in analyzing medium-term development but takes average growth as the dependent variable, thereby replicating the model used by Sachs and Warner in their 1995 paper, “Natural Resource Abundance and Economic Growth.” A standard growth model is utilized for the 1980-2005 period:

\[
\frac{1}{T} \log\left(\frac{Y_T}{Y_0}\right) = \delta_0 + \delta_1 \log(Y^i) + \delta'Z^i + \epsilon^i
\]

where growth, measured as the yearly average of the log of income at time T divided by income at time 0, is a negative function of initial income and a vector of growth determinants, Z.\(^{46}\) Potentially excluded growth determinants include government investment in infrastructure, as well as county savings and investment rates. It is questionable whether the former would actually impact local growth as banks operate across counties and low savings rates in any particular county would probably not decrease the available amount of capital for loans in that county.

**H2: Resource rents lead to lower rates of public taxation.**

The claim that natural resource wealth causes less accountable and more authoritarian governance depends on a logically prior causal claim: that resource rents free governments from taxing their populations. Without such direct public taxation, it is then argued, citizens will demand less accountability and democracy from their governments.\(^ {47}\) Yet, as previously discussed, the inclusion of GDP in the measure for resource rents has prevented this claim from being effectively evaluated.

I believe that Kentucky counties provide an ideal set of cases to test the first part of this mechanism: that high resource rents will decrease taxation levels. First, the argument can

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\(^{46}\)Sachs, 1995.  
\(^{47}\)Ross, 2001.
certainly be translated into the local setting: we can imagine that access to resource rents would tempt politicians to increase their popularity by issuing tax cuts or, at the very least, not raising taxes while still maintaining or expanding county services (fire, police, schools, etc.). This, in turn, could lead to increasing dependence on resource rents and, hence, the coal industry, thereby lowering accountability to the general public. Second, each county has control over its own rate of property taxation (real estate, tangible personal property, and motor vehicles). The state government of Kentucky, however, sets the taxation rate on coal mining and then returns 50% of revenues to their county of origin.\textsuperscript{48} The rate of resource taxation is thus entirely exogenous to local politics and is, moreover, not itself causally effected by local tax rates. Thus, results may be clearly interpreted as an effect of resource rents on local taxes, and not vice versa.

We can thus answer the question, do politicians in counties that receive the “easy money” generated by resource rents keep public tax rates artificially low? To do so, I construct two different models. The first model takes as its dependent variable the county property tax rate (in cents per $100) from 2002-2006, averaged across real estate, tangible personal property, and motor vehicles.\textsuperscript{49} The second model analyzes each county’s tax effort, measured in 1997 using the standard comparison formulas developed by the Advisory Commission on Intergovernmental Relations (ACIR).\textsuperscript{50} This measure essentially weights county tax rates by type (property, sales, motor vehicle, etc...) according to the relative size of their average

\textsuperscript{48}Some restrictions are placed on what the returned coal money can be spent on. Administrative salaries, in particular, are excluded. Nonetheless, returned severance taxes can be spent on a wide variety of economic development projects and social services including roads, law enforcement, health, recreation, libraries, workforce training, and environmental protection, among others. (Kentucky Governor’s Office for Local Development, \textit{Office of State Grants: Program Guide, June 2007}).

\textsuperscript{49}This model excludes taxes levied in support of the school system, which will be considered separately under the third hypothesis.

\textsuperscript{50}Applied to Kentucky counties by William H. Hoyt of the Center for Business and Economic Research of the University of Kentucky, and published in the 2008 \textit{Kentucky Annual Economic Report}. 
bases across the state and then applies each county’s individual tax rates to those averages, thereby creating a comparable measure of how much revenue a county’s tax rates would generate if all counties had the same tax base. Both models use the same set of independent and control variables: the log of the average amount of returned severance taxes over the previous five years,\textsuperscript{51} the log of the county population (to control for county size), and the log of average personal income (to control for county wealth). Unemployment is included in the first model, but not the second, as county-level employment data does not extend back to 1996. Both population and personal income are lagged by one year as county tax rates are determined in the year prior to their implementation.

