DOES NATURAL RESOURCE WEALTH SPOIL AND CORRUPT GOVERNMENTS? A NEW TEST OF THE RESOURCE CURSE THESIS

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Countries with rich natural resource endowments suffer from lower economic growth and various other ills. This work tests whether the resource curse also extends to the quality of regulation and the level of corruption. A theoretical framework is developed that informs the specification of interactive random effects models. A cross-national panel data set is used to estimate these models. Due to multicollinearity, only an effect of metals and ores exports on corruption can be discerned. Marginal effects computations show that whether nature corrupts or not crucially depends on a country's institutions. A broad tax base and high levels of education appear to serve as inoculations for countries against the side-effects of mineral wealth.

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TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF ILLUSTRATIONS

Page

CHAPTER 1

INTRODUCTION

> *Men of a fat and fertile soil are most commonly effeminate and cowards; whereas contrariwise a barren country makes men temperate by necessity, and by consequence careful, vigilant, and industrious. (Jean Bodin, "Six Books of the Commonwealth")*

This classical yet still provocative quote by the 16th century thinker Jean Bodin points to a long-observed regularity: where income can be gained without effort, negative side-effects often result. This may be true for nations just as for individuals. Recently, great research efforts have been devoted to the apparent links between the natural resource endowments of countries and the various ills from which these countries suffer. Resource-rich countries seem to have lower average economic growth rates, lower chances to become consolidated democracies, and appear to be more likely to experience civil wars. Economists and more recently political scientists have devised a number of theoretical explanations for these different aspects of the so-called *resource curse*. This line of research has a long tradition in area studies. However, it only became widely recognized in the broader literature when Sachs and Warner (1995) found that the degree of natural resource wealth of a country, controlling for other determinants of growth, is inversely related to its economic growth rate. A few researchers have also begun to look at the relationship between the importance natural resource extraction takes on in a country and the quality of its institutions.

The main motivation for these scholars is to find better explanations for why the "Holy Grail" of sustained economic growth has remained so elusive (Easterly 2001). The quality of a country's institutions appears to be related to the health and growth potential of that country's economy. Institutions such as the rules that govern the interactions between rulers and ruled mediate the effects of the rents flowing in from natural resource extraction. On the one hand, they can channel these rents into uses that are not harmful to the nation's economic future. On the other hand, they can also exacerbate the negative effects, and not

just economic ones, of resource extraction. They may help corrupt oligarchs maintain a firm grip on 'their' citizens. For those reasons, it is prudent to examine the determinants of the quality of institutions. It is important to understand under what circumstances natural resource extraction has a negative impact on the quality of a country's institutions. Considering that regulation is necessary for markets to fulfill their potential, it would be helpful to know more about how these rules come about in different countries. Resource extraction may play a role but its impact on regulatory quality is largely unexplored.

If good regulation allows markets to flourish and many people to benefit from participating in them, corruption may undermine the health of an economy and the trust in a political system. The rent streams that flow in from the sales of natural resources such as petroleum and metals are a huge temptation to political leaders. There is a need to better understand the link between these rent streams and political corruption. It remains to be seen whether such connections generally exist, or whether there are ways to harness the fruits of today's 'fat and fertile soils' in such a manner as not to corrupt the guardians of these soils.

Big questions like 'What determines corruption?' or 'Why do some countries have well-working laws but others do not?' call for a truly comparative approach. As long as one believes that there are certain generalities in human behavior, widely applicable and parsimonious explanations remain the goal of social scientific research. This thesis is written with such a background. Human beings are assumed to essentially behave in the same way no matter what their cultural background is and to be motivated primarily by self-interest, not by class membership or ideology. With this foundation, it is possible to examine whether the alleged resource curse truly extends to the quality of institutions, as Isham, Woolcock, Pritchett, and Busby (2003) and Leite and Weidmann (1999) claim to observe in their attempts to discover the determinants of economic growth. Neither of these papers describes well what role politics plays in the relationship between natural resource wealth and low institutional quality. To test this link in the present thesis, first a theoretical framework

has to be created to illustrate the behavior of political actors in countries with and without substantial natural resource endowments. This theoretical framework then informs a series of hypothesis tests. The goal of the thesis is to provide an answer to the following related questions:

1. *Does the natural resource endowment of a country negatively affect the quality of its regulatory framework?*

2. *Does the natural resource endowment of a country increase its level of corruption?*

CHAPTER 2

LITERATURE REVIEW

It may be argued that all of economics can be boiled down to one essential statement: "People respond to incentives. The rest is commentary" (Landsburg 1995, 3). One may further argue that this holds for political science as well, at least if one adds a phrase such as 'politics is about setting the incentives.' In any case, the first statement implies that people that happen to live above huge deposits of valuable minerals will act differently from those that do not because they face a different set of incentives.

Regulatory Quality Matters for Economic Development

Knack and Keefer (1995) evaluate different institutional indicators such as Gastil's index of civil rights and liberties and risk analysis agencies' country ratings of property rights protection as determinants of investment. They find that property rights protection scores are much better predictors of investment than the more general index by Gastil. Keefer and Knack (1997) find strong empirical support for the hypothesis that property rights and the enforcement of contracts serve as accelerators for economic growth. Chong and Calderón (2000) use a time-series cross-sectional data set of 55 countries to test for the existence of linear feedback between contract enforceability and economic growth and find evidence pointing at two-way causality between these variables. These findings demand an explanation. The quality of a country's regulatory framework appears to be very important for the growth prospects of its economy, but why?

De Soto (2000) makes a powerful theoretical case for the importance of regulations to economic development. A good regulatory framework allows for capital accumulation and usage, which is precisely what is lacking in the developing countries. He observes that while capitalism generates economic well-being for the majority of the population in the rich

countries, it fails to do so in the rest of the world. There a small elite sector of the population enjoys capitalism's fruits and the benefits of increased trade, but this elite exists under a *bell jar*, cut off from the rest of the population. Only those few under the bell jar have working capital, whereas the rest of the population has only dead capital. Capital denotes that part of a country's assets that initiates surplus production and increases productivity. The potential in capital can only be realized if property rights exist that allow for an easy transfer of property, and if these property rights are enforced. In the Third World and most successor states of the Soviet Union, these rights exist and work only for the elites. Much of the population lives and works in the extralegal sector, as it is prohibitively expensive for them to legalize their capital for greater uses. Thus they have very limited access to credit, limited or no access to lucrative investment opportunities, and they cannot expand their small businesses because no effective law allows them to limit liability.

De Soto (2000) goes on to explain that Third World slums are not heaps of anarchy and disease but orderly communities full of business activity. Since the law does not recognize the slum's dwellers' property rights, they have to resort to inefficient ways to build their houses. They can only do business with people they know, as an illegal business cannot enforce contracts through the state. They have to resort to mafias and similar organizations for protection. De Soto (2000) conservatively estimates the value of the assets of the poor in the extralegal sector of the Third World countries at forty times all the foreign aid received throughout the world since 1945. The problem is that these immense assets are dead, i.e., they cannot be put to any further use. The United States and other rich countries succeeded because they gradually changed their law to reflect the behavior and working norms of the majority of their population. In the Third World, this has sometimes been attempted, but it so far failed because those politicians that wanted to reform failed to convince the skeptical elites that legalization of property would in the end increase their opportunities for profit.

North (1990) complements De Soto's (2000) main theme by arguing that the absence of functioning low-cost contract enforcement mechanisms is the principal cause of the continuing lack of sustained economic growth in Third World countries.

Corruption Matters for Economic and Political Development

Unlike economic regulation that mainly affects economic growth, the impact of corruption extends even further into the quality of life of ordinary citizens. Besides lowering economic growth, corruption also affects developing countries' chances to consolidate their democracies. The generally deteriorating effects of corruption on economic growth work through several mechanisms.

First, countries with a relatively high level of corruption also tend to have relatively high levels of rent-seeking. Once again, the incentives for people are decisive. In a country where people can do better by lobbying government rather than by being productive, fewer will invest their talent into generating wealth than in a country where industriousness provides better chances over rent-seeking. Murphy, Shleifer, and Vishny (1991) investigate the behavior of the most talented people in a country. These people face a fundamental choice between occupations that generate wealth (e.g., entrepreneurship) and occupations that mostly redistribute wealth. Among the latter one may count working for the government bureaucracy, the army, or a bureaucratically organized religion. Murphy et al. (1991, 504–505) provide the example of Latin America, where many talented young people join the armed forces to move up the social ladder. Whether the most talented people in a nation choose wealth-generating or wealth-redistributing (rent-seeking) occupations has a major impact on the health of that nation's economy. Murphy et al. (1991, 525–526) add enrollment in engineering and law as explanatory variables to a regression of economic growth on several explanatory variables in a cross-section of nations analogous to Barro's (1991) regression model of the determinants of economic growth. They find that as enrollment in engineering increases, controlling for

other factors, economic growth also increases. On the other hand, an increase in law school enrollment is associated with a decrease in economic growth, other things equal. The authors interpret these findings as evidence corroborating their argument.

Second, corruption tends to lead to lower domestic and foreign investment. Tanzi (1998, 583) attributes this to corruption working like a high and arbitrary tax and the lack of reliable property rights protection in the presence of governmental corruption.

Finally, corruption alters the nature of public spending to favor infrastructure over education and health care because the former offers policymakers more opportunities to collect bribes. *Kleptocrats* such as President Mobutu in Zaire were well-known for using large infrastructure projects to redistribute wealth to their cronies (Rose-Ackerman 1999, 116).

The idea of a negative effect of political corruption on economic growth is not undisputed. Huntington (1968, 69) suggests that there is an optimal amount of corruption for any society. This optimal amount is usually positive, especially for relatively non-corrupt societies: "In terms of economic growth, the only thing worse than a society with a rigid, overcentralized, dishonest bureaucracy is one with a rigid, overcentralized, honest bureaucracy."

Corruption also has a negative impact on political development, especially in countries undergoing a transition to democracy. Tanzi (1998, 583) argues that it may not only undermine the legitimacy the market, but also the legitimacy of democracy. Again, Huntington (1968, 69) provides a counterargument: corruption may be beneficial to democratic consolidation if an overtly powerful bureaucracy discredits itself through corruption and thus allows fledgling new political parties to gain strength.

The Link between Natural Resource Endowment and Governmental Policy Output

Auty and Kiiski (2001) explain the qualitative difference between exports of crops and exports of minerals such as petroleum, metals, and ores. The latter are distinguished by the high concentration of ownership and production, leading to concentrated rent streams

flowing from the extraction of these resources. As will be argued below, concentrated rent streams encourage rent-seeking.

Beblawi and Luciani (1987) present the idea of *rentier state*, an important topic in Middle East area studies. The *petro-states* in the region serve as the main intermediaries between their oil sectors and the rest of society in these countries. Getting access to the oil rents has developed into the major activity of a large part of the working force. Consequently, the work-reward causation is broken. The regulatory frameworks in these countries do not encourage productive economic activity. Rather, they encourage rent-seeking.

Leite and Weidmann (1999) argue that natural resource extraction leads to corruption because it creates many opportunities for rent-seeking behavior. They mention Nigeria as a case in point for the corrupting effects of petroleum extraction. Their cross-sectional regression for a sample of 72 countries of corruption on natural resource exports, trade openness, rule of law, and a few other control variabless finds that oil and mineral exports are associated with an increase in corruption.[1] While Leite and Weidmann (1999) try out a number of control variables, they do not include education or related measures of human capital.

