Natural Resources and Bureaucratic Corruption

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Abstract

Natural resource abundances beguile societies with their promises of wealth but more often than not cause greater harm than good. How does this "resource curse" arise, why does it happen in varying degrees, and how do some countries evade it all together to experience a "resource blessing?" This paper presents a political economy model of public sector bureaucrats interacting with private sector producers to offer a possible driver of these divergent findings. The model shows that resource abundances' effects depend upon how abundances alter bureaucratic corruption, public sector investment and producer effort. Bureaucratic discretionary power, wages and the size of the abundances relative to the institutional constraints on bureaucrats drive the direction and magnitude of these effects. Case study materials from a variety of countries support the model and elucidate its points.

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Contents

1 Introduction

Natural resource abundances beguile societies. Diamonds, metals, minerals, petroleum—all these primary exports evoke fantasies of wealth, glory, power, untold riches—and yet a large and growing body of econometric evidence finds that countries endowed with vast allotments of them tend to underperform relative to those with less (e.g. Sachs and Warner (1995), (2001); Auty (2001); Gylfason, Herbertsson and Zoega (1999); Atkinson and Hamilton (2003); Isham et al. (2005); Mehlum, Moene and Torvik (2006b); Norman (2007)).[1] It is as though resource abundances mimic Midas's touch: They charm with promises of riches in theory but curse with destitute outcomes in reality. If these abundances could be channeled well and sowed across a country's economy for growth, a multitude of endowed and developing countries could doubtlessly pull themselves out of the poverty traps and capital-starved states in which they languish. Except this repeatedly fails to happen, and the misuse of resource abundances remains a plague to efforts of development.

What explains this phenomenon and how can it be undone? Researchers continue to make progress toward an actionable and comprehensive theory but difficulties abound. Not only are the mechanisms and transmission channels of the phenomenon elusive, but countries' under-performances also vary greatly, even when controlling for levels of abundance, and some actually manage to do well by their endowments.[2]

[1] It should be noted that some disagree with this assessment, e.g., see Stijns (2001), Lederman and Maloney (2002), Wright and Czelusta (2004). These voices are squarely in the minority, however, as "it is now almost conventional wisdom that resources are a 'curse' for currently developing countries" (Robinson, Torvik and Verdier (2006), p. 448.).

[2] Indeed, Stevens (2003) stresses the need to discuss the "resource impact" as some countries have experienced a "blessing" instead of a "curse". Consider Botswana: Through its abundance of diamonds and other minerals it achieved an average 8 percent per-capita GDP growth rate between

Without doubt, a cogent and cohesive understanding of resource abundances' *modi operandi* for good or ill remains a primary goal of economic scholarship.

This thesis is a foray into this scholarship. It presents a political economy model that focuses on a mostly overlooked interaction within the literature on resource abundance: that between public sector bureaucrats and private sector producers. Whether a government is a dictatorship or democracy, all public sector discretionary spending passes through the hands of bureaucrats who have some control over its disbursement. With this control comes the potential for corruption, which reduces productivity–enhancing public investment. By swelling the size of a government's coffers, resource abundances can increase discretionary spending and incentivize bureaucratic corruption. Corruption increases dependent upon the interaction between institutional constraints and the size of the discretionary spending increase. Meanwhile, private sector producers face a leisure–income tradeoff and set their work level dependent upon their productivity. If the corruption increase is large enough to crowd out public investment, producers reduce their work level and the abundance becomes a "curse." If the institutional constraints mitigate corruption, public investment increases, producers raise their work level and the abundance becomes a "blessing." Thus, the model illuminates one way through which resource abundances give rise to divergent cross-country outcomes.

The remainder of the text proceeds as follows. Section 2 summarizes the resource abundance literature. Section 3 outlines the model sketched above and details its

1966-1998, among the very highest in the world. Undoubtedly the people of Botswana do not speak of a "diamond curse."

implications and predictions. Section 4 offers support by highlighting complementary econometric studies and through a variety of case study analyses. Section 5 offers a few extensions and concludes.

2 Background

Since ancient times, scholars have used resource abundances to explain divergences in productivity among nations. In the sixteenth century, French political philosopher Jean Bodin summarized an observation made by Roman historian Livy before him, writing:

> The inhabitants of rich and fertile country are normally mean and cowardly, whereas a barren soil makes men sober of necessity, and in consequence careful, vigilant, and industrious. [3]

Recent decades have witnessed economists and political scientists extend this observation to create a dizzying breadth of literature on resource abundances.[4] While initially, this research looked solely at how resource abundances cause negative outcomes, its focus has shifted to examine the variation in outcomes to discover this variation's source. This section follows that progession, beginning by highlighting the adverse economic and political effects of resource abundances and concluding with the current scholarship on variation.

2.1 Economic Effects

Broadly speaking, resource abundances' adverse economic impacts can be divided into three categories: Dutch Disease, revenue volatility and debt overhang.

[3] From Bodin, translated in Tooley (1955), p. 195; also referenced in Sachs and Warner (1995).
[4] For a relatively recent and exhaustive survey see Stevens (2003).

2.1.1 Dutch Disease

The term "Dutch Disease" was first coined by *The Economist* magazine in 1977[5] based on the observation that the 1960s discovery of natural gas by the Netherlands led to a decline in its tradable manufacturing sector. Dutch Disease now refers to the generalized shrinking of a resource-rich country's exportable industries caused by the expansion of a resource extraction industry. First extensively explored in Corden and Neary (1982), this phenomenon results as follows: A resource extraction industry, in times of initial discovery and positive price shocks, acts as a "booming" sector relative to the rest of the nation's economy. As resources are tradable, the nation's currency appreciates and both increases the demand for non-tradables such as services (the "spending" effect) and reduces the competitiveness of the nation's other tradable industries, shifting labor and capital from these industries into resource extraction (the "resource movement" effect).[6] Taken together, these two effects result in enlarged resource extraction and non-tradable sectors at the expense of the other tradable sectors. The economy specializes.

In contrast to classical theory, which holds that comparative advantage specialization is beneficial, this specialization harms countries by reducing the level of "learning by doing" of a country's labor force. Learning by doing describes a type of kinesthetic education in which working itself increases one's human capital. As many papers detail (e.g. Van Wijnbergen (1984), Krugman (1987), Matsuyama (1992), Sachs and

[5] *The Economist* pp. 82-83, November 26, 1977.

[6] For resource abundant countries with fixed-exchange regimes or without their own currencies altogether, these effects can still be witnessed through an increase in real wages and returns to investment for the booming industry. See Paldam (1997) for an in-depth examination of Greenland.

Warner (1995), Gylfason, Herbertsson and Zoega (1999)), resource extraction industries require minimal training and skill and inherently produce less learning by doing than other industries. This works to reduce the real rate of human capital growth in a country, retarding growth.

2.1.2 Revenue Volatility

The study of revenue volatility revolves around resource abundances' destabilizing effects on nations' macroeconomies. As the past three decades in the oil and gas market have spectacularly shown and econometric studies corroborate,[7] primary commodities experience large and sudden price shocks that make the revenue streams fluctuate for those who sell them. These fluctuations act to amplify boom–bust cycles and increase investment uncertainty, creating turmoil and impairing growth in those resource abundant countries strongly coupled to them.[8] As the degree of exacerbation logically depends on how specialized a nation is in its resource extraction industry, the impacts of revenue volatility and Dutch Disease go hand-in-hand.

2.1.3 Debt Overhang

Debt overhang occurs when borrowers owe interest on their debt that exceeds their profits. In times of positive price shocks, many resource-rich countries take on debt based on the high price level only to have a reduced capability to pay it back when prices subsequently fall. Manzano and Rigobon (2001) study this effect for resource-rich countries during the 1980s and find that it explains a substantial portion of the

[7] See e.g. Clem (1985) or the more recent Regnier (2007).