\textbf{Model 2.1}: \( \text{county}_{ij} = \beta_0 + \beta_1 \log \text{severence.avr}_{ij} + \beta_2 \log \text{county.pop}_{(i-1)j} + \beta_3 \log \text{PI}_{(i-1)j} + \beta_4 \text{unemploy}_{(i-1)j} + \epsilon_{ij} \)

\textbf{Model 2.2}: \( \text{tax.effort}_{1997i} = \beta_0 + \beta_1 \log \text{severence.avr}_{1991-1996i} + \beta_2 \log \text{county.pop}_{1996i} + \beta_3 \log \text{PI}_{1996i} + \epsilon_i \)

\textbf{H3: Resource rents lead to lower rates of investment in public goods, especially in education.}

Research in both economics and political science suggests that the possession of natural resources can divert government expenditures away from the provision of public goods, especially education. Employment in the production of natural resources may not require much education and, if that sector dominates the economy, neither individuals nor governments

\textsuperscript{51}A note of explanation is in order for the treatment of the returned severance taxes, which are predominantly from coal but include other mineral rents as well. Data for these taxes is only currently available for every other tax year. Thus, in order to create a reliable and consistent indicator, for each year I average the reported returned severance taxes, where available, from the previous five years. Although not perfect, this measure should capture the relevant fluctuations experienced by coal counties in their expected incomes from severance taxes, which would then theoretically influence their decisions to raise or lower local tax rates.
may see much point in devoting time and limited finances to the school system. Also, if resource rents are used to build patronage networks through the provision of divisible, private goods, public education may also suffer.52 Arguably, either of these mechanisms is just as likely to operate in both local and national contexts, as well as in both democratic and authoritarian systems.

Do coal-rich Kentucky counties devote fewer resources to public education than their non-resource endowed counterparts? To answer this question, I construct two time series models covering the same period (2002-2006) and incorporating the same set of independent and control variables (the same as in Models 2.1 and 2.2). They differ in that I employ two different measures for the outcome variable, each of which attempts to capture the concept of public investment in education. Model 3.1 uses the rate of county school taxes (in cents per $100 of assessed property value) as its dependent variable. Each county in Kentucky has its own school district and levy’s a local property tax specifically for school funding. This measure thus captures the relative effort counties make to raise school funds through property taxes, but does not reflect the actual amount of money invested in education. Indeed, nothing precludes the county from drawing money from other revenue sources, including resource rents and state coffers, to supplement this funding. Therefore, Model 3.2 takes as its dependent variable per pupil spending by county. This measure, however, also captures state funding, which is disproportionately directed toward poorer districts. Each measure should provide a robustness check against the other.

\[
\text{Model 3.1: } \text{school.tax}_{ij} = \beta_0 + \beta_1 \log \text{severence.avr}_{ij} + \beta_2 \log \text{county.pop}_{(i-1)j} + \beta_3 \log P_{(i-1)j} \\
+ \beta_4 \text{unemploy}_{(i-1)j} + \epsilon_{ij}
\]

52Although schools do provide what can amount to a substantial proportion of local jobs in rural areas, and thus can themselves become a successful vehicle for political patronage.
Model 3.2: $stu.expend_{ij} = \beta_0 + \beta_1 \log severence.avr_{ij} + \beta_2 \log county.pop_{(i-1)j} + \beta_3 \log PI_{(i-1)j} + \beta_4 \text{unemploy}_{(i-1)j} + \epsilon_{ij}$

H4: Natural resource abundance and/or resource rents lead to higher rates of corruption.

It is hypothesized that the production of natural resources, and the rents it generates, create incentives for rent-seeking behavior, patronage, and other forms of corruption. In Kentucky, resource rents are collected by the state government and returned, in part, to the counties annually. This difference in context from cross-national studies is critical: the counties themselves have a diminished capacity to rent-seek as they are neither in charge of the collection of severance taxes nor the distribution of licenses and contracts for mining. Nevertheless, they do receive rents from the production and sale of coal. We can thus examine whether merely increasing the pot of non-tax based revenues in turn increases the likelihood of corruption.

To evaluate this hypothesis, I first construct a dichotomous corruption variable. Corruption is notoriously difficult to measure. It often simply goes unreported. And even when caught, its duration and true extent might remain uncertain. It thus makes little sense to construct a yearly variable or to try and use dollar figures to estimate a continuous variable as any such measure would end up extremely noisy and unreliable. Instead, I examined the yearly financial audits for the County Clerk’s offices and the County Fiscal Courts between 2000 and 2006. In Kentucky, these are the only two government offices at the county level that have direct access to resource rents. If there was an instance of corruption detected in a county at any point during this time period, the corruption variable was coded as 1. If all of the audit reports were clean, the variable was coded as 0.