Other Economic Aspects of the Apparent Resource Curse

Sachs and Warner (1995) can be considered the article that started the research into the reasons behind the various ills associated with natural resource wealth. The authors present evidence that countries with a high ratio of natural resource exports to GDP had a comparatively low average growth rate between 1971 and 1989. The negative impact of natural resource exports on economic growth is still visible when they control for initial per capita income, trade policy, investment rates, region, an index of bureaucratic efficiency, the volatility of the terms of trade, and income inequality.

[1]Their indicator of corruption is an index developed by the country risk analysts of the International Country Risk Guide.

In economic explanations of the negative impact of a rich natural resource endowment on growth, the *Dutch Disease* mechanism figures prominently. The term describes how economic booms caused by a newly discovered natural resource eventually lead to slower growth. First, when the resource is discovered, the increased disposable income in the economy is spent in part on non-tradeable goods such as construction and services. The prices of these goods then rise. This in turn leads to an increase in the real exchange rate and a decline in the real wages that can be earned in the non-tradeable goods sector. The non-resource exporters suffer from the increase in the exchange rate and workers and capital are drawn from other sectors into the more attractive resource extraction business. The overall real growth of the economy then slows or even halts (Leite and Weidmann 1999, 8–9).

Other Political Aspects of the Apparent Resource Curse

Ross (1999) provides a concise review of the political and economic aspects of the resource curse. The main political implications of an extractive economy are a lack of accountability by the government leaders and an overexpansive bureaucracy that becomes the target of rent-seekers. Ross (1999, 321–322) criticizes scholars for their overreliance on case studies and their failure to test the theoretical arguments they develop from these case studies. This preference among many comparative politics scholars has led to the problem that there is very little cumulation of knowledge about the politics of development.

To empirically evaluate the claim brought forth by Middle East area scholars that petroleum extraction supports authoritarian regimes, Ross (2001, 337–340) regresses the Polity indicator of regime type on the export values of fuels (oil and gas) and ores and metals as fractions of GDP as well as on classical predictors of regime type.

The author reports a negative impact of fuel exports on the level of democracy. However, one cannot take this result as a stylized fact due to a statistical problem in the study. Ross's (2001) panel data set contains more countries (113) than time periods (27). He uses feasible

generalized least squares (FGLS) to estimate his model and cites Beck and Katz (1995) to justify his choice of estimation method. Beck and Katz (1995, 639–644), however, advocate exactly the opposite: feasible generalized least squares ought *not* to be employed *unless* the number of time points *exceeds* the number of countries in a panel. Otherwise, FGLS estimates have excessively small standard errors which may lead the researcher to reject null hypotheses when there would be no reason to reject them. Unless Ross's (2001) study is replicated using an appropriate estimation method, one cannot know whether his 'findings' about the antidemocratic properties of oil and gas are not mere artifacts resulting from too small standard errors that make one overconfident in the results.

The alleged political effects of natural resource wealth extend to political violence. De Soysa (2000) argues that mineral resource abundance motivates rapacious behavior. This provides inducements for political violence and plays an important role in the start and continuation of civil wars. Currently, the evidence is inconclusive. While De Soysa (2000, 129) finds that the logit coefficient on the natural resource variable in his analysis is statistically different from zero, Fearon and Laitin (2003, 87) cannot reject the null hypothesis that this variable does not matter in determining the onset of a civil war. As far as the duration of civil wars is concerned, research on whether natural resource wealth matters is still pending.

The Need for Further Tests of the Resource Curse Thesis

Further tests of aspects of the resource curse are limited by data availability. One of the tests that can be done is to evaluate the impact of a country's natural resource endowment on the quality of its regulatory framework and its level of corruption, when the impact of the natural resource endowment is mediated by the political institutions in place. The thesis makes a contribution by taking on this challenge.

CHAPTER 3

THEORETICAL FRAMEWORK

In order to evaluate whether natural resource wealth influences the quality of regulation and the level of corruption in a country, a theoretical framework is constructed that helps to structure the various arguments from the literature. The framework is then used to formulate several hypotheses that are tested against a sample of countries from all six populated continents.

A Tale of Three Countries

As a first approximation to the problem, one may compare three imaginary Third World countries, Mineralia, Petrolia, and Scarceland. Beneath Mineralia's fertile soils lie immense deposits of valuable metal ores. Petrolia's parched deserts are home to huge and easily accessible deposits of petroleum and natural gas. Under Scarceland's rocky surface, no such treasures can be found.

Looking only at the natural resource endowment, an alien visitor would expect Mineralia and Petrolia to be in a much better situation economically than Scarceland. However, this is far from the truth. In fact, Scarceland has outperformed Mineralia and Petrolia in real economic growth per capita by great lengths over the past several decades. Scarceland is better off in other ways, too. Mineralia endured several dictatorships in the past. While it is now officially a democracy, its landed elites still actually rule the country. The periodic elections are not very competitive and the threat of a return to open dictatorship still looms rather large. Petrolia is ruled autocratically by a small elite headed by a royal family. Scarceland, on the other hand, is a reasonably consolidated democracy with competitive elections. Unlike in Mineralia, Scarceland's transition to democracy was preceded by an elite settlement, i.e., "a procedural and substantive accomodation [...] among elites who

have the capability to disrupt the regime" (Peeler 1995, 244). This settlement was very conducive to the development of a well-working bureaucracy.

The government bureaucrats in Mineralia and Petrolia are recruited from a very different pool of talents than they are in Scarceland. In the former countries, especially in Petrolia, the government gives out positions in the bureaucracy as rewards to loyal citizens. These coveted jobs and other rewards given out by the government have led to the development of a large lobbying industry that specializes in supporting rent-seekers. In Buchanan's (1980, 8) words, "[t]hey will invest effort, time, and other productive resources in varying attempts to shift the queen's favor toward their own cause." Consulting about how to gain from patronage and how to lobby optimally is in high demand. This is in stark contrast to Scarceland, whose civil service is mostly merit-based so that there is less lobbying.

The elites that rule Mineralia and Petrolia have privileged access to the rents from the extraction of the rich natural resources. These rents are tapped by the elite-controlled states via taxes on the export of the resources, corporate taxes, and/or by controlling the resource extraction directly through nationalized enterprises (Ross 2001, 331). This leads to a small tax base in both countries. In addition to the resource rents, Mineralia's government also extracts some taxes from its population. Overall, taxation there is low but regressive. Petrolia does not have an income tax nor many other taxes on individuals. Most of government revenue comes from the sales of petroleum and natural gas. Scarceland's government depends on its population for revenue. The tax base is broad and there is an income tax.

The governments of Petrolia and Mineralia use the rent stream flowing from the extraction of the natural resources in different ways: While Petrolia's ruling elite maintains various schemes for distributing a part of the resource rents among the populace in exchange for acquiescence, Mineralia's landed elites have built an elaborate national security system using the resource rents. The military is large and serves as an internal security force, deterring protests. This situation has not fundamentally changed with the incomplete transition to

democracy that the country has experienced. Scarceland's government lacks the convenient tools of patronage and well-developed repression for political survival.

The differences between Mineralia and Petrolia on the one hand and Scarceland on the other hand do not end with the political system. They also permeate society. Income inequality is very high in Mineralia, still relatively high in Petrolia, but rather moderate in Scarceland. The median citizen of Scarceland is far better educated than his or her counterpart in the two other countries. In addition, the higher educational institutions of Scarceland produce a much greater percentage of engineers than those of Mineralia and Petrolia. Especially in Petrolia, the content of higher education is irrelevant for most students' future careers, as the majority prepare to work in the non-meritocratic bureaucracy where their level of skill is not related to their career success. Looking at the competition for rents from the government in Petrolia and the fear of repression in Mineralia, it is not surprising that their citizens are far more distrustful of each other than the citizens of Scarceland. Ethnic fractionalization leads to far more friction in Mineralia than in Scarceland, even though both countries are somewhat diverse.

Looking at the three countries' characteristics presented so far, it is no surprise that Scarceland's bureaucracy produces regulations that are generally conducive to sustained economic growth, whereas the two resource-rich countries lack such a fine body of laws. Also, corruption of government and bureaucracy is rampant in Mineralia and even more so in Petrolia, while it is relatively modest in Scarceland.

A General Theoretical Framework

Of course, no real countries completely resemble the caricatures drawn up so far. The story about these three fictional countries serves to develop the contours of the theoretical framework. The underlying theme of the story is that the differences in the quality of formal bureaucratic institutions among various countries can be traced back to the role natural

resources such as petroleum, natural gas, and mineral ores play in their economies. The theoretical framework that is presented subsequently may explain the processes underlying this nexus, keeping Box's (1979, 202) advice in mind: "All models are wrong but some are useful." Certainly it should not be inferred from the theoretical framework that the degree of natural resource importance to an economy is the 'silver bullet' that ultimately explains the origins of political and institutional development. After the framework has been developed, some of its implications are then tested. These tests help to evaluate how useful the theoretical framework proposed here is for understanding development problems compared to alternative models found in the literature.

A Theoretical Framework for the Indirect Effects of the Natural Resource Endowment

In the framework proposed here, natural resource wealth influences the quality of formal bureaucratic institutions through three channels, the *state channel*, the *economy channel*, and the *society channel*. First, the *state channel* describes how the design of the political institutions follows in part from the role resources play in a country's economy. This design has serious consequences for the quality of the country's formal bureaucratic institutions. Second, the *economy channel* illustrates another two-step process: Diversification and equity of an economy are functions of how important natural resources are to the economy. Individuals and business entities in reasonably diversified and equitable economies then have more of a stake in a well-working government bureaucracy than individuals and business entities in resource-dependent countries where rent-seeking is a major economic activity. Third, the *society channel* describes how the average citizen of a resource-abundant country has fewer incentives to gain human capital and is more distrustful of others than the average citizen of a resource-scarce country. In the aggregate, this leads to very different institutional quality in resource-rich countries compared to resource-poor countries. The three channels of influence are summarized in Figure 1 for regulatory quality as the outcome and in Figure 2 for

corruption as the outcome. The following sections explain the components of this model in greater detail.

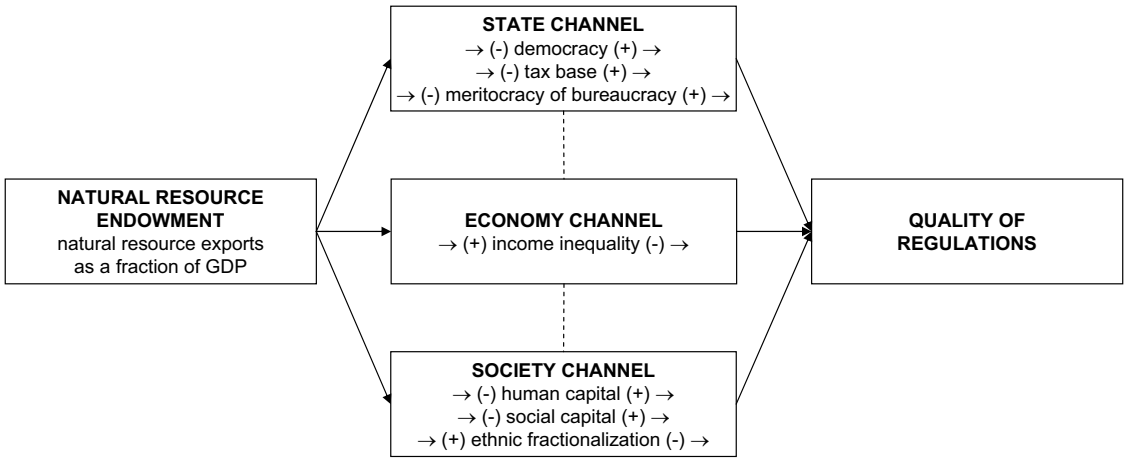

Figure 1: The determinants of Regulatory Quality in the theoretical framework. The signs in parentheses describe the expected directions of the effects.