[8] See Mikesell (1997) and Auty (1998) for further elucidation. Additionally, Hamilton (1988) derives a general theoretical model and Gylfason, Herbertsson and Zoega (1999) gives details on investment, export and import effects.

poor growth results witnessed.[9] Economically, however, it is unclear what about resource abundances causes the poor investment decisions that lead to debt overhang in the first place. Resource extraction industries are capital intensive and require formidable investment outlays, so perhaps this was debt issued to finance start-up projects (new mines, rigs, etc.) that turned out to be infeasible. Yet the record says otherwise: Sachs and Warner (1995), Atkinson and Hamilton (2003), Dietz, Neumayer and de Soysa (2007), among others, have found that resource endowed nations invest and save *less* than those less endowed.

2.2 Political Effects

Despite the significance of their economic effects identified above, scholars consider resource abundances' political effects to be most important in explanation of countries' adverse outcomes. As George Soros writes in the foreword to Humphreys, Sachs and Stiglitz (2007), referencing resource abundances:

> Three different processes come into play. One is the currency appreciation due to resource revenues and its negative effect on the competitive position of other industries. This is called the Dutch Disease. The second is the fluctuation in commodity prices and its disruptive effects. And the third is the effect on political conditions. The first two are purely economic and have been studied extensively. It is the third factor that needs to be better understood, especially as its impact is far greater than the other two.[10]

Broadly speaking, these political effects can be divided into five categories: increased competition, destabilization, rent-seeking, corruption, and poor decision-making.

[9] "...We show that [the "curse"] is due to the fact that these countries decided to take advantage of high commodity prices in the 70s and to use them as implicit collateral and found themselves on a debt overhang when commodity prices fell in the 80s" (Manzano and Rigobon (2001), p. 26).

[10] Humphreys, Sachs and Stiglitz (2007), xi.

2.2.1 Increased Competition

Resource abundances increase political competition by raising the stakes of holding office. Karl (2007) explains that unlike governments of resource-poor countries that can only raise revenue through consensual citizen taxation, governments of resource-rich countries generate substantial rents exogenous of the citizenry. These rents accrue through nationalization or direct taxation of the resource industry. With their bottom lines less tied to their citizens, *ceteris paribus* these governments wield greater discretion that gives those in charge more clout. The sheer amount of resource revenue entering into the treasury also directly acts to increase political power. With more power to gain, more actors enter the political fray and competition intensifies.

Karl (2004) details how this makes the state a "type of 'honey pot' in which competing interests try to capture a significant portion of resource rents by capturing portions of the state."[11] Political actors begin to operate more ruthlessly, forestalling compromises and negotiations. Writing on Nigeria, Diamond (1995) tells of oil triggering the descent into an "'uncivic society'" whose "political culture and social culture stunningly la[ck] the 'horizontal relations of reciprocity and cooperation'"[12] that make for good governance and resultant positive growth outcomes. Inefficiency, waste and poor policy result as political actors exhaust resources and time in increased diplomatic overhead, partisanship and efforts to maintain or seize power.[13]

[11] Karl (2004), p. 666.

[12] Diamond (1995), p. 418.

[13] Although within a somewhat orthogonal literature, Skaperdas (2002) derives an incisive theoretical framework for an analogous situation of competition among "warlords" that shows how the overall size of the rents the warlords seek is reduced as competition for the rents increases. This stands in contrast to classical economic theory, as it finds that too much competition leads to an *inefficient* outcome.

Venezuela's president Hugo Chávez's constitutional revision to eliminate term limits readily exemplifies such actions. Needless to say, growth and output suffer.

2.2.2 Destabilization

Destabilization refers to how resource abundances' can divide a whole citizenry with explosive and violent results. Often the sheer size of resource rents makes their use contentious and foments disagreement. Collier and Bannon (2003) and Collier (2007), among others, argue that resource rents both incentivize revolutionaries and provide ready funds for fighting, sparking off civil wars. The usual, regional concentration of resources introduces geographically-tied economic divisions into nations with abundance, creating focal points for civil fracturing and exacerbating any pre-existing ethnic fractionalization.[14] The tangibility of resources provides a way to supply loot and spoils for engaged fighters—allowing combatants to raise armies and purchase weapons—and behaviorally drives potential fighters to more readily take up arms.[15] Sierra Leone and its civil war largely over diamonds from 1991-2002 too-readily substantiates this connection.

2.2.3 Rent-Seeking

Conceived of in the seminal work Krueger (1974), rent-seeking refers to the unproductive activities of economic actors who divert effort from production and into

[14]For a study of an ongoing example, see Weisbrot and Sandoval (2008). The authors detail the case of Bolivia's localized natural gas industry and how it affects the country's ethnically and regionally–divided population. For a general model explaining the effect of geographically-clustered resources on instability, see Wick and Bulte (2006).

[15]Collier (2007), 17-36. This second reason refers to the largest demographic of combatants—15-30 year-old men—being lured to fight as foot soldiers by the promise of easy resource riches, even though as foot soldiers have a probabilistically-minimal chance of actually becoming rich. This is a behavioral effect as it is based on irrational determinations of the expected value from fighting.

lobbying and/or bribing in order to capture governmental revenues, or rents. In other words, these actors seek to increase the size of their slice of the economic pie, but in so doing, reduce the overall size of the pie. Using a simple theoretical model, Torvik (2002) illustrates how resource abundances increase rent-seeking payoffs and lower overall growth as the resulting increase in rent-seeking crowds out production. Baland and Francois (2000) and Bulte and Damania (2008) also demonstrate this effect, highlighting rent-seeking's opportunity costs as foregone entrepreneurship and manufacturing, respectively.

Beyond financial transfers, rent-seeking behaviors also include petitioning officials for public sector sinecures, impeding growth through an effective reduction in the productive labor force. The empirical work of Alesina, Baqir and Easterly (1998) illuminates the significant extent to which these acts of patronage occur even in the United States. Resource abundances increase the effectiveness of this type of rent-seeking by both reducing its political costs and providing positions, in the form of jobs at the sheltered state–owned enterprises that often make up the entirety of a country's resource extraction industry. Robinson, Torvik and Verdier (2006) derive a political-economy model of how political actors with resource rents but constrained by competitive elections rationally move to enable this behavior.

2.2.4 Corruption

Corruption is the misuse of public office for private gain. As agency is a central problem of governance, all public officials have some capability to seek private

returns from their positions.[16] In many ways the flip side of the same coin as rent-seeking, corruption nevertheless differs from rent-seeking because it involves public sector as opposed to private sector activity. Resource revenues incentivize corruption by increasing the discretionary power of the agents who channel them, providing more opportunities to seek bribes, buy votes, divert funds to friends or kin and/or directly embezzle, depending on a agent's role in government. Specifically, Corrales and Penfold-Becerra (2007) detail how petrodollar–financed corruption in the form of "cronyism"—channeling resources to friends, family and political elites—and "clientelism"—conditionally offering social spending to increase political support—has arisen in Venezuela. Large cross-country econometric studies such as Papyrakis and Gerlagh (2004) find similar links between resource abundances and the level of perceived corruption in a country.[17] From the theoretical direction, the writings of Susan Rose-Ackerman (see e.g. Rose-Ackerman (1978) and Rose-Ackerman (1999)) and the contributions Shleifer and Vishny (1993), Jain (1998), della Porta and Vannucci (1999), and Jain (2001), among others, explain how corruption is tied to the discretionary power of officials and, by extension, resource abundances.

2.2.5 Poor Decision-Making

A catch-all category, poor decision-making refers to the general finding that resource abundances seem to make governments pursue suboptimal policies with greater

[16] From *The Economist*, "Give people power and discretion, and whether they are grand viziers or border guards, some will use their position to enrich themselves" (Special report, "The etiquette of bribery: How to grease a palm, December 19th, 2006 p. 1).

[17] Although one should scrutinize such results. From Rose-Ackerman (1999): "Cross-country empirical work...is of little use in designing anti-corruption strategies...In fact, it is not even clear what it means for a country to rank highly on a corruption index...The surveys give no information that would help one understand their underlying meaning." (pp. 3-4, as cited in Kingston (2008) p. 91).

frequency.[18] The study of how this arises remains an active field of research but preliminary theories have come to the fore. Stevens (2003) posits that during booms, resource abundances swell a government's coffers to such a degree that the government forsakes "normal procedures of 'due diligence'" and "prudence" when deciding on expenditures, which results in wasteful investments and poor policy. The work further argues that booms raise expectations for political action among the populace, leading political actors into "spending revenues too quickly" and "introduc[ing] distortions into the way the economy works."[19] Humphreys and Sandbu (2007) support this claim and model how political pressures induce incumbents to overspend a resource fund in the present relative to the future, knowingly but rationally deviating from a socially optimal expenditure path. This deviation increases when the probability of maintaining power is positively influenced by present expenditure, something likely in reality.