But what counts as corruption? This is another notoriously difficult question to answer.
For the sake of this study, I used the following coding guidelines: If an instance of financial misconduct in an audit was referred to the Kentucky or U.S. Attorney General’s Office, Law Enforcement, the Kentucky Department of Revenue, and/or the IRS for criminal reasons, the county was automatically coded a 1. If an instance of egregious financial misconduct was for some unknown reason not referred to such agencies, then the county was still coded as a 1 if the infringement contained one or more of the following practices: illegal use of private contractors, extremely questionable and unaccounted for expenditures on roadwork or construction projects, or the violation of the ethics code in the distribution of government contracts (such as giving them to family members without a competitive bidding process). In all other cases, the county received a 0 coding, even if they were cited for some violation of state accounting and financial management codes.

Using this dichotomous dependent variable for corruption, I then created two probit models: Model 4.1 is a simple comparison between the corruption variable and a dichotomous variable indicating whether or not a county produced coal. This model is intended to demonstrate, at an incredibly simplified level, whether or not there is any reason to think that natural resources and government corruption are linked in Kentucky. Model 4.2 is a more sophisticated analysis of the effect of coal abundance and resource rents on county corruption which includes controls for the size (population), wealth (per capita personal income), and poverty rate of the county.

**Model 4.1:**
\[ corruption_i = \beta_0 + \beta_1 coal_i + \epsilon_i \]

**Model 4.2:**
\[ corruption_i = \beta_0 + \beta_1 \log abundance_{(1980)} + \beta_2 \log severence_{(1999-2005)} + \beta_3 \log PI_{avr}(2001-2005) + \beta_4 \log county\_pop(2004) + \beta_5 \log poverty(2004) + \epsilon_i \]
7 Results

Generally, the findings of this paper both support and raise challenges for the paradox of the resource curse. There is some evidence that natural resource abundance does indeed inhibit long-term growth, albeit through more indirect mechanisms that typically proposed. On the political side, however, their is no evidence that natural resources or their associated rents lead to lower taxation, less investment in public education, or greater corruption.

H1: Greater economic resource abundance inhibits economic development/ growth.

Collectively, the economic development models suggest that if resource abundance does indeed dampen long term growth rates, it is not through the extraction of the resources themselves. Indeed, Model 1.1 finds a positive and significant correlation between coal production and county incomes (although the magnitude of the effect is quite small). In models 1.2 and 1.3, neither coal abundance nor mining activity seem to have any effect on medium-term growth. The only other statistically significant resource variable is the indicator for the Eastern Coalfield. Location in this subregion of the state, all else being equal, is correlated with a 22% decline in long-term economic growth. But is this due to the presence of coal? Remember that the Eastern Coalfield has remarkably poor soil quality—far worse than even the Western Coalfield. Combined with the observed effects of being located in either the inner or outer bluegrass subregions (respectively a 31% and 10% increase in observed income levels), this suggests that the underlying causal story may be rooted in geology. It is probably not a coincidence that, in Kentucky, the bluegrass counties were the first to be settled, have historically led agricultural production, and also became the locus of many of Kentucky’s urban areas. Indeed, it is quite remarkable that this small set of variables, focused on geological and geographical characteristics of the land, actually explains roughly
34% of modern income distribution across counties (removing the coal production variable reduces the $R^2$ by about two percentage points).

Model 1.1

$$\log P_{I(1980)i} = \beta_0 + \beta_1 \log \text{coal.abundance}_{\text{original}i} + \beta_2 \log \text{coal.mined}_{1980i} + \beta_3 \text{one.river}_i + \beta_4 \text{two.river}_i + \beta_5 \text{inner.bluegrass}_i + \beta_6 \text{outer.bluegrass}_i + \beta_7 \text{east.coalfield}_i + \epsilon_i$$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (SE)</th>
<th>Coefficient (SE)</th>
<th>Coefficient (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>8.8727***</td>
<td>8.7901***</td>
<td>8.7357***</td>
</tr>
<tr>
<td></td>
<td>(0.0254)</td>
<td>(0.0318)</td>
<td>(0.0374)</td>
</tr>
<tr>
<td>log original coal abundance</td>
<td>-0.0098</td>
<td>-0.0102</td>
<td>-0.0029</td>
</tr>
<tr>
<td></td>
<td>(0.0069)</td>
<td>(0.0065)</td>
<td>(0.0059)</td>
</tr>
<tr>
<td>log coal mined through 1980</td>
<td>0.0068</td>
<td>0.0081</td>
<td>0.0126*</td>
</tr>
<tr>
<td></td>
<td>(0.0080)</td>
<td>(0.0076)</td>
<td>(0.0068)</td>
</tr>
<tr>
<td>one navigable river</td>
<td>0.1224***</td>
<td>0.0845**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0375)</td>
<td>(0.0339)</td>
<td></td>
</tr>
<tr>
<td>two navigable rivers</td>
<td>0.1402*</td>
<td>0.1608**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0747)</td>
<td>(0.0680)</td>
<td></td>
</tr>
<tr>
<td>inner bluegrass</td>
<td></td>
<td></td>
<td>0.3094***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0740)</td>
</tr>
<tr>
<td>outer bluegrass</td>
<td></td>
<td></td>
<td>0.0970**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0447)</td>
</tr>
<tr>
<td>eastern coalfield</td>
<td></td>
<td></td>
<td>-0.2222***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0538)</td>
</tr>
</tbody>
</table>