The State Channel of Influence

There is a causal link between the degree of natural resource dependence and the regime type of a country. The more important the extraction of high-rent natural resources is to a country's economy, the less likely it is that this country will be a consolidated democracy. Ross (2001, 327–328) has identified three underlying mechanisms: the *rentier effect*, the *repression effect*, and the *modernization effect*. The *rentier effect* posits that governments of resource-dependent countries use patronage to avoid being held accountable by their citizens. The idea behind the *rentier effect* is that the government, which controls the flow of rents from the exports of the country's natural resources, uses patronage to disspell latent opposition and low or zero taxation of individuals to avoid demands for representation from

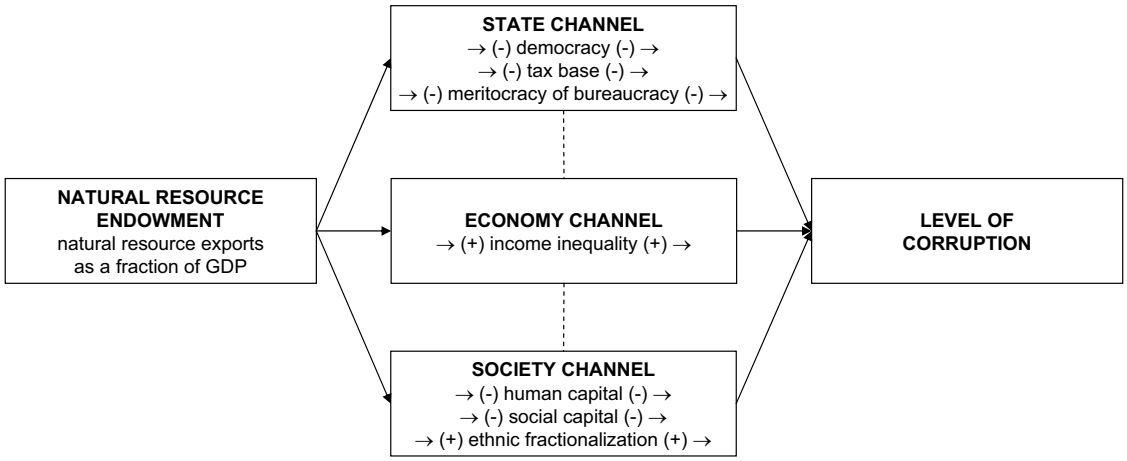

Figure 2: The determinants of corruption in the theoretical framework. The signs in parentheses describe the expected directions of the effects.

the citizens (Ross 2001, 333). The *repression effect* states that governments of resource-dependent countries use the rents from natural resource extraction to fund a large internal security apparatus that renders opposition ineffective, if it does not outright deter it. Finally, the *modernization effect* describes a qualitative difference in the effects of economic growth that is based on exporting natural resources compared to the effects of economic growth that is fueled by other sources. The *modernization effect* is further discussed below, as it is also part of the *society channel*.

Lam and Wantchekon (2003, 9–10) use a formal model to show that the populace will expend substantial amounts of money on lobbying for government patronage. They also argue that the *repression effect* should far outweigh the *rentier effect*, since autocrats are keenly aware that their potential dismissal from power would be violent. Summing up, natural resource wealth is likely to allow authoritarian governments to stay in power through patronage and repression, whereas a lack of natural resources makes a country more prone

to democratize. Government corruption is higher in non-democracies than in consolidated democracies, as there is less accountability in non-democracies.

Another facet of the *state channel* is the design of the taxation system in a country. As a corollary to the *rentier effect* idea, one can argue that natural resources lead governments to adopt a narrow tax base. This leads to less pressure for accountability from the citizens, opening the field for more corruption than in countries with broader tax bases. In countries where landed elites still play an important role in government, they will try to maintain a highly regressive taxation system to protect their status. Landed elites are dependent on protection since they produce inefficiently and therefore cannot maintain their wealth without the coercive force of the government, be it by using the military or through taxation (Paige 1975, 17).

Bureaucracies with meritocratic recruitment are expected to produce regulations that are more beneficial to sustained economic growth than bureaucracies where positions are filled through patronage. Bureaucrats who owe their positions to someone's favor will eventually be asked to return favors to their benefactors by producing regulations that help some other beneficiaries of the government. Regulations that are produced under such a system of incentives are unlikely to be optimal for the development of a healthy, capital-forming economy. At the same time, meritocratically recruited bureaucrats should be less prone to corruption than bureaucrats installed through patronage, as the former are under more scrutiny by the public.

The Economy Channel of Influence

The importance of natural resources in national income also partially determines characteristics of the economy of a country, especially the distribution of income among the population and the diversification of the economy. These two characteristics then affect the

quality of regulation that the government bureaucracy produces and the degree of corruption observed in the bureaucracy.

If natural resources are very important to an economy there will tend to be very high income inequality especially in countries where the government uses repression far more than patronage in its quest for political survival. As there are few opportunities for the majority of the population, due to the economy's reliance on the export of natural resources, corruption will be high among the government officials, the elites that support the government, and the state bureaucrats administering the flow of resource rents into government-contracted projects or procurements.

Economies that are not very diversified, i.e., where a large share of gross domestic product is earned in just one sector, tend to have lower quality regulations since government leaders will tend to favor the sector of the economy that is most conducive to their survival in office. This should lead to regulations that make it difficult for other sectors to develop. Diversification, however, is beneficial to the achievement of sustained economic growth.

The Society Channel of Influence

The natural resource endowment of a country also exerts a partial influence on the way its citizens educate themselves and interact with each other. First of all, in resource-poor countries the most abundant factor of production is labor. This leads governments in these countries to regard their citizens as more important than governments of resource-rich countries would consider them. A strong negative relationship between the importance of natural resources to an economy and the level of human capital can be expected. In resource-poor countries, there will be comparatively more incentives for people to educate themselves in a manner that is conducive to sustained economic growth. For two otherwise comparable countries with similar fractions of their young people getting a tertiary education, one country being resource-rich and the other resource-poor, one would expect to see a far greater

percentage of university students in the resource-poor country enrolled in fields that yield high human capital, e.g., engineering. Certainly, the idea of human capital is not limited to formal education. On-the-job training will also be be more important in an economy that places a premium on skilled labor. A large fraction of skilled individuals is beneficial to the quality of regulations produced by the government bureaucracy, as the political participation by skilled individuals is generally higher than that of unskilled individuals. Therefore government bureaucrats will be under more scrutiny if there is a large fraction of skilled individuals in the populace. The first part of this link is described by Ross (2001, 336–337) under the term *modernization effect*. In the same way, a high level of human capital should also be negatively related to the degree of corruption in the government bureaucracy. There is some simultaneity at work here, as a better regulatory framework should also increase the incentives for people to increase their level of human capital.

The low level of trust among citizens in many poor countries may be surprising to the visitor coming from a rich country with a rather high level of interpersonal trust. Yet the natural resource endowment of a country also plays a role in determining social capital. As there is distributional conflict over the government-controlled income stream from natural resource exports, rent-seeking societies show a much lower level of interpersonal trust than societies focused on generating wealth by entrepreneurial activity. The level of interpersonal trust in a society then influences the quality of governmental regulations because regulations will impose fewer obstacles on simple business transactions if the level of interpersonal trust is high compared to when it is low. In addition, high levels of trust among strangers allow for smoother transactions between citizens and bureaucrats, reducing the need for bribes. Again, there is simultaneity at work here, as lower levels of governmental corruption should go hand-in-hand with higher levels of interpersonal trust. There will be a diffuse feeling that 'the system is working' among the citizens.

Finally, the effects of ethnic divisions within a country can be exacerbated or dampened by the role natural resources play in the country's economy. For countries with similar ethnic divisions, those with a high dependence on natural resources will have a regulatory framework that is less conducive to sustained economic development. This is because there will be many regulations that discriminate against one ethnic group, reducing the capability of people that do not belong to the favored group to develop their abilities and, with that, reducing their ability to contribute to a possible improvement of the national economy. The mechanism behind such discrimination would be control of the rent stream from the resource exports by the elites of only one of the ethnic groups in a country.

Interrelationships

For clarity of exposition, it has been helpful to group the intervening variables described thus far into three separate channels, the *state channel*, the *economy channel*, and the *society channel*. Of course, these three groups of intervening variables in the natural resources–quality of formal bureaucratic institutions nexus are not neatly separated empirically. A strong interrelationship between the *state channel of influence* and the *society channel of influence* is obvious: The more a government uses resource rents to control the population, the lower human and social capital should be, since there will be a considerable amount of rent-seeking and interpersonal distrust in countries where the *rentier effect* plays a large role. The relationship between social capital and democracy is ambiguous, as high levels of trustful civic interaction do not necessarily enhance democracy (Bayer Richard and Booth 2000, 234). Also, very high income inequality is not conducive to high interpersonal trust, as it implies a lack of opportunities for the majority of the population.

Conceptual Definitions

This thesis is an attempt to explain the quality of formal bureaucratic institutions of the state, calling for a definition of the term *institution*. In accordance with North (1990, 4), institutions are both formal and informal constraints that shape the interactions of humans. These constraints are "stable, valued, recurring patterns of behavior" (Huntington 1968, 12). *Institutional quality* describes the degree to which institutions generate incentives for properly functioning markets, protect property rights, and enable social and political stability (Rodrik 2003, 10).

The focus of this thesis is on the effects of those natural resources that generate a substantial rent stream. To that end, the term *natural resources* is defined rather narrowly as all the effectively available deposits of mineral ores, petroleum, and natural gas. The natural resource deposits of a country can equally be found on- and off-shore, so long as they fall under the jurisdiction of that country (Black 2002, 316–317). *Natural resource endowment* then simply denotes the sum of all effectively available natural resources in a country at a given point in time. The *relative importance of the natural resource endowment* is the degree to which an economy depends on income from natural resources.

Definitions of *democracy* abound. Dahl (1998, 85) lists six critical requirements for a large-scale democracy: elected officials, free, fair, and frequent elections, freedom of expression, access to alternative sources of information, associational autonomy, and inclusive citizenship. The core of this and many other definitions is that "in all democratic regimes the principal officers of government are chosen through competitive elections in which the bulk of the population can participate" (Huntington 1991, 580).

Another relevant term for this study is the *tax base*, the set of incomes on which direct taxes, and transactions of all kind (e.g., sales) on which indirect taxes are levied (Black 2002, 460).

The idea of *human capital* was introduced by Becker (1975, 9). It encompasses all skills, knowledge, and the health of a person that help him or her gain monetary or other incomes. Investments in human capital can be made by getting formal schooling, training on the job, or medical care, as well as by migrating. The idea of human capital focuses on the individual. It is distinct from *social capital* that denotes the "connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them" (Putnam 2000, 19).

The first dependent variable is *regulatory quality*. This concept denotes the extent to which government policies encourage properly functioning markets. Countries with independent supervision of the financial sector, few or no price controls, regulation favorable to international trade, and few regulatory obstacles to business development by definition have higher regulatory quality than countries with inadequate supervision of the financial sector, price controls in many areas, regulation obstructing foreign trade, and many formal obstacles to the development of businesses (Kaufmann, Kraay, and Mastruzzi 2003, 3).