2.3 Causes of Variation

While research into these adverse effects continues, the focus has undoubtedly shifted into studying what drives the degree to which each of them arises. After controlling for relative sector sizes, the question remains as to why resource-rich nations experience divergent growth and development outcomes. The successes of Botswana and Norway stand in stark contrast to the disasters experienced by Nigeria and Sierra Leone, a reality which demands elucidation. Perhaps some nations have simply ended up luckier than others, happening to make better policy or fortuitously

[18] Indeed, Newberry (1986) simply states that "Countries that experience booms...make such large and obvious mistakes" (p. 334, as cited in Robinson, Torvik and Verdier (2006) p. 448.)

[19] Stevens (2003), p. 14.

evading severe adverse effects. But this view offers nothing actionable and pushes researchers to seek more empirical determinations. Political institutions have come to the forefront of current theory to explain country's divergent outcomes.

This theory posits that the quality of political institutions determines a resource abundance's effect on a country. Considered the "rules of the game" that govern the behavior of individuals and structure their social interactions,[20] institutions in the political context are the constraints under which public sector actors interact.[21] A government's transparency, checks and balances, level of autonomy, monitoring, rule of law, and overall measure of accountability all affect the constraints placed on public sector actors and make up a nation's political institutions. If a nation has "good" institutions, with high degrees of accountability, transparency, etc., an abundance's adverse effects can be mitigated, while if the institutions are "bad" the adverse effects propagate unchecked. Institutional quality shapes a resource abundance's impact.

Mehlum, Moene and Torvik (2006a) argue this theory directly. They posit that institutions lie on a continuum, from "grabber friendly" to "producer friendly,"[22] where the position of a country's institutions determines a resource abundance's impact for good or ill. A country with more "grabber friendly" institutions becomes cursed by a resource abundance while one with more "producer friendly" institutions becomes blessed.[23] The work partners with Mehlum, Moene and Torvik (2006b) for

[20] See North (1990) for one of the seminal contributions to this framework.

[21] The literature surrounding institutions and their precise definition is hazy at best, likely because the field remains inchoate. See Kingston and Caballero (2009) for a discussion of the various meanings, studies and theories of change within this field.

[22] *Ibid.*, 1121.

[23] Indeed, the paper notes that "five of the top eight countries, according to natural resource wealth, were also among the top 15 according to income" (p. 1117).

formalized theory and econometric analysis.

Bulte and Damania (2008) further support this idea with a parallel theory that models resource wealth as incentivizing both rent-seeking and corruption. The argue that accountability through competition for office attenuates these effects. Increased political competition lowers rent-seeking and corruption because incumbent politicians fear being ousted, which leads them to pursue more developmental policies. Robinson, Torvik and Verdier (2006) also argue that political institutions determine a resource abundance's outcome but take a different approach. In their model, the fear of losing power that results from competition is actually what causes incumbents to misallocate resources. Instead, institutions of "accountability and state competence" work to check this problem and mitigate the curse.[24]

Finally, Acemoglu, Johnson and Robinson (2001) further supplement the field with a generalized, long-run hypothesis of how institutions shape economic performance. They link the institutions set up by colonial powers to the economic performances of their former colonies today. Still other theories contend that resource abundances alter institutions themselves,[25] but even in these cases institutional quality determines the degree to which change occurs. Variance in institutions drives cross–country divergent outcomes.

[24]Robinson, Torvik and Verdier (2006), p. 447.

[25]See Ross (2001) for empirical work on how oil and mineral wealth impedes the rise of democracy through adverse resource revenue disbursement. Murshed (2004), Isham et. al (2005) and Gylfason and Zoega (2006) provide supplementary theories.

2.4 Summary

The resource abundance scholarship spans the breadth of the macroeconomic and political economy fields. The identified economic and political effects clarify the mechanisms through which resource abundances evoke adverse results, but their monotonic predictions fail to explain the divergent real–world outcomes of resource-rich countries. Political institutions are where recent research has turned for explanation of these cross-country variances.

3 Model

Given the background identified above, any model that encompasses the divergent experiences of resource-rich countries must incorporate political institutions. To be powerful, such a model must also identify 1) which adverse effect of resource abundances is most generalizable and important in countries' divergences, and 2) how political institutions shape the extent to which that adverse effect arises. Stiglitz (2007) offers guidance on these points:

> The central problem facing resource-rich countries may be easily stated: Various individuals wish to divert as much of that endowment as possible for their own private benefit...Constraints can be imposed on actions that can be undertaken. Constraints on decision-making processes might affect the magnitude of distortions that arise... with the cost–benefit calculus for corruption changed, there might be less corruption.[26]

These words motivate the following model. A resource abundance acts to incentivize officials to engage in corruption, constrained by a measure of accountability. The model then examines how this behavior interacts with production decisions made by

[26] Stiglitz (2007), p. 26.

actors within the private sector. For cross-country generality, it focuses on low-level bureaucrats and producers and takes as exogenous formal political structures.

3.1 Derivation

3.1.1 Foundations

Consider a stylized resource-rich country that accrues resource revenues R directly into government coffers. Concurrent with this accrual, a taxed fraction τ, $\tau \epsilon (0, 1)$ of the country's total output Y is collected for a total government budget $R + \tau Y$. The exact nature of both the resource revenue accrual and taxation are taken as exogenous. The country is populated by two types of citizens, producers and government bureaucrats,[27] who together make up the country's private and public sectors. For simplicity these citizen types are considered homogenous and come from distinct populations both normalized to unity. Additionally, bureaucrats are all paid salaries w, yielding a discretionary government budget X of

$$X = R + \tau Y - w, \quad w \leq R + \tau Y \ . \tag{1}$$

In this economy, the entirety of the total output Y is created by producers generating uniform quantities of a homogenous, unit-price good determined by the Cobb-Douglas production function

$$Y = A\sqrt{ek} \ , \tag{2}$$

where A is the level of public sector inputs, e is a producer's fractional level of effort, $e \ \epsilon \ [0, 1]$ and k is a collection of all other private inputs henceforth taken

[27] e.g. producers may be taken as artisans, famers, or business owners, while bureaucrats mayors, country officials, general agents, selectmen, etc, depending on the context.

as the producer's level of "capital," $k > 0$. A can be thought of as infrastructure, technological research, market supervision, regulatory activities, etc, all governmental activities complementary to production. Producers choose e to maximize

the utility function

$$U_p = (1 - \tau)Y - e \ ; \tag{3}$$

Combining (2) and (3) yields a completed expression

$$U_p = (1 - \tau)A\sqrt{ek} - e \ . \tag{4}$$

By inspection, this functional form creates a leisure-income tradeoff that induces producers to adjust their level of effort e for utility maximization given τ, k and A.[28] The variables τ and k are taken as exogenous parameters, while A enters the model endogenously through bureaucratic action. Bureaucrats set A by spending governmental discretionary money: They contract for physical infrastructure, fund research and development, spend on regulation, etc. However, bureaucrats can also act corruptly and embezzle this discretionary money for private gain. Let ζ denote fraction of total discretionary money X under each bureaucrat's supervision, $\zeta \ \epsilon \ (0, 1]$, and let g be the fractional amount of ζX that each bureaucrat chooses to embezzle or divert for private gain, $g \ \epsilon \ [0, 1]$. Then

$$A = (1 - g)\zeta X \ . \tag{5}$$

Because A directly enters into (2), the explicit opportunity cost of g is a decreased

[28] An alternative interpretation is to consider producers as workers who can operate in an informal, "shadow" economy or a formal sector with higher returns (access to A and k) regulated by the government: See Lane and Tornell (1999) for a precedent (p. 23). In this context e is the proportion of output produced in the formal sector. Either way, the salient point is that utility-maximizing producers choose e.

amount of public sector inputs that lowers producer productivity. Finally, the utility U_b of each bureaucrat is given by

$$U_b = w + g\zeta X - \phi w g^2, \tag{6}$$

where ϕ is the measure of bureaucratic accountability determined by country institutions, $\phi > 0$. This whole last term, $-\phi w g^2$, is effectively a bureaucrat's expected disutility of embezzlement.[29] Bureaucrats maximize their utility by choosing a level of g given w, ζ, X and ϕ.