Adjusted $R^2$              | 0.0283           | 0.1456           | 0.3357           |

Model 1.1.a: Breusch-Pagan Test: $\chi^2 = 3.9868, p = 0.0459$
Model 1.1.b: Breusch-Pagan Test: $\chi^2 = 0.0091, p = 0.9240$
Model 1.1.c: Breusch-Pagan Test: $\chi^2 = 2.2793, p = 0.0000$

Computing HAC robust errors neither diminished the magnitude nor the significance of the results. The more conservative, original estimates are thus reported.

$*** = p \leq 0.001, ** = p \leq 0.01, * = p \leq 0.05$
Models 1.2 and 1.3

1.2: \[ \log P_{I(2005)i} = \beta_0 + \beta_1 \log \text{coal.abundance}_{(1980)i} + \beta_2 \log \text{coal.mined}_{(1980-2004)i} + \beta_3 \log P_{I(1980)i} + \beta_4 \text{poverty}_{(2004)i} + \epsilon_i \]

1.3: \[ \text{Growth}_i = \beta_0 + \beta_1 \log P_{I(1980)i} + \beta_2 \log \text{coal.abundance}_{(1980)i} + \beta_3 \log \text{coal.mined}_{(1980-2004)i} + \beta_4 \text{poverty}_{(2004)i} + \epsilon_i \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.2 Personal Income</th>
<th></th>
<th>1.3 Growth</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (SE)</td>
<td>Coefficient (SE)</td>
<td>Coefficient (SE)</td>
<td>Coefficient (SE)</td>
</tr>
<tr>
<td>constant</td>
<td>4.0640*** (0.4872)</td>
<td>5.7328*** (0.6806)</td>
<td>0.1563*** (0.0187)</td>
<td>0.2205*** (0.0262)</td>
</tr>
<tr>
<td>1980 personal income</td>
<td>0.6832*** (0.0549)</td>
<td>0.5134*** (0.0728)</td>
<td>-0.0122*** (0.0021)</td>
<td>-0.0187*** (0.0028)</td>
</tr>
<tr>
<td>1980 coal abundance</td>
<td>-0.00004 (0.0042)</td>
<td>0.0006 (0.0040)</td>
<td>-0.0000 (0.0002)</td>
<td>0.0000 (0.0002)</td>
</tr>
<tr>
<td>coal mined 1980-2004</td>
<td>-0.0053 (0.0048)</td>
<td>-0.0022 (0.0047)</td>
<td>-0.0002 (0.0002)</td>
<td>-0.0001 (0.0002)</td>
</tr>
<tr>
<td>2004 poverty rate</td>
<td>-0.0107*** (0.0032)</td>
<td></td>
<td>-0.0004*** (0.0001)</td>
<td></td>
</tr>
</tbody>
</table>

Adjusted $R^2$: 0.6143 0.6459 0.26 0.3206

Model 1.2.a Breusch-Pagan Test: $\chi^2 = 0.0004, p = 0.9834$
Model 1.2.b Breusch-Pagan Test: $\chi^2 = 0.0028, p = 0.9581$
Model 1.3.a Breusch-Pagan Test: $\chi^2 = 1.3801, p = 0.2401$
Model 1.3.b Breusch-Pagan Test: $\chi^2 = 2.1091, p = 0.1464$

$*** = p \leq 0.001$, $** = p \leq 0.01$, $* = p \leq 0.05$

Mining activity, in the absence of agricultural possibilities, may also be ill-suited to long-term, sustained growth. While resource extraction certainly generates income while the mines are open, individual mines do eventually close. When the mineral or fuel resources on a particular piece of land are exhausted, the resource business moves on to greener pastures, withdrawing all of the indirect as well as direct benefits they bring to the local economy. Jobs, people, and money may all rapidly depart. Where no alternative industries also support
the economy (such as agriculture), you would get a veritable “ghost town” effect that would surely set back local development and growth for some time.\textsuperscript{53} Multiplying this effect across many locales may also have significant repercussions for larger economic units, such as states and countries.