The other dependent variable in search of a convincing explanation is *corruption*, which denotes the extent of "the exercise of public power for private gain" (Kaufmann et al. 2003, 4). Corruption is important because a high level of it shows "a lack of respect of both the corrupter (typically a private citizen or firm) and the corrupted (typically a public official or politician) for the [formal] rules which govern their interactions" (Kaufmann et al. 2003, 4). Another, broader definition of corruption is the one Nye (1967, 419) proposed:

> Corruption is behavior which deviates from the formal duties of a public role because of private-regarding (personal, close family, private clique) pecuniary or status gains; or violates against the exercise of certain types of private-regarding influence. This includes such behavior as bribery (use of a reward to pervert the judgement of a person in a position of trust); nepotism (bestowal of patronage by reason of ascriptive relationship rather than merit); and misappropriation (illegal appropriation of public resources for private-regarding uses).

Hypotheses

From the theoretical framework drawn up this far, several interesting implications can be developed. First, the theoretical framework is built around the core idea that natural resource wealth works as a negative influence on the quality of a nation's regulatory framework through governmental, economic, and societal factors. Natural resource wealth is also theorized to increase corruption through these same channels.

Hypothesis 1 *An increase in Fuel Exports as a fraction of GDP decreases Regulatory Quality, ceteris paribus.*

Hypothesis 2 *An increase in Fuel Exports as a fraction of GDP increases Corruption, ceteris paribus.*

Hypothesis 3 *An increase in Metal and Ore Exports as a fraction of GDP decreases Regulatory Quality, ceteris paribus.*

Hypothesis 4 *An increase in Metal and Ore Exports as a fraction of GDP increases Corruption, ceteris paribus.*

Hypothesis 5 *An increase in Total Mineral Exports as a fraction of GDP decreases Regulatory Quality, ceteris paribus.*

Hypothesis 6 *An increase in Total Mineral Exports as a fraction of GDP increases Corruption, ceteris paribus.*

The design of the political institutions in a country clearly affects the quality of the regulatory framework and the level of corruption. In particular, democracies are expected to produce better regulations and less corruption than non-democracies. Also, a broad tax base is associated with higher quality regulations and less corruption because of the accountability it induces.[1] Since the presence of a democracy and a broad tax base are expected to have effects of the same direction, they may be grouped together in joint hypotheses testing the existence of the state channel of influence.

Hypothesis 7 *The* ***STATE*** *factors increase Regulatory Quality, ceteris paribus.*

Hypothesis 8 *The* ***STATE*** *factors decrease Corruption, ceteris paribus.*

[1] The effect of the recruitment methods for bureaucrats is also part of the theoretical framework, yet there are not enough observations at this point to perform a conclusive hypothesis test.

As described in the theoretical framework, high income inequality is associated with a low quality regulatory framework and high corruption:

Hypothesis 9 *An increase in the* ***ECONOMY*** *factor income inequality decreases Regulatory Quality, ceteris paribus.*

Hypothesis 10 *An increase in the* ***ECONOMY*** *factor income inequality increases Corruption, ceteris paribus.*

Does the structure of a society work as a mediating influence on the effects of the size of the natural resource endowment on regulatory quality and corruption? The theoretical framework gives an affirmative answer to this question. The first and major component of the society channel of influence is human capital. Apart from human capital, social capital is also expected to mediate the negative impact of a rich natural resource endowment on regulatory quality and the control of corruption. Unfortunately, the effect of social capital cannot be tested conclusively at present due to a lack of observations. Therefore, the only variables left to consider are the measures for human capital and ethnic fractionalization. Under the assumption that human capital outweighs ethnic fractionalization in determining the levels of the dependent variables, the expected overall effect of the society factors can be summarized by the following hypotheses:

Hypothesis 11 *The* ***SOCIETY*** *factors have a positive impact on Regulatory Quality, ceteris paribus.*

Hypothesis 12 *The* ***SOCIETY*** *factors have a negative impact on Corruption, ceteris paribus.*

The remaining hypotheses examine the effects of the mediating variables individually. First, democracy is expected to lead to 'better' government.

Hypothesis 13 *The presence of a democratic regime leads to an increase in Regulatory Quality, ceteris paribus.*

Hypothesis 14 *The presence of a democratic regime leads to an decrease in Corruption, ceteris paribus.*

The increased government accountability induced by a broad tax base in comparison to a narrow one has been pointed out. In hypothesis form, this becomes:

Hypothesis 15 *An increase in the tax base leads to an increase in Regulatory Quality, ceteris paribus.*

Hypothesis 16 *An increase in the tax base leads to an decrease in Corruption, ceteris paribus.*

Human capital is expected to improve the quality of regulations and reduce corruption:

Hypothesis 17 *An increase in the average person's schooling leads to an increase in Regulatory Quality, ceteris paribus.*

Hypothesis 18 *An increase in the average person's schooling leads to an increase in Corruption, ceteris paribus.*

Finally, a high level of ethnic fractionalization is often readily abused by politicians as a means to treat people unequally and distract from their graft. Even though ethnic fractionalization by itself should not affect the level of corruption or the regulatory framework directly, the final hypotheses still make the following predictions:

Hypothesis 19 *An increase in ethnic fractionalization decreases Regulatory Quality, ceteris paribus.*

Hypothesis 20 *An increase in ethnic fractionalization increases Corruption, ceteris paribus.*

CHAPTER 4

RESEARCH DESIGN

The goal of this thesis is to shed some light on whether a country's natural resource endowment affects the quality of regulation produced by that country's government as well as its level of graft. The theoretical framework applies to countries in the modern international economic system. In order to test the hypotheses from this framework, the research design needs to be able to fulfill at least three criteria. First, the research design needs to allow for inferences to the universe of all countries in the modern international economic system. Second, both the dependent and the independent variables need to vary. Third, the study must be able to refute plausible alternative explanations.

The research design in this thesis is to use a panel study of a large number of countries analyzing publicly available secondary data to test the hypotheses. Given time and budget constraints, this is an optimal choice of research design. If the sample is large enough and the sampling mechanism not correlated with the dependent variables, inferences to the larger universe of countries are justified. Panel studies generally offer two advantages over purely cross-sectional designs: temporal variation can be analyzed and the number of observations is greater. For reasons detailed below, only the second advantage is pertinent to this thesis. Since a large number of countries is included, there is enough variation on the variables to allow for hypothesis tests. The most plausible alternative explanation for a negative correlation between natural resource endowment and corruption is that both are related to the level of economic development of a country. The research design can easily refute this alternative explanation by accounting for the level of economic development in the analysis. The next section describes how the variables in the hypotheses are operationalized.

Operationalization

The indicators chosen to represent the variables discussed in the theoretical framework need to be reliable and valid. Reliability may be assumed since most of the indicators stem from well-known sources and have been used in previous studies. Therefore they can be expected to provide similar results in similar situations. Validity demands correspondence between the variables in the theoretical framework and the empirical indicator. On face, all of the measures employed here do indeed correspond to the variables in the theoretical framework. Where this case is not self-evident, supporting arguments are provided. A short presentation of the indicators for the dependent and explanatory variables follows. It is concluded by summary statistics. More details about some of the variables are provided in Appendix A.

Dependent Variables

The data on both dependent variables, *Regulatory Quality* and *Corruption*, stem from an ongoing effort by World Bank researchers to aggregate various governance indicators in a systematic fashion. These indicators are exclusively based on perceptions rather than on direct and objective measurements because the latter are virtually impossible to obtain.[1]

Currently, the most advanced versions of the aggregate indicators of *Regulatory Quality* and *Corruption* (the ones used in this thesis) were developed by Kaufmann et al. (2003). These aggregate indicators cover four years: 1996, 1998, 2000, and 2002. Kaufmann et al. (2003) used both polls of experts and surveys of business people as sources for their composite indicators. The former are explicitely designed for cross-national comparisons, while the latter arise within the context of one single culture, which makes it problematic to use them

[1]Indirect objective measures of the incidence of corruption could in principle be gathered, but at this point no one has done so for a large cross-section of countries. An example of such an objective measure of corruption would be the variation in procurement prices for homogeneous products, e.g., certain medical supplies (Kaufmann et al. 2003, 20) or office supplies. To collect such data on a global scale would require a very substantial effort. For the time-being, perception data allow for the broadest cross-country coverage.

directly for comparisons across different cultures. Kaufmann, Kraay, and Zoido-Lobatón (1999) discuss this issue as an additional source of uncertainty.[2] Kaufmann et al. (2003) tried to avoid including sources that are based on some other already included source as that would increase the measurement error of their indicators, yet they could not completely rule this potential problem out.[3]

Under the assumption that each source indicator is a function of the latent variable *regulatory quality* or *corruption* and an error term, Kaufmann et al. (2003) use a random-coefficients regression of each of the source indicators on each other, multiplying the right-hand side by an error term. The regression coefficients and the variance of the error term for each source were estimated using the method of maximum likelihood. To aggregate the different sources, the authors then assigned weights to each that are inversely proportionate to the estimated variance of the error term from that source. The indicators then result from adding the weighted sources up. Details about the sources and the weights they received are listed in Appendix A. The two dependent variables used here are based on their measures:

ln(Regulatory Quality) captures responses by experts and businesspeople on the thoroughness of financial sector supervision, the absence or presence of price controls, and the extent to which regulations encourage or impede trade and the development of new businesses. In particular, the individual sources contain information on the extensiveness and effectiveness of banking supervision, the incidence of price controls, government subsidies, export and import regulations and/or restrictions, and how easy or difficult it is to start a company from a legal-administrative point of view (Kaufmann et al. 2003, 94–95). The variable was made strictly positive. Then its natural logarithm was taken to allow for a percentage-point change interpretation in the data analysis.

[2] A possible remedy is proposed by King, Murray, Salomon, and Tandon (2004), yet it will take some time until the use of anchoring vignettes becomes a standard in comparative survey research.

[3] An example would be a paper that is subsequently graded by two professors. If the second professor knew the grade assigned by the first, her judgement might have been influenced and therefore her grade choice would not give much additional information to the inquisitive student about the quality of their paper.

ln(Corruption) is composed of responses by experts and business people to questions about the degree of corruption by public officials in a society (Kaufmann et al. 2003, 97). This variable, too, was made strictly positive and then its natural logarithm was taken to allow for a percentage-point change interpretation in the data analysis.

Explanatory Variables

The indicators for the explanatory variables originate from a number of public sources. First, the three natural resource variables *Fuel Exports as a Fraction of GDP*, *Metal and Ore Exports as a Fraction of GDP*, and *Total Mineral Exports as a Fraction of GDP* are taken from United Nations Conference on Trade and Development (2003). The UNCTAD Handbook of Statistics offers very broad coverage of many countries and their disaggregated export and import structures. Several authors who previously studied aspects of the resource curse already employed similar operationalizations (Sachs and Warner (1995), Ross (2001), and Isham et al. (2003)). The next paragraphs present the definitions of the three natural resource variables.

ln(Fuel Exports as a Fraction of GDP) This variable contains the fuel exports as a proportion of Gross Domestic Product (GDP). Fuel exports are all exports in Section 3 of the Standard International Trade Classification (SITC), Revision 2, i.e., mineral fuels, lubricants, and related materials. Especially important for the purposes of this this thesis is that SITC section 3 includes petroleum oils, crude, and crude oils obtained from bituminous minerals (SITC code 333) and gas, natural and manufactured (SITC code 341). It also includes electric current, SITC code 351 (UNCTAD 2003, 201).[4] The fuels export data are expressed in current U.S. dollars that UNCTAD (2003) converted from the national currencies using the prevailing official exchange rates. Similarly,

[4]This is a possible source of measurement error that may somewhat confound the overall importance of petroleum and gas, as the theoretical framework did not spell out any expected effects of electricity generation.

the GDP data are in current U.S. dollars after UNCTAD (2003) converted them from national currencies. The fuels export data were collected by the United Nations Statistics Division and the GDP were also collected by that division and by the World Bank (UNCTAD 2003, 315). After computing the ratio of fuel exports to GDP, the natural logarithm was taken to avoid the computational problems that would arise from using the original right-skewed variable whose modal values are very small positive fractions.

ln(Metal & Ore Exports as a Fraction of GDP) Exports of metals and ores were defined as exports that fall under SITC subsections 27, 28, or 68. A list of the crude materials and metals that fall under this classification is included in Appendix A. Similar to *ln(Fuel Exports as a Fraction of GDP)*, the natural logarithm was taken of this variable.

ln(Total Mineral Exports as a Fraction of GDP) Again, this variable gives a proportion. The value of exports of fuels and metals and ores, as defined above, in a given year, was divided by the GDP for that country and year. Subsequently the natural logarithm of the variable was taken.