In essence, the framework distills down to a simple two-sector, neoclassical production model where the inputs into each sector depend on the outputs of the other. Two actions matter: producers' choices of e and bureaucrats' choices of g, given outside parameters that impact the utility derived from each decision. Resource rents act as one of these parameters, entering into the government's discretionary budget X directly through (1).

3.1.2 Equilibrium Determination

To solve the model, we need to simultaneously determine the optimal selections e^*, g^* derived from U_p and U_b to yield an overall equilibrium output Y. As U_p and U_b are interlinked through (4) and (5), however, the respective maximizing values

[29] Admittedly this term is abstracted from reality. A bureaucrat's expected disutility from engaging in corruption is complex and a function of a multitude of variables, likely including τ, e, Y, and exogenous factors such as transparency, "social capital," cultural linkages, etc., as previously presented and much beyond w and g. Still, for simplicity only including w and g explicitly seems reasonable: If being caught embezzling entails job loss or demotion, w matters, and g must be relevant as the degree of embezzlement no doubt alters the expected disutility from engaging in it. One can take all these other factors as entering into the model through the magnitude of ϕ. As a final note, g^2 is used as it makes the disutility from embezzlement increasing in the level of embezzlement: Petty theft is punished lightly and is more difficult to detect, while instances of large-scale misappropriation are monitored closely and reprimanded harshly.

e^*, g^* are codependent. Similar to a Cournot Duopoly, producers and bureaucrats generate best response functions whose point of intersection is a Nash equilibrium equal to (e^*, g^*). In contrast to a Cournot Duopoly, here each bureaucrat and producer lacks "market power": Small, rank-and-file actors in the country, none consider her individual choice as altering the overall level of output or public sector inputs. Specifically, this means that all actors individually view A and X as fixed.

Lemma 3.1. *Producers' optimal effort e^* is increasing in A.*

Proof. A producer's first order condition is

$$-1 + \frac{(1-\tau)A\sqrt{k}}{2\sqrt{e^*}} = 0 \ , \tag{7}$$

solved by

$$e^* = \frac{(1-\tau)^2 A^2 k}{4} \ . \tag{8}$$

It quickly follows that

$$\frac{\partial e^*}{\partial A} = \frac{(1-\tau)^2 Ak}{2}, \text{ always} > 0 \text{ given the parameter constraints.} \tag{9}$$

□

Lemma 3.2. *Bureaucrats' optimal embezzlement g^* is increasing in X.*

Proof. A bureaucrat's first order condition is

$$\zeta X - 2\phi w g^* = 0 \ , \tag{10}$$

simply solved by

$$g^* = \frac{\zeta X}{2\phi w} \ . \tag{11}$$

It quickly follows that

$$\frac{\partial g^*}{\partial X} = \frac{\zeta}{2\phi w}, \text{ always} > 0 \text{ given the parameter constraints.} \tag{12}$$

□

The intuitive results arise: A greater amount of public sector inputs elicits increased effort and a larger discretionary allotment incentivizes embezzlement. An

increase in R therefore has two effects. By increasing X, through (11) it increases g^* and lowers A. Through (5), however, it directly increases A when g^* is held constant. As these effects work in opposite directions, the overall change in A, and by extension, e^* and Y depends on their relative magnitudes. We see the outline of how a resource abundance can result in either a curse or a blessing.

We now derive the best response functions by eliminating A and X from (8) and (11). From (1) and (2),

$$X = R + \tau Y - w \;\rightarrow\; X = R + \tau A\sqrt{e^* k} - w \;; \tag{13}$$

inserting (13) into (5) and algebraic rearrangement yields

$$A = \frac{(1-g^*)\zeta(R-w)}{1-(1-g^*)\zeta\tau\sqrt{e^* k}} \;, \tag{14}$$

and comparing (14) and (5) shows that

$$X = \frac{(R-w)}{1-(1-g^*)\zeta\tau\sqrt{e^* k}} \;. \tag{15}$$

Recall from (8) that the producers' optimal choice of e^* (taking A as given) is $e^* = \frac{(1-\tau)^2 A^2 k}{4}$. Therefore in equilibrium,

$$e^* = \frac{(1-\tau)^2 k}{4}\left(\frac{(1-g^*)\zeta(R-w)}{1-(1-g^*)\zeta\tau\sqrt{e^* k}}\right)^2 \;, \tag{16}$$

while a similar process for g^* through (15) and (11) yields

$$g^* = \frac{\zeta}{2\phi w}\left(\frac{(R-w)}{1-(1-g^*)\zeta\tau\sqrt{e^* k}}\right) \;. \tag{17}$$

These equations (16) and (17) implicitly relate e^* and g^*. Yet we desire the best response functions that have e^* and g^* explicitly related. Using *Mathematica*, we find

these best response functions to be

$$e^* = \frac{1-(1-g^*)^2\zeta^2(R-w)\tau(1-\tau)k - \sqrt{1+2(1-g^*)^2\zeta^2(R-w)\tau(1-\tau)k}}{2(1-g^*)^2\zeta^2\tau^2 k} \quad (18)$$

and

$$g^* = \frac{2\phi w(\zeta\tau\sqrt{e^*k}-1) + \sqrt{8\sqrt{e^*k}\phi w\tau\zeta^2(R-w) + [(2\phi w)(1-\zeta\tau\sqrt{e^*k})]^2}}{2\phi w\tau\zeta\sqrt{e^*k}} \quad (19)$$ [30]

A careful examination of (18) and (19) could provide insight into their functional forms. But the regrettable truth cannot be avoided: (18) and (19) are horrendous expressions, the model's recursive nature being the culprit, and this examination would leave much to be desired. Fortunately, we can again use *Mathematica* and generate a plot and visualize the two functions. Using the Plot[ ] command, Figure 1 illustrates these best response functions for the parameter values $\zeta = .75,\ R = 3,\ w = 1,\ \tau = .3, \phi = 3$ and $k = 1.5$.[31]

Figure 1 shows that (18) and (19) resolve intuitively and clearly. A producer's optimal choice of e^* decreases in g while a bureaucrat's optimal choice in g^* increases in e. The importance of attenuating embezzlement is revealed in that embezzlement directly disincentivizes production. Concurrently, we see the difficulty of this attenuation as more production incentivizes embezzlement. Note that these findings parallel those of Lemma 3.1 and Lemma 3.2.

Although Figure 1 is visually useful, ultimately we want to find the impact of the

[30] All *Mathematica* notebooks are available on request from the author. While these equations are solvable algebraically and with the quadratic formula, *Mathematica* is used to check the roots to see which do not violate the model's assumptions.

[31] *Mathematica* requires numerical parameter values in order to draw a plot. Nothing is special about these values save they do not violate the model's assumptions.