Alternatively, the seemingly contradictory results between the models (that long-term growth in the eastern coalfield is depressed while coal seems to have no effect on medium-term growth) may be a remnant of the traumatic experience of mining mechanization. In the beginning of the 20th century, coal production expanded rapidly in the Eastern Coalfield, leading to the large-scale migration of workers and their families to the region. By 1940, the coal workforce in eastern Kentucky had expanded to around 63,000 laborers. Then, in the following decade and a half, mechanization led mining employment to fall by some 70%. Many people simply left, looking for work elsewhere. The net population loss (around 25,000), however, still could not compensate for the volume of jobs lost and unemployment soared.\textsuperscript{54} Nonetheless, the shock of rapid mechanization was experienced across the coal industry, in both the Eastern and Western Coalfields. and yet the Eastern Coalfield counties have experienced significantly slower growth.\textsuperscript{55}

\textsuperscript{53}Moreover, extractive industries often leave the land environmentally damaged and unsuitable for any type of post-mining use. Currently, the national Abandoned Mine Land Inventory System (AMLIS), counts roughly 40,000 acres of high priority (levels 1 and 2) damaged land in Kentucky; hazards that include clogged streams, landslide prone hillsides, polluted water, underground fires, and vertical shafts, among other such dangers to humans and wildlife. Such land requires major reclamation efforts before it can be converted to other uses, even to state and national parks.


\textsuperscript{55}If a separate indicator variable for the Western Coalfield is included in the regression the difference between their coefficients is 0.1858. In other words, the growth rate of the East was depressed by roughly an additional 19%.
H2: Resource rents lead to lower rates of public taxation.

The statistical evidence does not support the hypothesis that Kentucky counties benefitting from coal rents tax their publics any less than other counties. In fact, in Model 2.1, resource rich counties tax property at higher average rates, a statistically significant finding. The magnitude of the effect, however, is minimal: a 1% increase in returned coal rents is associated with an increase of 1-2 cents per $1000 of assessed property value (which would

<table>
<thead>
<tr>
<th>Models 2.1 and 2.2</th>
<th>2.1DV= County Property Tax Rate (cents per $100)</th>
<th>2.2 DV= 1997 Tax Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>county\textsubscript{ij} = β₀ + β₁ log severence\textsubscript{avr} \textsubscript{ij} + β₂ log county\textsubscript{pop} \textsubscript{(i-1)j} + β₃ log PI \textsubscript{(i-1)j} + β₄ unemploy \textsubscript{(i-1)j} + ε\textsubscript{ij}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>tax.effort\textsubscript{1997} = β₀ + β₁ log severence\textsubscript{avr} \textsubscript{1991-1996} + β₂ log county\textsubscript{pop} \textsubscript{1996} + β₃ log PI \textsubscript{1996} + ε\textsubscript{i}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2.1 County Taxes</th>
<th>2.2 Tax Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
<td>a</td>
</tr>
<tr>
<td>constant</td>
<td>95.3466***</td>
</tr>
<tr>
<td></td>
<td>(12.8482)</td>
</tr>
<tr>
<td>severence taxes</td>
<td>0.2931***</td>
</tr>
<tr>
<td></td>
<td>(0.0553)</td>
</tr>
<tr>
<td>population</td>
<td>-6.0579***</td>
</tr>
<tr>
<td></td>
<td>(0.3585)</td>
</tr>
<tr>
<td>personal income</td>
<td>-10.1960***</td>
</tr>
<tr>
<td></td>
<td>(3.2172)</td>
</tr>
<tr>
<td>unemployment</td>
<td>0.9160***</td>
</tr>
<tr>
<td></td>
<td>(0.2205)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.28</td>
</tr>
</tbody>
</table>

a: N=598, Groups=120, Missing Obs=2
b: N=598, Groups=120, Missing Obs=2
Breusch-Pagan Test:
a: χ² = 27.624, p = 0.0000
b: χ² = 36.5866, p = 0.0000
Breusch-Pagan Test:
N=120
χ² = 30.0377, p = 0.0000

*** = p ≤ 0.001, ** = p ≤ 0.01, * = p ≤ 0.05
total no more than a few dollars a year for most homeowners). Nevertheless, this finding presents a bit of a puzzle: why would counties benefitting from returned coal rents choose higher rates of taxation? The most likely answer is that coal counties happen to be poorer on average than other counties, which logically means that their tax base is lower. They therefore must employ higher tax rates in order to garner the same amount of revenue. Indeed, there appears to be no effect, in either direction, of resource rents on tax effort, an arguably better measure that takes into account the extent of each county’s tax base.