Democracy To achieve very broad cross-country coverage, a dichotomized version of the democracy score from the Polity IV data set is used this thesis. The Polity IV data set is better than its predecessors in that many ambiguities in the coding scheme were removed and high intercoder reliability could be established in three subsequent tests (Marshall and Jaggers 2002, 6–8). The Polity IV democracy score captures institutionalized democracy on three dimensions: whether institutions exist so that citizens can effectively express their political preferences; whether the power of the executive is institutionally constrained; and whether civil liberties are guaranteed. It is an additive eleven-point scale (Marshall and Jaggers 2002, 13–15). Since it cannot be considered an interval-level variable, it was transformed into a simple dummy variable that takes on the value of 1 if the Polity IV democracy score is 7 or greater, and 0 otherwise.

The alternative would have been to use ten dummy variables for all but one of the eleven different levels of the Polity IV democracy scale. This choice would have made interpretation far more difficult without providing much additional information.

Income & Profits Taxes/Current Revenue As a rough approximation of the tax base, the variable *Income, Profits, and Capital Gains Taxes (% of Current Revenue)* was taken from the World Bank's World Development Indicators.

Meritocratic Recruitment ranges from 0, meaning that the recruitment of bureaucrats is not meritocratic at all to 1 (almost completely meritocratic recruitment). The biggest problem with this variable is that it only has observations on 34 mostly developing countries. Details on its source can be found in Appendix A.

ln(Income Inequality) The Gini coefficient is the most common measure of income inequality. This variable was taken from the World Development Indicators. The natural logarithm was taken of this variable to allow for a more intuitive percentage-point change interpretation in the data analysis.

ln(Average Years of Schooling of a 25-Year-Old) As an indicator of human capital, the variable *Average Years of Schooling of a 25-Year-Old* in 1995 from Barro and Lee's (2000) data set was chosen. This ratio-level variable is preferable to one where people are only grouped in strata, such as less than primary, primary, secondary, and tertiary education, because the average number of years a young adult has spent in formal schooling is more informative about the level of training people receive in a society. It would be desirable to also include a measure on the average quality of training in addition to its average length, yet this is left for further research. To allow for a percentage-point change interpretation, the natural logarithm was taken of this variable.

Interpersonal Trust The indicator for social capital stems from the third wave of the World

Values Survey (1995–1997). The proportion of respondents answering "Most people can be trusted" to the question, "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?" was chosen as a proxy for the level of interpersonal trust in a country. It is an extremly rough measure and probably suffers from a lack of direct comparability across cultures, as discussed by King et al. (2004). Unfortunately, values on this variable are only available for 45 of the countries where observations exist on the dependent variables of this thesis. The variable can range from zero to one, with higher values indicating more expressed interpersonal trust.

Ethnic Fractionalization[5] The index of ethnic fractionalization was taken from Yeoh (2001). This study is a major improvement over the still commonly used but outdated index of ethnic fractionalization by Taylor and Hudson (1972) that is mainly based on data from a Soviet atlas from the 1960s. *Ethnic Fractionalization* theoretically ranges from 0 for a completely homogeneous country to 1 for a completely fractionalized country.

The Data Set and the Estimation Sample

Table 1 gives an overview over the main variables in the data set that were compiled for this investigation.

While this data set is far from the ideal one, which would be a panel of most countries in the world observed for several decades, it nevertheless allows for testing the hypotheses spelt out in the last chapter. This is certainly done in a crude fashion, yet it serves as a useful collection of variables that are not often studied together. The next chapter describes the specifications of the models that were estimated, the results, some diagnostics, and conclusions from the hypothesis tests.

	Countries	Obs.	Mean	Std. Dev.	Min.	Max.
Dependent Variables						
ln(Regulatory Quality)	170–177	687	2.31	0.09	1.95	2.51
	(58)	*(133)*	*(2.36)*	*(0.07)*	*(2.13)*	*(2.51)*
ln(Corruption)	142–177	657	2.29	0.10	2.00	2.46
	(58)	*(133)*	*(2.25)*	*(0.12)*	*(2.00)*	*(2.40)*
Nat. Resource Vars.						
Fuel Exports/GDP‡§	89–125	1092	0.05	0.10	≈ 0	0.65
	(57)	*(130)*	*(0.03)*	*(0.06)*	*($\approx$ 0)*	*(0.40)*
Metal & Ore Exp./GDP‡§	93–134	1178	0.02	0.05	≈ 0	0.84
	(58)	*(133)*	*(0.02)*	*(0.03)*	*($\approx$ 0)*	*(0.29)*
Mineral Exports/GDP‡§	88–124	1086	0.07	0.12	≈ 0	0.85
	(57)	*(130)*	*(.044)*	*(0.07)*	*($\approx$ 0)*	*(0.41)*
STATE Variables						
Democracy (binary)	144–146	1553	0.48	0.50	0	1
	(58)	*(133)*	*(0.74)*	*(0.44)*	*(0)*	*(1)*
(Income & Profits Taxes/	59–106	946	0.23	0.14	0	0.80
Current Revenue)	*(58)*	*(133)*	*(0.28)*	*(0.15)*	*(0.07)*	*(0.80)*
Meritocratic Recruitment†	34	11×34	0.59	0.24	0.04	1
	– not used for estimation due to lack of observations –					
ECONOMY Variable						
Income Inequality (Gini)†§	116	11×116	40.79	10.13	24.40	70.60
	(58)	*(133)*	*(40.59)*	*(9.34)*	*(24.40)*	*(60.80)*
SOCIETY Variables						
Avg. Years of Schooling†§	101	11×101	5.84	2.88	0.69	12.18
	(58)	*(133)*	*(6.65)*	*(2.81)*	*(1.53)*	*(12.18)*
Ethnic Fractionalization†	176	11×176	0.45	0.26	≈ 0	0.88
	(58)	*(133)*	*(0.41)*	*(0.26)*	*($\approx$ 0)*	*(0.88)*
Interpersonal Trust†	45	11×45	0.25	0.13	0.03	0.65
	– not used for estimation due to lack of observations –					
Control Variable						
GDP per Head in US$†‡§	173–175	1737	6238	9132	63	45643
	(58)	*(133)*	*(9498)*	*(11303)*	*(210)*	*(41416)*

Table 1: Summary statistics for the variables of interest. In total there are 177×11 = 1947 observations in the data set. *Summary statistics for the estimation sample are listed italicized in parentheses.* †) Variable is constant across time. ‡) No observations for 2002. §) Values in original scale (for the analysis, the natural logarithm of the variable is used).

CHAPTER 5
HYPOTHESIS TESTING

Predictions from a theory should adequately be mapped onto the empirical models used to estimate parameters from that theory. After all, theories can only be tested with empirical models that represent the theorized relationships. In political science, theoretical statements usually involve a variety of intervening variables. Especially institutional arguments inherently contain intervening variables that *interact* with the exogenous influences on the political system. Unfortunately, many researchers still only resort to linear-additive models in their attempts to test such theories (Kam and Franzese 2003, 9). It goes without saying that these researchers are not *testing* their theories because their empirical models are misspecified.

The theoretical framework drawn up in this thesis contains several intervening variables. The empirical models are therefore specified as interactive panel data regression models. Panel models take both cross-sectional and temporal variation into account. The general specification of the models is:

$$\begin{aligned} Dependent\ Variable_{it} \quad = \quad & \beta_1 + \beta_2\, Resource\ Exp._{it} \\ & + \beta_3\, Democracy_{it} + \beta_4\, [Democracy \times Resource\ Exp.]_{it} \\ & + \beta_5\, Taxes_{it} + \beta_6\, [Taxes \times Resource\ Exp.]_{it} \\ & + \beta_7\, ln(Gini)_{it} + \beta_8\, [ln(Gini) \times Resource\ Exp.]_{it} \\ & + \beta_9\, ln(Schooling)_{it} + \beta_{10}\, [ln(Schooling) \times Resource\ Exp.]_{it} \\ & + \beta_{11}\, Ethnic\ Fract._{it} + \beta_{12}\, [Ethnic\ Fract. \times Resource\ Exp.]_{it} \\ & + \beta_{13}\, ln(GDP\ per\ Capita) + \epsilon_{it} \end{aligned}$$

There are two dependent variables, *ln(Regulatory Quality)* and *ln(Corruption)*. For each dependent variable, the same three regressions are estimated. The first regression interacts

oil and gas exports as a share of GDP with the intervening variables listed above. The second regression interacts metal and ore exports with the same intervening variables. Finally, the third regression interacts all mineral exports (oil and gas exports and metal and ore exports combined) as a share of GDP with the intervening variables. In total, six regressions are estimated:

- **Oil and Gas/Regulatory Quality Model**: *ln(Regulatory Quality)* is regressed on *ln(Fuel Exports as a Fraction of GDP)* and the other variables listed above in the general model specification
- **Metals and Ores/Regulatory Quality Model**: *ln(Regulatory Quality)* is regressed on *ln(Metal & Ore Exports as a Fraction of GDP)* and the other variables listed above in the general model specification
- **Combined Minerals/Regulatory Quality Model**: *ln(Regulatory Quality)* is regressed on *ln(Mineral Exports as a Fraction of GDP)* and the other variables listed above in the general model specification
- **Oil and Gas/Corruption Model**: *ln(Corruption)* is regressed on *ln(Fuel Exports as a Fraction of GDP)* and the other variables listed above in the general model specification
- **Metals and Ores/Corruption Model**: *ln(Corruption)* is regressed on *ln(Metal & Ore Exports as a Fraction of GDP)* and the other variables listed above in the general model specification
- **Combined Minerals/Corruption Model**: *ln(Corruption)* is regressed on *ln(Mineral Exports as a Fraction of GDP)* and the other variables listed above in the general model specification

These models are random effects models, which assume that the country-specific errors are uncorrelated with the explanatory variables. Random effects models are better in this context than fixed effects models because the latter would include a dummy variable for each country, which would take away a large number of degrees of freedom where there are not that many available. Also, fixed effects does not allow one to estimate the effects of time-invariant explanatory variables and there are several in the present models. It would simply group these variables with the error term. It is assumed that there is no autocorrelation. Earlier test runs with a different estimation method (OLS with panel-corrected standard

errors[1]) included a test for autocorrelation, and no evidence of this problem was found.