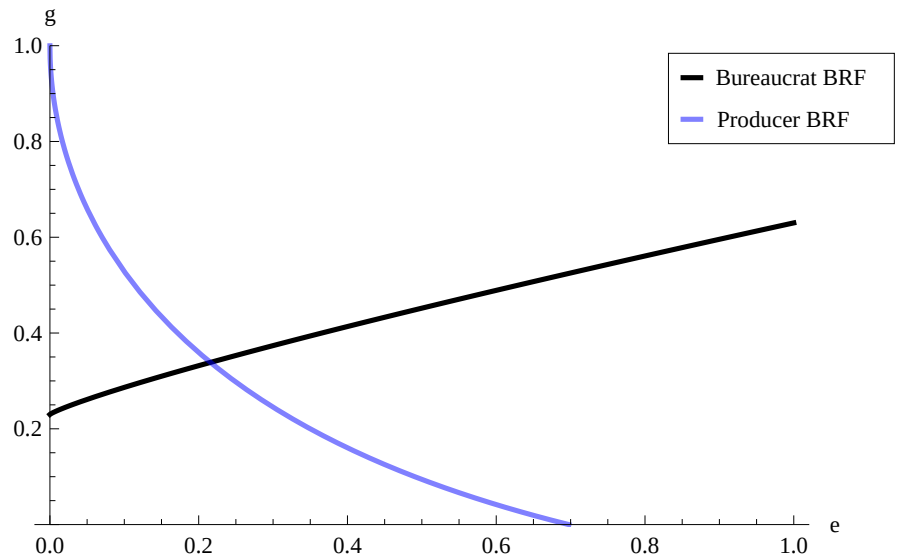

Figure 1: The best response functions

parameters on Y. From (2) and (14),

$$Y = A\sqrt{e^*k} \;\rightarrow\; Y = \frac{(1-g^*)\zeta(R-w)\sqrt{e^*k}}{1-(1-g^*)\zeta\tau\sqrt{e^*k}} \;. \tag{20}$$

As these $(e^*,\ g^*)$ values are where the best response functions intersect, we find them by solving the 2x2 system created by (18) and (19). Unfortunately, the transcendental nature of these equations makes an analytical solution impossible. We require a numerical solution, once more calling for the help of *Mathematica*.

Using the FindRoot[ ] command and Module[ ] environment, an array of $(e^*,\ g^*)$ values was created for given parameter inputs. This array was then linked to a function derived from (20) to create a table of Y values for these same parameter inputs. From the table, the ListPlot[ ] command was used to generate plots of Y by varying the parameter values. Figure 2 presents the parameter plots relevant to further analysis. Note that each plot within Figure 2 is a "slice" of Y with respect to the indicated parameter: All other parameters are held constant while the indicated

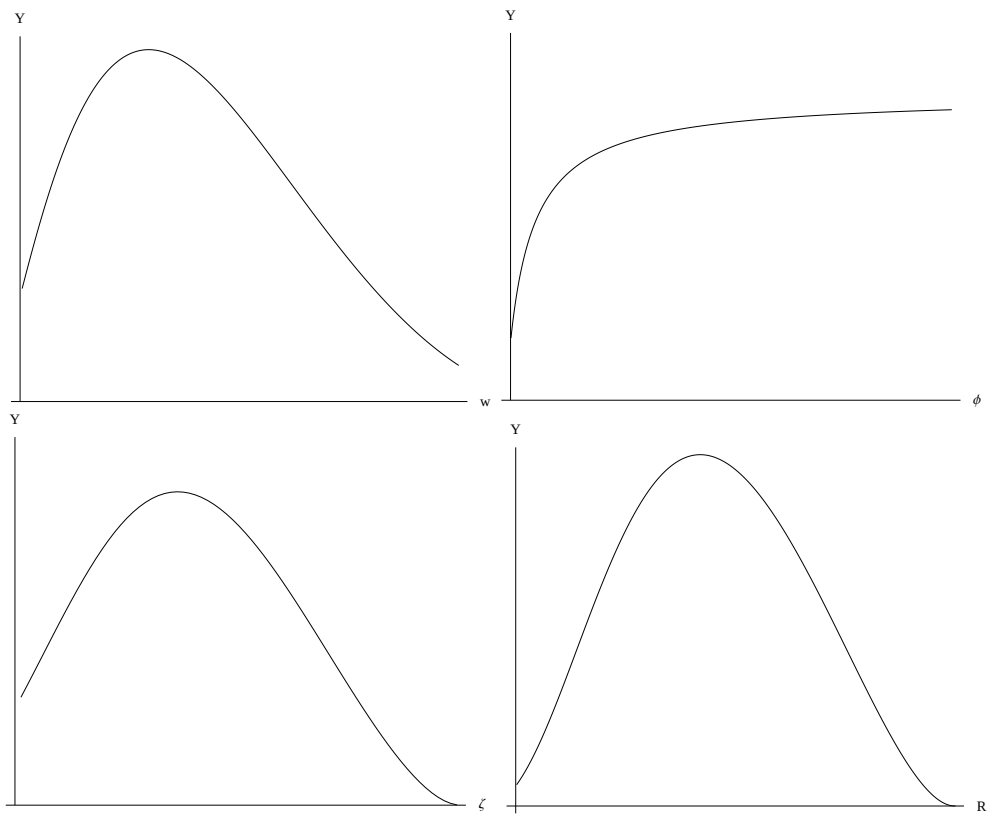

Figure 2: Total Output Y vs. Parameters. The Y axes are not relative.

parameter is varied.[32]

The figure reveals much about the model and its predictions. The first plot of Y against bureaucratic wages w shows that increasing bureaucratic wages raises output up to a point, after which it falls. This first part follows from U_b in (6) and g^* in (19): As wages increase, so too does the expected disutility from embezzlement; if embezzlement is present then the increased wage can lower it such that A increases, carrying Y with it. This second part comes from X in (1): Wages decrease the overall level of discretionary spending X, in turn lowering A and subsequently Y.

[32] All these graphs and those going forward use the same base parameter values: $\zeta = .75$, $R = 3$, $w = 1$, $\tau = .3$, $\phi = 3$ and $k = 1.5$. For the Y vs. w plot, w was varied from .5 to 2.5, for the Y vs. ϕ plot, ϕ was varied from 3.2 to 100, for the Y vs. ζ plot, ζ was varied from .685 to 1, and for the Y vs. R plot, R was varied from 1.5 to 9. These ranges were chosen so as to not violate the model's assumptions, given the base parameter values.

The competition between the magnitudes of these two effects results in the hump-shaped curve. Bureaucrat wages have an optimal point: The should be set high enough such that the fear of losing them mitigates embezzlement, but low enough such that not too much of a country's budget is spent on salaries to the detriment of public sector inputs and production.

The next plot of Y against ϕ, the measure of bureaucratic accountability derived from a country's institutions, indicates diminishing marginal returns. Increasing ϕ naturally reduces g^* and thereby raises A, which in turn increases e^*. As there are diminishing returns to e^*, ϕ exhibits them as well. The plot further shows that the slope of Y against ϕ is always positive, in line with the literature that universally considers an increase in institutional quality to always benefit production. This plot takes the general literature claim one step further, however, and showcases how in the opposite direction institutional decay can be disastrous: The converse of diminishing returns in ϕ means that a decrease in Y accelerates in a decrease in ϕ.

The third plot of Y against ζ, the degree of bureaucratic discretionary power, mirrors that of Y against w in that it too is hump-shaped. This reveals that ζ also has two conflicting effects on Y. On the one hand, giving bureaucrats more discretionary power, or more money to disburse, means that more public inputs will be provided (taking g^* as constant), thereby raising e^* and Y. On the other hand, this additional money incentivizes bureaucratic embezzlement and increases g^*, thereby lowering A, e^* and Y. Bureaucratic discretionary power also has an optimal point: It should be set high enough so that public sector inputs are sufficiently provided, but not too high that its incentivizing effects on embezzlement become problematic. Of course,

this optimal value of ζ depends upon the other parameter values of a country, most directly w and ϕ. In a country where these bureaucratic wages and the measure of accountability are high enough, the optimal level of ζ could even theoretically be 1, meaning that all of the country's discretionary money X could be channeled through bureaucrats without adverse effect.

Finally, the plot of Y against R, the level of resource abundance, mirrors the plot of w and ζ in that it is also hump-shaped. This effect arises from a resource abundance's conflicting impact on Y in (14) and (19): Through the first equation, R increases A (taking g^* as constant), thereby increasing e^* and Y, but through the second it increases g^*, thereby lowering A, e^* and Y. Together, these bring us to the model's key finding: the effect of R on Y.