**H3: Resource rents lead to lower rates of investment in public goods, especially education.**

Neither is their any statistical evidence to support the claim that coal rich counties invest fewer resources in public education. Returned severance taxes are positively correlated with both county school taxes (when unemployment is controlled for) and per pupil spending. It is important to note, however, that the comparison here is largely between resource abundant rural counties and their agricultural and forested counterparts. Many incorporated urban areas have their own, independent school districts, funded by special city taxes.\(^{56}\) Residents in such cities are consequently exempted from paying the county school tax (but not other county taxes). As the control variables do not distinguish between urban and rural school districts within a county, city schools had to be excluded from data. Thus, while coal counties may levy higher taxes or spend more money per pupil than other rural counties, they may very well tax and spend less than cities. A simple comparison of average school taxes suggests that this is the case:

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\(^{56}\)Though by no means do all or even most incorporated cities have independent school districts. In fact, the largest city in the state, Louisville, has been part of the Jefferson County School District since the 1970s when a federal court ruling forced their merger in order to further integration.
Urban residents seem willing to pay much higher tax rates for education than rural residents, regardless of whether or not natural resources are present. Cross-national studies of the resource curse generally do not take comparative levels of urbanization into consideration. This could, at least partially, account for the discrepancy between their findings and those presented here.

One must also consider that perhaps the positive correlation found here between resource rents and both school taxes and per student expenditures is an artifact of the time period under examination (2002-2006). This is both the era of No Child Left Behind and of a major overhaul of the state educational system under the Kentucky Educational Reform Act (KERA). KERA resulted from a 1989 ruling by the Kentucky Supreme Court

\[57\] in favor of 66 under-funded school districts that effectively declared the state’s entire system of education and its financing as unconstitutional. Reforms went into effect the following year and included the establishment of a state-wide standardized testing system, increased state funding for poorer districts, and provisions for state intervention.\[58\]. Were it the case that resource rich counties had historically invested less in public education, then their general performance levels would have been poor entering this period. We might thus expect such counties to temporarily push more resources into education than their peers in order to min-

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\[57\] Rose v. Council for Better Schools.
\[58\] Harrison and Klotter, 1997, p.392
imally meet new, stricter state and federal laws. This, of course, is purely speculative and a longer historical time frame merits analysis.

Models 3.1 and 3.2

3.1 DV= County Schools Tax Rate (cents per $100)

\[ \text{school.tax}_{ij} = \beta_0 + \beta_1 \log \text{severence.avr}_{ij} + \beta_2 \log \text{county.pop}_{(i-1)j} + \beta_3 \log \text{PI}_{(i-1)j} + \beta_4 \text{unemploy}_{(i-1)j} + \epsilon_{ij} \]

3.2 DV= Per Student County Education Expenditures

\[ \text{stu.expend}_{ij} = \beta_0 + \beta_1 \log \text{severence.avr}_{ij} + \beta_2 \log \text{county.pop}_{(i-1)j} + \beta_3 \log \text{PI}_{(i-1)j} + \beta_4 \text{unemploy}_{(i-1)j} + \epsilon_{ij} \]

### Table 3.1 School Taxes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (PCSE)</th>
<th>Coefficient (PCSE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>-52.0007***</td>
<td>-14.6930</td>
</tr>
<tr>
<td></td>
<td>(3.2283)</td>
<td>(9.2163)</td>
</tr>
<tr>
<td>severance</td>
<td>-3.2283**</td>
<td>0.1678**</td>
</tr>
<tr>
<td>taxes</td>
<td>(0.0385)</td>
<td>(0.0615)</td>
</tr>
<tr>
<td>population</td>
<td>4.1983***</td>
<td>3.4361***</td>
</tr>
<tr>
<td></td>
<td>(0.1191)</td>
<td>(0.2439)</td>
</tr>
<tr>
<td>personal income</td>
<td>18.5284***</td>
<td>12.2654***</td>
</tr>
<tr>
<td></td>
<td>(0.8060)</td>
<td>(1.6355)</td>
</tr>
<tr>
<td>unemployment</td>
<td>-1.1245***</td>
<td>0.2916</td>
</tr>
<tr>
<td></td>
<td>(0.2916)</td>
<td>(0.2916)</td>
</tr>
</tbody>
</table>