To see whether the assumption that country-specific errors and the explanatory variables are indeed uncorrelated and therefore the random-effects model appropriate, a Hausman specification test was conducted after each model estimation. The test statistic is *asymptotically* chi-square distributed. Small-sample properties of the test statistic are largely unknown. Thus even though the calculated test statistic was larger than conventional critical values in the *Metals and Ores/Regulatory Quality Model*, the *Oil and Gas/Corruption Model*, and the *Combined Minerals/Corruption Model*, their specifications may still be appropriate. Since the interpretation below focuses on the *Metals and Ores/Corruption Model* where the random effects assumption does seem appropriate according to the small calculated Hausman test statistic, the rejections of the null hypothesis for three of the models do not lead to major problems for the analysis.

Strong multicollinearity, and in some cases even severe multicollinearity is present in these data, as tends to be the case when models with many interaction terms are estimated. With multicollinearity, individual effects may become difficult to estimate (Franzese 2003, 460–461) and since standard errors are large due to the lack of information, it becomes more difficult to reject null hypotheses about the impacts of explanatory variables. Correlation matrices of the variables in each model are provided at the end of Appendix C.

Tables 2 and 3 present the results of testing the hypotheses in the six models. The complete estimation results are only listed in Appendix C because in interactive models, the individual coefficient estimates are not informative about the impacts of explanatory variables. These tests are Wald tests of joint hypotheses.[2] The first striking finding is that there appears to be no effect of natural resource endowment on regulatory quality.

[1]One reason that this estimation method was not used is that it was computationally not possible for some models.

[2]This is a practical approach, although it is not ideal since the alternative hypotheses do not necessarily resemble the hypothesis under investigation. If there are m restrictions in a null hypothesis, there are 2^{m-1} alternative hypotheses, all of which mean something substantively different.

Dependent Variable: ln(Regulatory Quality)				
			Model	
	Variable(s)	*Oil & Gas*	*Metals & Ores*	*All Minerals*
$\mathbf{H_1}$	ln(Fuel Exports/GDP)	0.176		
$\mathbf{H_3}$	ln(Metal & Ore Exports/GDP)		0.422	
$\mathbf{H_5}$	ln(Mineral Exports/GDP)			0.301
$\mathbf{H_7}$	Democracy *and* Taxes	0.595	0.592	0.628
$\mathbf{H_9}$	ln(Gini Index)	0.686	0.554	0.966
$\mathbf{H_{11}}$	Schooling *and* Ethnic Fract.	**0.097**	0.199	0.157
$\mathbf{H_{13}}$	Democracy	0.347	0.297	0.441
$\mathbf{H_{15}}$	Taxes	0.684	0.843	0.604
$\mathbf{H_{17}}$	ln(Average Years of Schooling)	0.267	**0.061**	0.128
$\mathbf{H_{19}}$	Ethnic Fractionalization	0.298	0.660	0.897

Table 2: Hypothesis tests: p-values from Wald tests for the models explaining *ln(Regulatory Quality)*.

Dependent Variable: ln(Corruption)				
			Model	
	Variable(s)	*Oil & Gas*	*Metals & Ores*	*All Minerals*
$\mathbf{H_2}$	ln(Fuel Exports/GDP)	0.690		
$\mathbf{H_4}$	ln(Metal & Ore Exports/GDP)		**0.021**	
$\mathbf{H_6}$	ln(Mineral Exports/GDP)			0.619
$\mathbf{H_8}$	Democracy *and* Taxes	0.546	0.413	0.714
$\mathbf{H_{10}}$	ln(Gini Index)	**0.079**	**0.028**	**0.053**
$\mathbf{H_{12}}$	Schooling *and* Ethnic Fract.	0.336	**0.036**	0.227
$\mathbf{H_{14}}$	Democracy	0.548	0.663	0.704
$\mathbf{H_{16}}$	Taxes	0.353	0.152	0.474
$\mathbf{H_{18}}$	ln(Average Years of Schooling)	0.289	**0.041**	0.134
$\mathbf{H_{20}}$	Ethnic Fractionalization	0.560	0.927	0.891

Table 3: Hypothesis tests: p-values from Wald tests for the models explaining *ln(Corruption)*.

In fact, *only* in the *Metals and Ores/Corruption Model* can the resource curse be seen at work. Mother Nature may have some corrupting influence after all. However, only for certain metals is the effect strong enough to shine through the fog of multicollinearity. At the least, this finding warrants an evaluation of the actual estimated impact of a small change in the export share of metals and ores on the occurence of corruption in government and

public administration. Of course, this impact cannot be read directly from the regression table because the variable is interacting with the intervening variables. The only way to find the estimated marginal effect of *ln(Metal & Ore Exports/GDP)* is to take the derivative of the dependent variable *ln(Corruption)* with respect to *ln(Metal & Ore Exports/GDP)*:

$$\begin{aligned}\frac{\partial\,(ln(\widehat{Corruption})_{it}|\,\mathbf{X})}{\partial\, ln(Metal\ \&\ Ore\ Exports)_{it}} \;=\; \hat{\beta}_2 \;&+\; \hat{\beta}_8 \times Democracy_{it} \;+\; \hat{\beta}_9 \times Taxes_{it} \\ &+\; \hat{\beta}_{10} \times ln(Gini\ Index)_{it} \;+\; \hat{\beta}_{11} \times ln(Schooling)_{it} \\ &+\; \hat{\beta}_{12} \times Ethnic\ Fractionalization_{it}\end{aligned}$$

This exercise shows that the estimated marginal effect of *ln(Metal & Ore Exports/GDP)* depends on the values of the other explanatory variables that interact with it. This idea is still widely underappreciated in political science (Kam and Franzese 2003, 6–9). To illustrate how the estimated marginal effect of *ln(Metal & Ore Exports/GDP)* varies across different groups of countries, it is evaluated for sixteen different scenarios: democracies and non-democracies, states with a relatively broad tax base and those with a relatively narrow one, countries with high and low income inequality, countries with a relatively well-educated populace and those without, and all combinations thereof. Democracy is a dummy variable, so it takes on a value of one if the country is classified as a democracy and a value of zero otherwise. Relatively broad tax base denotes the mean value of the variable *Taxes* in the estimation sample plus one standard deviation. Relatively narrow tax base indicates the mean value minus one standard deviation. High income inequality stands for the mean of *ln(Gini)* within the estimation sample plus one standard deviation and low income inequality denotes the mean minus one standard deviation. Similarly, relatively high education indicates the estimation sample mean of *ln(Schoooling)* plus one standard deviation and relatively low education the variable mean less one standard deviation. *Ethnic Fractionalization* is held at its mean value.

The estimated variances of the marginal effect were computed as follows (Kam and Franzese 2003, 23):

$$\widehat{var}\left(\frac{\partial\,(ln(\widehat{Corruption})_{it}|\,\mathbf{X})}{\partial\,ln(Metal\ \&\ Ore\ Exports)_{it}}\right) \;=\; \mathbf{z}'\,\widehat{V}(\hat{\beta}_{\mathbf{z}})\,\mathbf{z}.$$

$\mathbf{z}$ is a (6×1) vector whose first element is one and whose second to sixth elements are the five variables on the right-hand side of the first derivative that is shown above. Of course, to get a numerical estimate of the variance, these variables need to be evaluated the same way the marginal effect itself was evaluated earlier: different values of the explanatory variables have to be plugged in. $\widehat{V}(\hat{\beta}_{\mathbf{z}})$ is the (6×6) estimated variance-covariance matrix of the vector of estimated coefficients $\hat{\beta}_{\mathbf{z}}$ that contribute to the marginal effect of *ln(Metal & Ore Exports/GDP)* that is derived above.

Table 4 contains the estimated marginal effects and associated standard errors.

		Democracies		Non-Democracies	
		Rel. Broad Tax Base	Rel. Narrow Tax Base	Rel. Broad Tax Base	Rel. Narrow Tax Base
Rel. High Education	Rel. High Gini	-0.034 *(0.009)*	-0.020 *(0.009)*	-0.040 *(0.012)*	-0.026 *(0.011)*
	Rel. Low Gini	-0.019 *(0.011)*	-0.004 *(0.012)*	-0.024 *(0.013)*	-0.010 *(0.013)*
Rel. Low Education	Rel. High Gini	-0.014 *(0.009)*	≈ 0 *(0.008)*	-0.020 *(0.011)*	-0.006 *(0.009)*
	Rel. Low Gini	0.001 *(0.010)*	0.016 *(0.011)*	-0.004 *(0.011)*	0.010 *(0.010)*

Table 4: Estimated marginal effect of *ln(Metal & Ore Exports/GDP)* on *ln(Corruption)* for different values of the other explanatory variables. Figures in parentheses are estimated standard errors.

These results are striking because an increase in the exports of metals and ores only leads to an increase in corruption in three out of sixteen possible scenarios. The crucial variable is education because if it is relatively high, metals and ores do not show any corrupting influence. On the contrary, in countries like the United States (democracies with a broad

tax base, high levels of education, and a comparatively high level of income inequality) a one-percentage point increase in the export share of metals and ores in GDP is associated with a third of a percentage point *decrease* in corruption. Of course, for countries like the United States metal and ore exports play a very minor role in their economies.

What are the characteristics of the countries where increases in metal and ore exports actually *are* associated with increases in the level of corruption? First of all, the three scenarios all have in common that there are relatively low levels of education in the population, which is in accordance with the prediction from the theoretical framework that education tends to lessen corruption. The other commonality of the the three scenarios is that they all have relatively low income inequality, which is the opposite of what the theoretical framework states. This calls for an explanation. If these figures are somewhat reflective of the truth, i.e., the numbers truly are unbiased estimates of a correctly specified model, then low instead of high income inequality increases graft in conjunction with metal and ore exports. Looking at Table 4, *ceteris paribus* an increase in metal and ore exports always means less corruption when inequality is high compared to when it is low. Of course, this is only discussing the marginal impact of *ln(Metal & Ore Exports/GDP)* and there are few resource-extracting economies with low levels of income inequality, yet the finding remains puzzling and begs an explanation.

The regime type of a country does not seem to be decisive in determining whether mineral and ore exports are associated with corruption, as this effect can be seen both in democracies and non-democracies.

Also interesting, and in accordance with the predictions, is the beneficial effect of a broad tax base. If one compares otherwise identical countries that differ only on the breadth of their tax base, in all eight possible comparisons the marginal effect of *ln(Metal & Ore Exports/GDP)* on corruption is going to be more beneficial or, at least, less harmful: the increase in corruption is smaller if the tax base is broader, all else equal. This finding neatly

supports the idea that a broad tax base creates more accountability of the government and the bureaucracy.

CHAPTER 6

CONCLUSION

How and When Does Nature Corrupt?

In conclusion, with the more political and institutional approach used in this thesis and the resulting specification, Leite and Weidmann's (1999) finding about the generally corrupting influence of natural resource could not be replicated. Instead, whether nature corrupts or not crucially depends on the institutions a country has. Especially a broad tax base and high levels of education appear to serve as inoculations for countries against the side-effects of being blessed with rich mineral deposits.

Caveats

The results of this research project are preliminary and beg further study for a number of reasons. First, the data would benefit from augmentation. Many observations were lost due to listwise deletion of cases by the estimation software when only one or two of the explanatory variables in the regression model had a missing value for a country in a year. It is unclear how much this problem has affected the results. Until this question can be answered, one is left with some odd, unexpected findings.