Proposition 1. *A resource abundance can be either beneficial or harmful for a country's output, depending on the resource abundance's size. Up to an optimal level it increases output, after which it reduces output until output ultimately falls below its original level.*

Proof. See Figure 2 and the above discussion. □

This result indicates that the model encompasses both "blessings" and "curses"; within the model and concurring with reality, Y is not monotonic in R. Given a set of parameter values, a country can positively channel a resource abundance of up to a certain size. After this size is surpassed, however, a resource abundance induces a level of bureaucratic corruption whose net effect is to reduce public sector economic inputs, which in turn lowers the level of producer effort, production and

overall output.

The plot of Y against R further indicates that there is a range where an increase in resources causes a net increase in output, even though this increase is not maximal. In this case we can say that a country is "relatively" cursed, in that it does not achieve an optimal result, but not "absolutely" cursed, in that overall output does not fall below its original level. Consider Figure 3: A country with a level of resource abundance at $R2$ is "relatively" cursed compared to $R1$.[33] The increase in resources from $R1$ to $R2$ results in a higher level of output ($Y2 > Y1$), but the country still lies below the optimal potential output at R^* ($Y2 < Y^*$). Meanwhile, a country with a level of resource abundance at $R3$ is "absolutely" cursed compared to $R1$. The increase in resources from $R1$ to $R3$ results in a lower level of output ($Y3 < Y1$), and the country (obviously) still lies below the optimal potential output at R^* ($Y3 < Y^*$). In this way, we see that the model's non-monotonic result is additionally nuanced. It encompasses variation in a curse's severity.

These plots do much to elucidate the model's workings. Yet we still wish to know the exact mechanisms through which resource abundances' impacts diverge. Most directly through the plots of Y against R, Figures 2 and 3 hint at how this may happen but come up short of a full explanation. With a view to the case study material to follow, we now develop some comparative static implications for analysis.

[33] The parameter values used here are the same as for the Y against R plot in Figure 2.

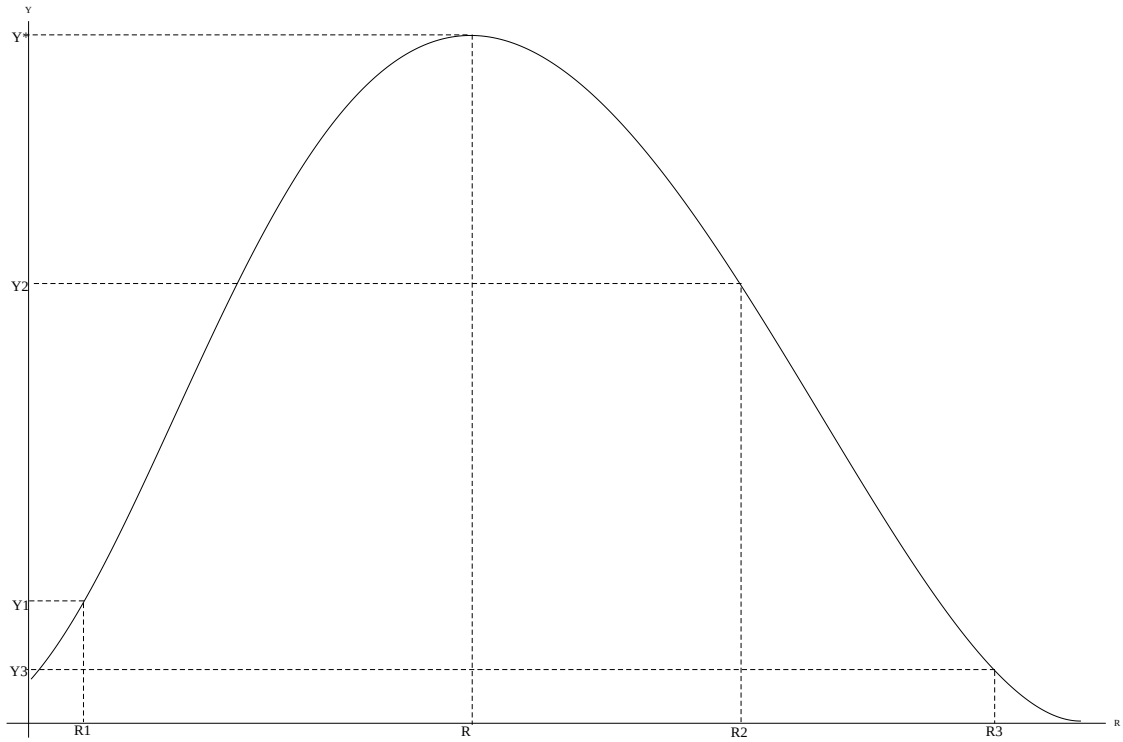

Figure 3: Comparing different levels of abundance.

3.2 Comparative Statics

Lemma 3.3. *Higher levels of bureaucratic discretionary power ζ increase a country's vulnerability to an adverse resource abundance impact. However, they also increase the positive impact from lower levels of R.*

Proof. Consider Figure 4.[34] The curve with a higher level of ζ peaks at a lower level of R relative to the curve with a lower level of ζ. This means that for a given level of R, countries that channel more of their revenues through bureaucrats are more likely to lie to the right of the peak, experiencing an adverse impact. However, the curve with the higher level of ζ also lies strictly above the curve with a lower level of ζ for the its entire length at the left of its peak. Within this range of lower levels R, output

[34]The base parameter values remain the same as in Figure 2. The ζ values used are .85 and .65, respectively.

Y is greater and the resource abundance's positive impact is magnified.

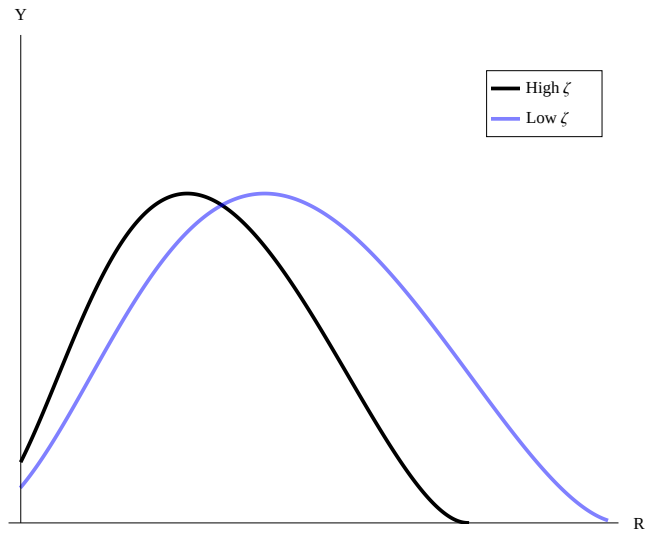

Figure 4: The impact of discretionary power.

□

This result comes about straightforwardly from the model. Raising ζ increases A and thus Y for all levels of R that g^* remains sufficiently small. The raised ζ, however, causes a contraction in the range of levels of R that this is true. A country with a small resource abundance will benefit from increasing ζ, as doing so will raise its output, but countries with large resource abundances should attenuate bureaucratic discretionary power.

Lemma 3.4. *High bureaucratic wages insulate a country from resource abundances' adverse impacts but reduce output at lower levels of R. At higher levels of R they increase output.*

Proof. Consider Figure 5.[35] The curve with a higher level of w peaks at a higher level

[35]The base parameter values remain the same as in Figure 2. The w values used are 1.25

of R relative to the curve with a lower level of w. This means that for a given level of R, countries that pay bureaucrats higher wages are more likely to lie to the left of the peak, experiencing a positive impact. For low levels of R, however, the curve with a higher level of w lies below the curve with a lower level of w, reducing relative output. After a point this reverses and the curve with a higher level of w lies strictly above the curve with a lower level of w, boosting relative output. □

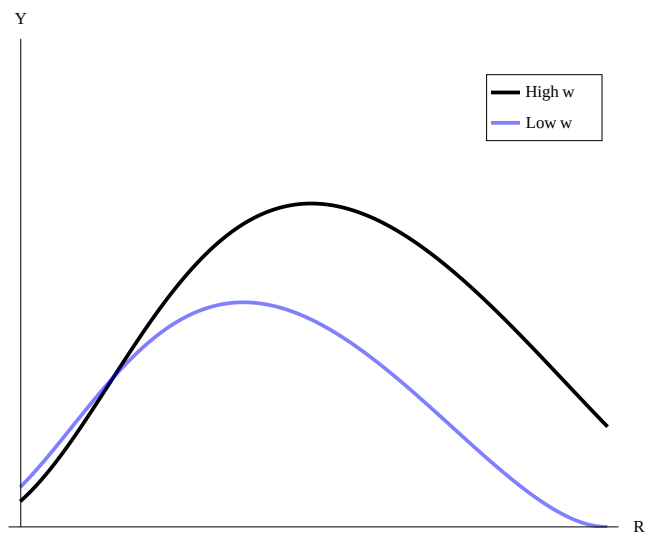

Figure 5: The impact of wages.