### Table 3.2 Per Student Expenditures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (PCSE)</th>
<th>Coefficient (PCSE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>3.8182***</td>
<td>3.1362***</td>
</tr>
<tr>
<td></td>
<td>(0.4416)</td>
<td>(0.5504)</td>
</tr>
<tr>
<td>severance</td>
<td>0.0091***</td>
<td>0.0049***</td>
</tr>
<tr>
<td>taxes</td>
<td>(0.0013)</td>
<td>(0.0012)</td>
</tr>
<tr>
<td>population</td>
<td>-0.0368*</td>
<td>-0.0229</td>
</tr>
<tr>
<td></td>
<td>(0.0145)</td>
<td>(0.0117)</td>
</tr>
<tr>
<td>personal income</td>
<td>0.0465</td>
<td>0.1610</td>
</tr>
<tr>
<td></td>
<td>(0.1153)</td>
<td>(0.1312)</td>
</tr>
<tr>
<td>unemployment</td>
<td>0.0205***</td>
<td>0.0051</td>
</tr>
<tr>
<td></td>
<td>(0.0051)</td>
<td>(0.0051)</td>
</tr>
</tbody>
</table>

Adjusted \( R^2 \): 0.2029 (a), 0.2514 (b), 0.0962 (a), 0.1899 (b)

a: N=598, Groups=120, Missing Obs=2
b: N=596, Groups=120, Missing Obs=4
Breusch-Pagan Test:
a: \( \chi^2 = 0.0003, p = 0.9864 \)
b: \( \chi^2 = 0.0298, p = 0.8630 \)
a: \( \chi^2 = 0.8375, p = 0.3601 \)
b: \( \chi^2 = 0.4231, p = 0.5154 \)

* ** = \( p \leq 0.001 \), ** = \( p \leq 0.01 \), * = \( p \leq 0.05 \)
H4: Natural resource abundance and/or resource rents lead to higher rates of corruption.

Historical evidence suggests that both financial and political corruption have long been prevalent across Kentucky. In the early 20th century, urban and rural political bosses shamelessly controlled and sold votes to politicians. In 1909 it was estimated that as many as one quarter of votes in the average county could be purchased.\(^{59}\) As late as the 1960s, county jobs were still considered the principal payout to faithful members of the winning political party.\(^{60}\) While no systematic data exists, historical accounts do not point to a systematic relationship between natural resources and corruption: political bosses were especially powerful in urban areas, and the political parties seemingly operated their patronage machines across all counties, regardless of economic base.

Today, corruption is still fairly widespread in Kentucky: nearly one quarter of counties were coded as having experienced at least one instance of corruption over the short time period under analysis (25 of 120 counties). The findings from models 4.1 and 4.2, however, suggest that natural resources are not the cause of this corruption. There is no significant

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>-0.9872***</td>
<td>0.1822</td>
</tr>
<tr>
<td>coal county</td>
<td>0.3721</td>
<td>0.2606</td>
</tr>
</tbody>
</table>

Probit Model with dichotomous DV
N=120, Null Deviance= 122.82. Residual Deviance= 120.77

\(* * * = p \leq 0.001, * * = p \leq 0.01, * = p \leq 0.05\)


relationship between either coal abundance or rents and the dependent variable. Only poverty has a statistically significant impact on corruption: a 1 percentage point climb in the poverty rate leads to a 9% increase in the likelihood of corruption. Even when poverty is removed from the model, the natural resource variables remain insignificant. We can thus only claim that natural resource wealth, here, affects corruption only insofar as we can demonstrate that it causes poverty. Merely increasing the pot of non-citizen-based tax revenue does not, in and of itself, lead to increased corruption. If natural resource endowments do directly cause corruption at other levels of government, then other mechanisms must be at play, such as control over the distribution of extraction contracts or a state monopoly over prices. Yet, there is no solid theoretical reason to think that these mechanisms are exclusive
to natural resource management. As Bates has argued in the African context, government control over pricing and contracts pertain to agricultural commodities (through marketing boards) as well as to many small-scale industries.61

There is, however, a story about corruption and poverty here. Within the county audit reports, a significant number of counties were repeatedly cited for not complying with state standards relating to the division of financial duties. Distributing duties across staff members creates a system of checks and balances for the management of money, making it more difficult for individuals to steal public funds. In other words, the absence of segregated financial duties leaves a county particularly vulnerable to corruption. Along with these citations often came the following note of explanation: that the county in question could not comply with the state standards because they lacked the financial resources to hire enough staff. Thus the poorest counties with the fewest resources are the least able to hire sufficiently large staffs, and are thereby the most vulnerable to corruption. The notion of a threshold (i.e. $n$ staff members is sufficient to ensure proper segregation of duties) would explain why poverty rates are significant and income levels are not: it is only the very poorest counties that cannot afford to buffer themselves against corruption.