Suggestions for Future Research

First and foremost, data coverage needs to be extended in future research in both time and space. Initially, the analysis done here will be replicated with an augmented data set, where some of the missing values on key explanatory variables are multiply imputed. The main purpose of this exercise will be to check the robustness of the unexpected findings from the data analysis done for this thesis. The next step will be to actually extend the data set

with new empirical observations. For the most part this will mean tapping new data source to cover more countries.

Going further, an expansion of the temporal dimension would certainly be welcome so that the dynamics of regulatory quality and corruption could be analyzed. Due to a lack of reliable cross-national data on these variables prior to the 1990's, at best this will be possible only for some subsets of countries and it will involve substantial coding efforts. The macrocomparative nature of the research in this thesis does not allow for a test of the mechanisms that are alleged to lead to corruption *within* a country, for instance. The only way to do so would be to examine various actors inside a country, and to do so for a sufficiently large number of countries to have variation on the dependent and independent variables. The data collection effort would be very substantial.

The theoretical framework would benefit from expansion and formalization. It especially needs to contain more detail on the incentives for and constraints of individual actors such as government leaders. Formalization would allow for stringent checks on logical consistency.

Policy Implications

While truly informed policy recommendation have to await checks for the robustness of the findings in this thesis, it could be seen that education positively mediates whatever effects resource export dependence does have. Investments in education and campaigns to spread literacy have once again shown beneficial effects. Also, accountability of government and bureaucracy seem to be enhanced if governments can be prevented from relying on a narrow tax base only. The disaffected average citizens of Mineralia and Petrolia may only mildly smile at these recommendations. Their incentives to improve their education are mixed at best and their governments are unlikely to voluntarily allow more public scrutiny. Short of the exhaustion of the high-rent natural resources, citizens will need to resort to collective action if they want their governments to produce better regulation and be less corrupt.

APPENDIX A

DETAILS OF OPERATIONALIZATION

Some of the operational choices made in this thesis require further elaboration. To that end, additional information about origin and coding of some variables is provided here.

Table 5 shows the original indicators of regulatory quality and corruption that Kaufmann et al. (2003) used to compute their composite measures. They assigned weights to each individual source indicator that are inversely proportionate to the estimated variance of the error term from that source. The composite measures then result from adding the weighted source indicators up.

Regulatory Quality

Kaufmann et al.'s (2003) variable is standardized, so that in every time period (1996, 1998, 2000, and 2002) it has a mean of approximately zero and a standard deviation of approximately one, and is approximately normally distributed. It ranges from -3 to 2.27. A higher value indicates a higher quality of regulations. Since the average *Regulatory Quality* is the same (zero) in each year that is covered, one cannot make conclusions about whether the quality of regulation in the world as a whole changes (Kaufmann et al. 2003, 11).

Since the values of this variable have no intuitive interpretation, the natural logarithm was taken to allow for a percentage-point change interpretation in the data analysis. To do so, first ten was added to all values, then the natural logarithm was taken. The variable remains approximately normally distributed after this transformation. Henceforth this variable is therefore referred to as *ln(Regulatory Quality)*.

Corruption

The variable that Kaufmann et al. (2003) actually constructed is known as *Control of Corruption*. This variable is approximately normally distributed with a mean of zero and a standard deviation of one in each of the four years covered (1996, 1998, 2000, and 2002). It ranges from -1.7 to 2.58. The higher the value, the lower the level of corruption in a

Name of Source	Countries	Weight for *Regulatory Quality*	Weight for *Control of Corruption*
Afrobarometer Survey	12	0	0 – 0.02
BERI Business Risk Service	50	0	0 – 0.03
BERI Qualitative Risk Meas. in Foreign Lending	115	0	0 – 0.11
Columbia University State Capacity Project	98	0	0 – 0.08
Economist Intelligence Unit	115	0 – 0.23	0.07 – 0.24
EBRD Transition Report	26	0.07 – 0.23	0
Freedom House Nations in Transition	27	0	0 – 0.23
Gallup Millenium Survey	60	0	0 – 0.04
Heritage/Wall Street Journal Economic Freedom Index	161	0.05 – 0.1	0
World Competitiveness Yearbook	49	0.1 – 0.21	0.07 – 0.36
Latinobarometro Surveys	17	0	0 – 0.06
PRS Int. Country Risk Guide	140	0.03 – 0.09	0.01 – 0.05
DRI Country Risk Review	111	0.03 – 0.23	0.05 – 0.09
World Bank Business Enterprise Environmt. Survey	18	0	0 – 0.08
World Bank World Business Environment Survey	81	0 – 0.01	0 – 0.07
World Bank Country Policy and Institutional Assessments	136	0.07 – 0.21	0 – 0.11
WEF Global Competitiveness	75	0.04 – 0.19	0.06 – 0.12
WEF Africa Competitiveness	23	0 – 0.15	0 – 0.17
World Markets Online	186	0 – 0.26	0 – 0.09

Table 5: Sources for the composite indicators *Regulatory Quality* and *Control of Corruption*. The weights were applied to a country appearing in all of the sources for that dependent variable. For countries with a lower number of available sources, the weights were applied relatively to all available sources (Kaufmann et al. 2003, 43).

country. In other words, the higher the value of this variable, the better corruption is kept under control in a society. To allow for a more intuitive interpretation (corruption instead of control of corruption), all values of the variable were multiplied by (-1), then ten was added to them, and finally the natural logarithm was taken. In the analysis, this variable consequently shows up as *ln(Corruption)*.

ln(Fuel Exports/GDP)

The variable *Fuel Exports/GDP* was computed as follows:

$$Fuel\ Exports/GDP \quad = \quad \frac{SITC\ Section\ 3\ exports\ (dollars)}{GDP\ (dollars)}\ ,$$

which yields a number greater than zero and less than one for each country-year for which data were available.

Metal & Ore Exports/GDP

The variable was computed in the same way as *Fuel Exports/GDP*:

$$Metal\ and\ Ore\ Exports/GDP \quad = \quad \frac{SITC\ Subsection\ 27+28+68\ exports\ (dollars)}{GDP\ (dollars)}$$

Table 6 contains a list of the crude materials and metals that are included in this explanatory variable (UNCTAD 2003, 200 and 203).

Meritocratic Recruitment

Rauch and Evans's (2000) study of the structure of the bureaucracy in developing countries serves as the source of an indicator of the way bureaucrats are recruited in various

SITC code	Product
271	Crude fertilizers
273	Stone, sand, and gravel
274	Sulphur and unroasted iron pyrites
277	Natural abrasives (including industrial diamonds)
278	Other crude minerals
281	Iron ore and concentrates
282	Waste and scrap metal of iron or steel
286	Ores and concentrates of uranium and thorium
287	Ores and concentrates of base metals
288	Non-ferrous base metal waste and scrap
289	Ores and concentrates of precious metals; waste and scrap
681	Silver, platinum, and other metals of the platinum group;
682	Copper
683	Nickel
684	Aluminium
685	Lead
686	Zinc
687	Tin
688	Uranium depleted in U235, thorium and alloys
689	Miscellaneous non-ferrous base metals, metallurgy

Table 6: SITC subcategories of materials and metals included in *ln(Metal & Ore Exports/GDP)*.

countries. The authors sent questionnaires to country experts asking them to evaluate various aspects of the bureaucracy in their nation of expertise. Two of the questions dealt with the degree of meritocracy in recruiting bureaucrats:

Question 4 Approximately what proportion of the higher officials in these agencies enter the civil service via a formal examination system?

Codes: 1=less than 30%, 2=30-60%, 3=60-90%, 4= more than 90%

Question 5 Of those that do *not* enter via examinations, what proportion have university or postgraduate degrees?

Codes: 1=less than 30%, 2=30-60%, 3=60-90%, 4= more than 90%

The variable *Meritocratic Recruitment* was then computed in the following way (Rauch and Evans 2000, 54–56):

$$Meritocratic\ Recruitment \quad = \quad \frac{\left[\frac{(Question\ 4)-1}{3} + \frac{(Question\ 5)-1}{3}\right]}{2}$$

APPENDIX B

ESTIMATION SAMPLE COUNTRIES

Table 7 presents the countries in the estimation sample. are the country-years in the estimation sample. They are sorted from the highest metal and ore export share (*Metal and Ore Exports/GDP*) to the lowest.

1.	Papua New Guinea (1998)	30.	Mexico (1996, 1998, 2000)
2.	Jamaica (1996, 1998, 2000)	31.	United Kingdom (1996, 1998)
3.	Chile (1996, 1998, 2000)	32.	Thailand (1996, 1998, 2000)
4.	Bolivia (1996, 1998, 2000)	33.	Tunisia (1996, 1998, 2000)
5.	Peru (1996, 1998)	34.	France (1996)
6.	Jordan (1998, 2000)	35.	People's Republic of China (1996, 1998)
7.	Australia (1996, 1998)	36.	Turkey (1996, 1998, 2000)
8.	Zimbabwe (1996)	37.	Egypt (1996)
9.	Norway (1996, 1998)	38.	Israel (1996, 1998, 2000)
10.	South Africa (2000)	39.	Portugal (1996, 1998)
11.	Canada (1996, 1998, 2000)	40.	Costa Rica (1996, 1998, 2000)
12.	Singapore (1996, 1998, 2000)	41.	Swaziland (2000)
13.	Indonesia (1996, 1998)	42.	Denmark (1996, 1998, 2000)
14.	Hungary (1996, 1998, 2000)	43.	Italy (1996, 1998)
15.	Netherlands (1996)	44.	India (1996, 1998, 2000)
16.	Switzerland (1996, 1998, 2000)	45.	El Salvador (1998, 2000)
17.	Venezuela (1996, 1998, 2000)	46.	South Korea (1996)
18.	New Zealand (1996, 1998, 2000)	47.	Uganda (1998, 2000)
19.	Poland (1996, 1998, 2000)	48.	Nicaragua (1996, 1998, 2000)
20.	Finland (1996, 1998)	49.	U.S.A. (1996, 1998, 2000)
21.	Malaysia (1996)	50.	Algeria (1996, 1998, 2000)
22.	Senegal (1996, 1998, 2000)	51.	Panama (1996, 1998, 2000)
23.	Sweden (1996, 1998)	52.	Iran (1998, 2000)
24.	Philippines (1996, 1998, 2000)	53.	Uruguay (1996, 1998, 2000)
25.	Austria (1996, 1998)	54.	Colombia (1996, 1998)
26.	Greece (1996, 1998)	55.	Paraguay (1996, 1998, 2000)
27.	Brazil (1998)	56.	Dominican Republic (1996)
28.	Germany (1996, 1998)	57.	Pakistan (1996, 1998, 2000)
29.	Kenya (1996, 1998)	58.	Nepal (1996, 1998, 2000)

Table 7: The estimation sample of the metal and ore models, ordered from the highest metal and ore export share to the lowest.

APPENDIX C

ESTIMATION RESULTS AND CORRELATION MATRICES

This appendix presents the full results from the estimation of all six different models. Table 8 shows the results of regressing regulatory quality on the oil and gas variable (*Oil and Gas/Regulatory Quality Model*), the metals and ores variable (*Metals and Ores/Regulatory Quality Model*), and the combined minerals variable that encompasses both oil and gas and metals and ores (*Combined Minerals/Regulatory Quality Model*). Similarly, Table 9 lists the results from estimating the same models for corruption as the dependent variable. Please be aware that in all these models the coefficient estimates by themselves are not informative about the impact of the interacting explanatory variables. In addition, this appendix contains correlation matrices of the explanatory variables in these three specifications: Table 11 for the oil and gas models, Table 12 for the metals and ores models, and Table 13 for the combined minerals models. Of course, the correlation matrices were computed for the estimation sample only. The abbreviations of the variable names used in Tables 11–13 are explained in Table 10.