Bureaucratic wages produce a nuanced effect. Depending on where a country lies on its R vs. Y curve, increasing wages can either hurt or help output. The harmful effect arises because the reduction in the country's discretionary budget reduces A at a greater rate than it reduces the negative effect of g^*. The helpful effect arises for the opposite reason. A prudent policy would likely keep bureaucratic wages slightly elevated to balance between these two outcomes.

and 1, respectively.

Lemma 3.5. *Increasing ϕ unambiguously improves the effect of R on Y.*

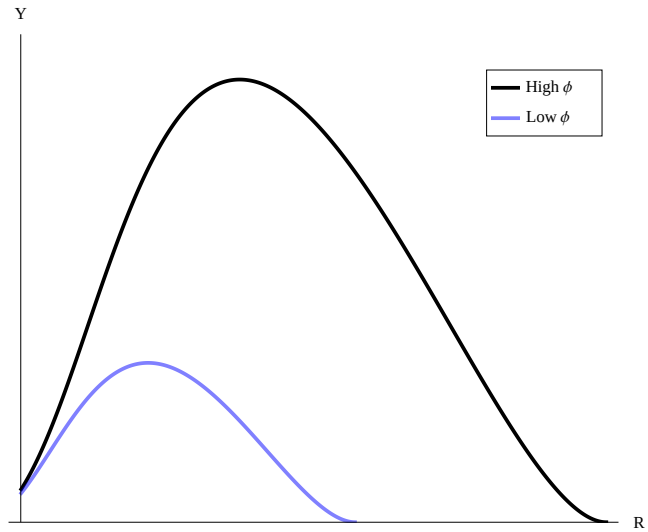

Figure 6: The impact of institutions.

Proof. Consider Figure 6..[36] The curve with a high level of ϕ lies strictly above the curve with a low level of ϕ and additionally peaks at a higher level of R. This means that increasing ϕ amplifies a resource's positive effect on output and increases the range of R for which an abundance remains strictly positive. □

Institutional quality through the parameter ϕ directly drives a country's susceptibility to an adverse resource outcome. By affecting bureaucrat's disutility from corruption, ϕ alters g^* for a given level of R. Countries with higher quality institutions are both able to greater resist resource abundances' corruptive effects and channel the abundances for greater benefit than those with poorer quality institutions.

[36]The base parameter values remain the same as in Figure 2. The ϕ values used are 5 and 3, respectively.

3.3 Summary

This model has produced some important results. First, examining resource abundances' corruptive effects on bureaucrats constrained by institutions lets us see how divergent cross-country outcomes arise. For any given country, there exists a lower range of resource revenues that increases output and an upper range within which output suffers until it eventually falls. This occurs because of the competing effects of resource revenues on the level of public investment. On the one hand, resource revenues increase a government's budget and provide more funds for investment. On the other, revenues incentivize bureaucratic corruption that crowds out public investment. The relative magnitudes of these effects determine the final level of public investment, producer effort and output. Countries that experience resource blessings have the former effect dominate the later, while those that are cursed have this reversed. Additionally, cursed countries can be impacted in varying degrees, becoming either "relatively" cursed or "absolutely" cursed, as compared to if they had a lower level of a resource abundance.

Second, bureaucratic discretionary power and wages adjust these ranges and the effect on output for any given level of resource abundance. Discretionary power acts to increase the positive effect from lower levels of abundance, but with a trade-off of reducing the sustainable level before which the effect becomes negative. Conversely, wages lower the positive effect from lower levels of abundance but insulate a country from the negative effects of higher levels. A country's determination of these two values greatly influences its resource abundance experience.

Finally, the strength of institutional constraints on bureaucrats is what ultimately determines a resource abundance's impact. Stronger institutions unambiguously improve a country's experience with a resource abundance. Still, there always exists a level of abundance after which an abundance turns negative. Critically, it is the *interaction* between a country's institutional quality and the size of the abundance that determines that country's experience.

4 Support

Given the model's low-level nature, it is difficult to find and isolate supportive empirical evidence. Bureaucratic corruption and producer effort are both hard to observe, while producer output is a noisy indicator of performance that also has a significant causal time lag. The model is static while reality is dynamic; institutional quality is additionally challenging to ascertain. Caveats aside, evidence does suggest that the model's mechanisms are relevant to real-world resource abundance outcomes.

To begin, Leite and Weidmann (1999) supply direct econometric support of resource abundances increasing corruption and corruption decreasing growth, even after controlling for the economic effect of resource price volatility.[37] The authors further offer evidence that institutional structures affect corruption, as their "results also support the hypothesis that monitoring efforts tend to dampen corruption" and that "sounder institutions, indicated as a high score on rule of law, tend to be associated with lower corruption"[38] Lambsdorff (2003) also provides evidence that bureaucratic corruption lowers productivity and that this corruption is checked by "law and order"

[37]See Leite and Weidmann (1999), Table 2 p. 24.
[38]Leite and Weidmann (2008), p. 23.

and "bureaucratic quality"[39] These papers together suggest that the model's transmission mechanisms have legitimacy. Still, cross-country econometric works that employ corruption indices are rife with endogeneity problems, compelling one to turn to more descriptive support via case studies.

Norway provides a first instance of general support. Rich in oil and natural gas, it has managed to do stunningly well by its endowment: Since discovering petroleum in 1969 and beginning production in 1971, the country has surged ahead of the other Scandinavian countries in terms of GDP per capita,[40] wiped out a 60% of GDP governmental debt and converted it into a 100% of GDP savings account, achieved on average a half-percentage point higher annual growth rate than the mean of other OECD countries, and now consistently tops the Human Development Index.[41] So what explains this outcome, with petroleum surely acting as a resource blessing? Across the board, the literature cites strong institutional constraints on government and the successful implementation of a natural resource fund that sequesters petrodollars.[42] In model terms, this equates to a high ϕ and low ζ: g^* is minimized and R can be fully channeled for productive means.

Of note, however, is that since the late 1990s Norway's growth has started to slow, concurrent with an increase in the paying out of the resource fund. In other words, ζ has risen and could possibly be adversely affecting Y. As Larsen (2006) posits, this effect may be enough to reverse the blessing and tip Norway more toward

[39] Lambsdorff (2003), pp. 463-464.

[40] See Larsen (2005) for detailed analysis.

[41] The OECD Economic Survey of Norway, 2007: The Petroleum Sector and Its Impact. Available online at `http://www.oecd.org/dataoecd/38/46/37979526.pdf`.

[42] See Larsen (2006), Bell and Faria (2007) and Stiglitz (2007) for a sample.

a curse, although the verdict is still out regarding the final outcome.[43] Either way, the model's mechanisms and transmission channels, both in how they promote a blessing and could be now causing a curse (likely of the "'relative" kind), are found relevant.