8 Conclusions

This paper has attempted to submit four aspects of the resource curse theory to empirical testing, using reliable and easily interpretable measures of abundance and production. The wealth and growth models suggest that coal counties have indeed developed more slowly than others. Yet, there is evidence that this effect has little to do with typical macroeconomic

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explanations and more to do with the underlying geology of the land and its unsuitability for agriculture. Natural resource production, and mining in particular, may move location too frequently to support the growth of a stable, secondary local economy. Ghost towns do not engender development. Neither do significant decreases in labor demand, which may be caused either by the exhaustion of the resource or by massive upheavals such as the mecha-
nization of an industry. In the political realm, this paper has found no evidence to support the claim that natural resource abundance and its associated rents lead to lower tax rates, less investment in public goods, or greater corruption. Rather than using resource rents as a substitute for public taxation, Kentucky coal counties actually levy property taxes at higher rates than their non-resource rich counterparts. Severance taxes are also positively correlated with increased spending on education. Finally, there is no evidence that resource rents make coal counties more vulnerable to corruption. Only insofar as natural resource abundance contributes to poverty, does it increase the likelihood of corruption.

While these results are embedded in a particular local context, and must be generalized with caution, they should still give us pause for they do not support existing hypotheses connecting natural resource wealth to poor economic and political development. Rather, this paper points to the importance of understanding how the geological features of the land may interact with production processes to hinder sustained growth. And if poverty is the conduit through which natural resources hurt political development, then solving the problem of resources and slow growth would also have far-reaching secondary benefits in the political sphere.
9 Appendix: Data Sources

(1) Coal Abundance and Severance Taxes:

Provided by the Kentucky Governor’s Office of Energy Policy, the Division of Fossil Fuels & Utility Services. Coal abundance figures are contained in the Blue Book of Kentucky Coal and Severance Tax numbers are published in the biannual Kentucky Coal Facts Guide. Both were generously provided by Dennis McCully, the Western Kentucky Coal Representative. Missing 2005 cumulative production data for the smallest producer counties was estimated from the Kentucky Geological Survey (online: http://www.uky.edu/KGS/coal/production/kycoal01.htm [last accessed July 31, 2009]).

(2) Corruption:

Data collected from annual audit reports of Kentucky County Clerk’s Offices and Fiscal Courts. Reports are available from the Office of the Kentucky Auditor of Public Accounts (online by county: http://www.auditor.ky.gov/Public/Audit_Reports/KentuckymapSearch.asp [last accessed March 28, 2008]).

(3) County Property and School Taxes:

Available from the Kentucky Department of Revenue’s annual tax books (online: http://revenue.ky.gov/newsroom/publications.htm#PTR [last accessed July 31, 2008]).

(4) Educational Expenditures:

Data on per student spending by county as well as on student achievement and standardized test scores is publicly available from the Kentucky Department of Education’s School Report Card Archive (online by county: http://apps.kde.state.ky.us/schoolReportCardArchive/ [last accessed March 28, 2008]).

(5) Navigable Rivers and Bluegrass Counties:

Obtained by compiling information from the following maps and accompanying documents: (a) map of navigable Kentucky rivers (online: www.waterwayscouncil.org [last accessed September 14, 2008]); (b) map of Kentucky rivers overlaid on Kentucky counties (online: http://geology.com/state-map/kentucky.shtml [last accessed September 14, 2008]); (c) generalized geological map of Kentucky (online: http://www.uky.edu/KentuckyAtlas/map-kentucky-geologic.gif [last accessed September 15, 2008]); (d) the pamphlet “The Geology of

(6) Personal Income and Population:

Data is available for the years 1999-2005 from the Regional Economic Information System of the Bureau of Economic Analysis, housed in the U.S. Department of Commerce (online: http://www.bea.gov/regional/reis/ca1-3fn.cfm [last accessed January 10, 2008]).

(7) Poverty Rates and Unemployment:

Available from the U.S. Census Bureau, Data Integration Division, Small Area Estimates Branch (online: http://www.census.gov/hhes/www/saipe/index.html [last accessed January 10, 2008]).
References


[27] Office of Surface Mining: Reclamation and Enforcement. Abandoned mine land inventory system (amlis).