Dependent Variable: *ln(Regulatory Quality)*			
	Model		
	Oil & Gas	*Metals & Ores*	*All Minerals*
ln(Fuel Exports/GDP)	-0.046		
	(-0.81)		
ln(Metal & Ore Exports/GDP)		0.047	
		(0.67)	
ln(Mineral Exports/GDP)			-0.033
			(-0.43)
Democracy	0.035	0.005	0.031
	(1.44)	(0.15)	(1.17)
Income & Profits Taxes/Curr. Revenue	-0.033	-0.063	-0.052
	(-0.46)	(-0.55)	(-0.67)
ln(Gini Index)	0.061	-0.103	0.019
	(0.86)	(-1.02)	(0.22)
ln(Average Years of Schooling)	0.065	0.109	0.088
	(1.49)	(2.36)	(1.99)
Ethnic Fractionalization	-0.090	0.111	-0.025
	(-1.32)	(0.91)	(-0.29)
ln(...†Exports/GDP)×Democracy	0.006	-0.002	0.005
	(1.38)	(-0.29)	(0.85)
ln(...†Exports/GDP)×Taxes	-0.013	-0.010	-0.021
	(-0.78)	(-0.45)	(-0.95)
ln(...†Exports/GDP)×ln(Gini)	0.011	-0.020	0.003
	(0.82)	(-1.08)	(0.16)
ln(...†Exports/GDP)×ln(Schooling)	0.007	0.017	0.015
	(0.92)	(2.12)	(1.48)
ln(...†Exports/GDP)×Ethnic Fract.	-0.020	0.020	-0.008
	(-1.54)	(0.88)	(-0.40)
ln(GDP per Capita)	0.027	0.029	0.027
	(3.47)	(3.80)	(3.35)
Constant	1.804	2.306	1.909
	(5.93)	(6.06)	(5.76)
N [Number of countries in brackets]	130 [57]	133 [58]	130 [57]
Wald test χ^2_{12}	94.90	101.76	94.79
p-value	<0.001	<0.001	<0.001
"$R^2_{overall}$"	0.633	0.625	0.634
$\hat{\sigma}_u$ [$\hat{\sigma}_e$ in brackets]	0.041 [0.021]	0.038 [0.021]	0.040 [0.022]
Intraclass correlation coefficient	0.788	0.757	0.777
Hausman test χ^2_9	13.17	**33.20**	11.86
p-value	0.155	**<0.001**	0.221

Table 8: GLS random effects estimation results. z-statistics are listed in parentheses. †) The interactions are with the natural resource group shown in the relevant column heading.

Dependent Variable: *ln(Corruption)*			
	Model		
	Oil & Gas	*Metals & Ores*	*All Minerals*
ln(Fuel Exports/GDP)	0.017		
	(0.24)		
ln(Metal & Ore Exports/GDP)		0.155	
		(1.84)	
ln(Mineral Exports/GDP)			0.123
			(1.27)
Democracy	0.017	0.037	0.013
	(0.55)	(0.90)	(0.40)
Income & Profits Taxes/Curr. Revenue	0.017	-0.265	-0.016
	(0.19)	(-1.93)	(-0.17)
ln(Gini Index)	0.051	-0.100	-0.044
	(0.58)	(-0.83)	(-0.43)
ln(Average Years of Schooling)	-0.056	-0.139	-0.098
	(-1.03)	(-2.52)	(-1.76)
Ethnic Fractionalization	0.066	0.056	0.051
	(0.78)	(0.39)	(0.47)
ln(...†Exports/GDP)×Democracy	≈0	0.006	0.001
	(0.08)	(0.90)	(0.07)
ln(...†Exports/GDP)×Taxes	0.019	-0.047	0.013
	(0.94)	(-1.77)	(0.47)
ln(...†Exports/GDP)×ln(Gini)	-0.006	-0.034	-0.030
	(-0.39)	(-1.52)	(-1.27)
ln(...†Exports/GDP)×ln(Schooling)	-0.002	-0.020	-0.012
	(-0.23)	(-2.11)	(-0.98)
ln(...†Exports/GDP)×Ethnic Fract.	0.017	0.010	0.012
	(1.02)	(0.37)	(0.48)
ln(GDP per Capita)	-0.054	-0.057	-0.052
	(-5.52)	(-6.28)	(-5.23)
Constant	2.571	3.306	2.985
	(6.79)	(7.26)	(7.21)
N [Number of countries in brackets]	130 [57]	133 [58]	130 [57]
Wald test χ^2_{12}	210.01	263.44	212.74
p-value	<0.001	<0.001	<0.001
"$R^2_{overall}$"	0.796	0.823	0.800
$\hat{\sigma}_u$ [$\hat{\sigma}_e$ in brackets]	0.051 [0.025]	0.048 [0.026]	0.051 [0.025]
Intraclass correlation coefficient	0.805	0.769	0.803
Hausman test χ^2_9	**17.40**	7.65	**19.54**
p-value	**0.043**	0.570	**0.021**

Table 9: GLS random effects estimation results. z-statistics are listed in parentheses. †) The interactions are with the natural resource group shown in the relevant column heading.

Abbreviation	Independent Variable
$\mathbf{X_2}$	*ln(Resource‡Exports/GDP)*
$\mathbf{X_3}$	*Democracy*
$\mathbf{X_4}$	*Income & Profits Taxes/Current Revenue*
$\mathbf{X_5}$	*ln(Gini Index)*
$\mathbf{X_6}$	*ln(Average Years of Schooling)*
$\mathbf{X_7}$	*Ethnic Fractionalization*
$\mathbf{X_8}$	*ln(Resource‡Exports/GDP)×Democracy*
$\mathbf{X_9}$	*ln(Resource‡Exports/GDP)×Taxes*
$\mathbf{X_{10}}$	*ln(Resource‡Exports/GDP)×ln(Gini)*
$\mathbf{X_{11}}$	*ln(Resource‡Exports/GDP)×ln(Schooling)*
$\mathbf{X_{12}}$	*ln(Resource‡Exports/GDP)×Ethnic Fractionalization*
$\mathbf{X_{13}}$	*ln(GDP per Capita)*
C	*Constant*

Table 10: Legend for Tables 11–13. ‡) *Resource* denotes oil and gas in Table 11, metals and ores in Table 12, and both mineral groups combined in Table 13.

	$\mathbf{X_2}$	$\mathbf{X_3}$	$\mathbf{X_4}$	$\mathbf{X_5}$	$\mathbf{X_6}$	$\mathbf{X_7}$	$\mathbf{X_8}$	$\mathbf{X_9}$	$\mathbf{X_{10}}$	$\mathbf{X_{11}}$	$\mathbf{X_{12}}$	$\mathbf{X_{13}}$
$\mathbf{X_2}$	1											
$\mathbf{X_3}$	-.85	1										
$\mathbf{X_4}$	-.76	.76	1									
$\mathbf{X_5}$	-.94	.86	.87	1								
$\mathbf{X_6}$	-.91	.89	.88	.96	1							
$\mathbf{X_7}$	-.76	.66	.75	.85	.75	1						
$\mathbf{X_8}$	.89	-.96	-.70	-.83	-.84	-.63	1					
$\mathbf{X_9}$	.88	-.83	-.92	-.87	-.89	-.73	.83	1				
$\mathbf{X_{10}}$	>.99	-.85	-.76	-.94	-.90	-.77	.89	.87	1			
$\mathbf{X_{11}}$	.98	-.87	-.78	-.91	-.94	-.70	.90	.89	.97	1		
$\mathbf{X_{12}}$	.84	-.68	-.66	-.81	-.73	-.93	.72	.75	.85	.77	1	
$\mathbf{X_{13}}$	-.92	.89	.89	.98	.99	.77	-.84	-.89	-.91	-.93	-.74	1
C	-.94	.86	.88	>.99	.97	.84	-.83	-.88	-.93	-.92	-.80	.99

Table 11: The correlation matrix for the regressors in the oil and gas models shows some high levels of multicollinearity in these data. Please see Table 10 for the abbreviated variable names.

	$\mathbf{X_2}$	$\mathbf{X_3}$	$\mathbf{X_4}$	$\mathbf{X_5}$	$\mathbf{X_6}$	$\mathbf{X_7}$	$\mathbf{X_8}$	$\mathbf{X_9}$	$\mathbf{X_{10}}$	$\mathbf{X_{11}}$	$\mathbf{X_{12}}$	$\mathbf{X_{13}}$
$\mathbf{X_2}$	1											
$\mathbf{X_3}$	-.82	1										
$\mathbf{X_4}$	-.83	.76	1									
$\mathbf{X_5}$	-.96	.85	.87	1								
$\mathbf{X_6}$	-.91	.89	.88	.96	1							
$\mathbf{X_7}$	-.80	.65	.75	.85	.75	1						
$\mathbf{X_8}$	.85	-.96	-.71	-.83	-.84	-.62	1					
$\mathbf{X_9}$	.87	-.74	-.97	-.86	-.85	-.73	.74	1				
$\mathbf{X_{10}}$	>.99	-.81	-.82	-.96	-.90	-.80	.85	.86	1			
$\mathbf{X_{11}}$	.95	-.87	-.85	-.95	-.97	-.72	.88	.88	.95	1		
$\mathbf{X_{12}}$	.84	-.62	-.70	-.82	-.69	-.95	.64	.74	.85	.72	1	
$\mathbf{X_{13}}$	-.94	.88	.89	.98	.99	.77	-.85	-.87	-.93	-.97	-.73	1
$\mathbf{C}$	-.96	.86	.88	>.99	.97	.84	-.83	-.86	-.96	-.95	-.81	.98

Table 12: High multicollinearity can also be found between several of the regressors used to estimate the metals and ores models. Please see Table 10 for the abbreviated variable names.

	$\mathbf{X_2}$	$\mathbf{X_3}$	$\mathbf{X_4}$	$\mathbf{X_5}$	$\mathbf{X_6}$	$\mathbf{X_7}$	$\mathbf{X_8}$	$\mathbf{X_9}$	$\mathbf{X_{10}}$	$\mathbf{X_{11}}$	$\mathbf{X_{12}}$	$\mathbf{X_{13}}$
$\mathbf{X_2}$	1											
$\mathbf{X_3}$	-.86	1										
$\mathbf{X_4}$	-.78	.76	1									
$\mathbf{X_5}$	-.94	.86	.87	1								
$\mathbf{X_6}$	-.92	.89	.88	.96	1							
$\mathbf{X_7}$	-.76	.66	.75	.85	.75	1						
$\mathbf{X_8}$	.90	-.95	-.70	-.82	-.84	-.61	1					
$\mathbf{X_9}$	.88	-.82	-.93	-.87	-.88	-.71	.83	1				
$\mathbf{X_{10}}$	>.99	-.85	-.77	-.94	-.91	-.76	.90	.88	1			
$\mathbf{X_{11}}$	.97	-.89	-.80	-.92	-.95	-.69	.92	.90	.96	1		
$\mathbf{X_{12}}$	.82	-.67	-.67	-.80	-.71	-.94	.70	.74	.82	.73	1	
$\mathbf{X_{13}}$	-.93	.89	.89	.98	.99	.77	-.84	-.88	-.92	-.94	-.73	1
$\mathbf{C}$	-.94	.86	.88	>.99	.97	.84	-.82	-.87	-.94	-.93	-.80	.99

Table 13: This is the correlation matrix of the regressors in the combined minerals models. Please see Table 10 for the abbreviated variable names.

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