The history and case of oil in Venezuela provides second and most detailed support. That Venezuela is now cursed by oil is not disputed; Venezuelan founder of OPEC Juan Pablo Pérez Alfonso himself has famously said "we are drowning in the devil's excrement"[44]. Venezuela is consistently held up as a primary example of a resource-cursed country. To be certain, much of Venezuela's adverse experience can be attributed to non-corruption effects, with the triple strikes of oil price volatility, subsequent debt overhang problems from the late 1970s and early 1980s, and ongoing political instability all drivers of the curse.[45] But bureaucratic corruption is certainly a reason as well, with researchers finding that the oil boom of the mid-1970s spawned a corruption surge. From Coronel (2006):

> From 1975 to 1998 Venezuelan corruption levels generally increased and stayed high...Several factors contributed to soaring corruption: Weak political and social institutions...Lack of adequate administrative norms and controls... [and] large volumes of income coming from petroleum production...The use of national assets for personal benefit, among both the political elite and the population at large, lost much of its pejorative meaning... In 1997 Pro Calidad de Vida, a Venezuelan nongovernmental organization (NGO) doing anti-corruption work, estimated that some $100 billion in oil income had been wasted or stolen during the last 25 years.[46]

A large oil windfall in the context of poor "administrative norms and controls" and when "the use of national assets for personal benefit... lost much of its pejorative

[43]Larsen (2006), p. 634.
[44]Karl (1997), p. 4.
[45]See Karl (1997) for an exhaustive analysis.
[46]Coronel (2006), p. 3. Gustavo Coronel was on the exexcutive board of PDVSA, Venezuela's nationalized oil company, from 1976-1979 (p. 1).

meaning": In the model's terms, Venezuela experienced a rise in R while having high ζ and low ϕ values. No wonder the literature field readily classifies Venezuela as cursed: ϕ is too low in comparison to R to attenuate g^*, leading the country to lie to the right of the peak on the R vs. Y plot and underachieving relative to its potential.

Although this quote only extends to 1998, the rest of the Coronel (2006) details the corruptive qualities of Venezuela since—the years of the Chávez regime. Campaigning on and largely coming to power through an anti-corruption platform, Chávez's rule has instead been characterized by wholesale and widespread increases in "hypercorruption" (p. 8), with "bureaucratic corruption" a leading problem fueled by "the enormous amount of oil income... and almost total absence of proper government controls." (p. 10). Once more the model captures this effect: Venezuela has a high R in the context of a low ϕ, causing corruption to run rampant. To add further credence, Coronel (2006) highlights that low bureaucratic wages and low public sector investments, coming in the form of "infrastructure problems," are pervasive throughout the county, corroborating the model's predictions that a low value of w makes a country more susceptible to a high g^* and resultant decline in A. These "infrastructure problems" are particularly illustrative:

> In fact, the main bridge on the highway connecting Caracas with the international airport collapsed in early 2006... As another example of inattention to basic government functions, garbage frequently remains uncollected in the cities and towns of the country.[47]

These examples fall directly in line with the model's prediction that a decline in A results from a rise in g^*.

[47] Coronel (2006), p. 17.

From the econometric realm comes an additional piece of supporting evidence. Pineda and Rodriguez (forthcoming) estimate that since 1982, the reduction in Venezuelan public investment has been both staggering and catastrophic: "If the public capital stock had stayed constant at its 1983 values... [the paper] find[s] that per capita GDP would be 37% higher than its present value" in 2008.[48] The authors arrive at this result by first estimating Venezuela's elasticity of productivity with respect to public capital investment, and then take this estimate to simulate Venezuela's output had public capital investment remained constant. They determine the elasticity of productivity by employing state-level variations in federal public infrastructure funds to best control for problems of endogeneity.[49] These two works taken together, with Coronel (2006) arguing that the oil abundance increased corruption and corruption reduced infrastructure, and Pineda and Rodríguez (forthcoming) arguing that this reduction greatly impeded growth, affirm the model's mechanisms and predictions for Venezuela during this time period.

Finally and more broadly, factual snippets from other resource abundant nations additionally supplement the model. Nigeria, a country universally considered cursed by its petroleum, is also one where corruption pervades the bureaucracy. Indeed, the anthropological work Eames (2000) details how employing public office for private gain is not even considered corrupt in Nigeria but is instead the entire purpose of holding office: Nothing is impartial and everything is given or disbursed in order to "perpetuate some mutually beneficial relationship" or because a bureaucrat "wishes

[48]Pineda and Rodriguez (forthcoming), p. 135.
[49]See Pineda and Rodriguez (forthcoming), p. 121-123.

to initiate a relationship by putting you in her or his debt."[50] This translates into a ϕ value either very near or equal to zero, through the model making the finding of Gylfason (2001) that Nigeria's GNP was the same in 2000 as it was in 1960 seemingly obvious.[51] In contrast to Nigeria's story, the small African country of Botswana has achieved stupendous growth with its diamond wealth, propelled forward by what Acemoglu, Johnson and Robinson (2003) detail as "good policies" including "a meritocratic, relatively non-corrupt and efficient bureaucracy,"[52] a claim further supported by Iimi (2007). A high ϕ and a high R that leads to a high Y: Again the model is corroborated.

Finally, the story of Chile in contrast to Venezuela convincingly reveals the model's explanatory power. Both resource-rich South American nations with similar population demographics and colonial histories, they share comparable factors that are in general theoretically-linked to growth. Yet their resource experiences of the past few decades could not differ more: In contrast to the cursed and corruption-ridden story of Venezuela, Chile's return from its copper reserves has been positive, indeed acting as a main driver of non-mining sector success by spreading wealth into agriculture and through public investments.[53] The consensus on why this has happened rests on the implementation of Chile's natural resource fund, increasing governmental revenue and expenditure transparency and decreasing governmental agents' discretionary power.[54] In other words, Chile has maintained a high ϕ and low

[50] Eames (2000), p. 44.
[51] Gylfason (2001), p. 848.
[52] Acemoglu, Johnson and Robinson (2003) pp. 1-2.
[53] See Wright and Czelutsta (2004).
[54] See Humphreys, Sachs and Stiglitz (2007).

ζ while Venezuela has not. Transparency International's Corruption Perceptions Index provides further evidence of corruption as the cause of divergence between these two countries, for where Chile in 2008 scored a respectable 6.9 out of 10—23rd in the world and higher than France and Spain—Venezuela scored a dismal 1.9—158th in the world and below that of the Republic of Congo and Sierra Leone.[55]

With all these cases taken together, we see that real-world outcomes of resource abundances substantiate the model and convey its legitimacy.

5 Conclusion

The divergent experiences of resource-rich countries resist easy explanation. Current theories turn to political institutions for explanation of the "why" but often lack in determining "how" it is that these institutional effects operate. This thesis provides a model to get at this "how": Political institutions couple with resource abundances to determine the bureaucratic calculus of embezzlement. This interaction's net result influences corruption levels and thereby affects public investment and public sector inputs. The level of public sector inputs in turn affects producer effort, which together determine a country's overall output.

The model shows that this level of output is not monotonic in the level of a resource abundance. Up to some level of abundance output increases, but after this level output falls until it ultimately resides below its original level. Thus, the model additionally shows that countries can be cursed to varying degrees. Bureaucratic wages w and the level of bureaucratic discretionary power ζ both alter the relationship

[55] Transparency International's 2008 CPI table. Accessible at: `http://www.transparency.org/news_room/in_focus/2008/cpi2008/cpi_2008_table`.

between output and the level of resource abundance. Further, they have optimal levels that maximize output. Finally, the interaction between the measure of bureaucratic accountability ϕ and the size of a resource abundance drives a country's experience. Econometric analyses and case studies, especially that of Venezuela, support and elucidate these mechanisms.

Many obvious extensions exist. First, future efforts should work to discover a simpler and analytically–solvable system that could provide for greater insight. Second, one could attempt to encompass "larger" public and private sector actors, actors who would not take the levels of public sector inputs A and the government's discretionary budget X as fixed for their first order conditions, respectively, and see how incorporating these actors might change the analysis. Such an extension would be daunting to execute but could reap a large theoretical reward. Further, more needs to be done to examine how embezzled money might resurface in the economy. In the current model, this money vanishes or leaves the country, possibly entering into offshore accounts or something similar, but a more complete treatment would likely have it enter into producers' utility functions through a mechanism like rent-seeking. This inclusion could increase the model's nuance and perhaps even reveal something unexpected.

Ultimately, future work needs to endogenize the model's key parameters of ζ, w and ϕ. Although the current formulation explains how these parameters affect the impacts of resource abundances, it does not clarify how they themselves are determined nor how resource abundances might alter them. A dynamic model that incorporates these effects stands to be a true and major contribution for the field.

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