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By Robert T. Deacon

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The Political Economy of the Natural Resource Curse: A Survey of Theory and Evidence*

Robert T. Deacon

University of California, Santa Barbara and Resources for the Future, USA
deacon@econ.ucsb.edu

Former U.S. President William J. Clinton:

> *"With . . . [its] vast human and natural resources, a revitalized Nigeria can be the economic and political anchor of West Africa . . . ."*

From remarks on signing of a joint declaration with Nigerian President Obasanjo, August 26, 2000. (Obtained from CNN.com transcripts.)

Sheik Ahmed Yamani, former Oil Minister of Saudi Arabia:

> *"All in all, I wish we had discovered water."*

Cited in Ross, Michael. "The political economy of the resource curse." *World Politics* 1/1 (1999) 297–322.

* Professor of Economics, University of California-Santa Barbara and University Fellow, Resources for the Future. I am indebted to Katie Kimble for research assistance in preparing this review and to Antung Anthony Liu for carefully reading a preliminary version and offering editorial suggestions. Ragnar Torvik and Kevin Tsui deserve special thanks (and no attribution for errors) for numerous insightful comments and pointers to appropriate references. I also benefitted from comments by participants at the 17th Ulvön Conference on Environmental Economics, Umea, Sweden, June 2010.

Abstract

This survey focuses on political economy theories of the resource curse and scrutinizes how well, or poorly, these theories have been integrated with empirical work. One reason why this integration is important lies in the practical importance of pinning down the causal links involved in the resource curse. A second reason for focusing on integration of theory and empirics is that the resource curse is a potentially fruitful venue for testing political economy theories generally.

1

Introduction and Motivation

The preceding quotes illustrate both the optimism often expressed that natural resource abundance will lead to prosperity and the disappointment that too often accompanies the actual results. There is now abundant evidence that the populations inhabiting many resource rich countries are unusually poor, unhealthy, and politically oppressed. This is paradoxical. Both common sense and simple economics imply that natural resource abundance should confer benefits. Yet, Nigeria's per capita GDP in 2000 was 30% lower than in 1965, despite oil revenues of roughly $350 billion (1995$) during the intervening period.[1] Venezuela's terms of trade grew 13.7% per year during 1970–1990 due to its oil exports, but its output per capita fell by 1.4% per year.[2] Saudi Arabia's real GDP per capita was lower in 1999 than it was before the oil price increases of the 1970s. According to Gylfason (2001, p. 848), OPEC as a whole experienced per capita GNP *decreases* of 1.3% per

[1] The dollar figure represents oil revenues after payments to foreign companies, as reported by Sala-i-Martin and Subramanian (2003, p. 4). Information on income is from Heston et al. (2002).

[2] Information on Venezuela in this sentence and the next is from Lane and Tornell (1996, p. 216).

year during 1965–1998, while income increased at an average rate of 2.2% per year in all lower- and middle-income countries.

World Bank (2006, p. 43) statistics indicate that an unwillingness to save by resource rich countries is one aspect of the problem: genuine savings as a fraction of national income has a strong negative correlation with the share of income comprised of mineral rents. Circumstantial evidence also suggests that political jockeying for access to resource rents may be another common theme. During the oil price spike of 1979–1981, Venezuela's public spending on infrastructure and industrial policy, directed mainly to benefit political elites, jumped so sharply that the country actually ran a current account deficit. During the oil price run-up between 1970 the early 2000s, income in Nigeria became highly concentrated.[3] By 2000, the share of income held by the top 2% of the population equaled that of the bottom 55%, whereas it equaled the that of the bottom 17% in 1970. Over the same period the fraction of Nigerians who subsist on $1 per day or less rose from 26% to 70%.

Since some resource-rich countries have avoided this pattern and grown rapidly, including Botswana, Chile (after Pinochet), Malaysia, and Norway, some observers have expressed doubt over the robustness of broader statistical evidence supporting the curse.[4] From the evidence reviewed here, whether resource abundance is a curse or blessing appears to hinge on host country circumstances and on the particular resource involved; the generic label "curse" cannot be applied without qualification. Still, the notion that having more of *any* natural resource could be disadvantageous in *any* circumstance is sufficiently puzzling to invite further study — and the economics profession has responded to this invitation with uncommon vigor.

Certain patterns in empirical results have directed the search for causal links to consider interactions with political institutions. First, resource abundance or a resource boom tends to be a curse when governance and the rule of law are weak initially, but not otherwise. Second, a curse is more likely to plague resources found in dense concentrations, while other resources seem largely immune. The conventional,

[3] Van der Ploeg (2011, pp. 367–368).
[4] Brunnschweiler and Bulte (2008) and Alexeev and Conrad (2009) are examples.

market-based explanations summarized shortly do not predict either of these regularities. They are roughly consistent with theories of how resource extraction and political systems interact, however. Some theories regard political institutions fixed and examine how institutions shape the way a country's economy responds to a resource windfall. Others treat resource windfalls as exogenous events that alter a country's political institutions, for example by altering property rights, democracy, political stability or friendliness to rent-seeking.[5]

This survey focuses on political economy theories of the resource curse and scrutinizes how well, or poorly, these theories have been integrated with empirical work.[6] One reason why this integration is important lies in the practical importance of pinning down the causal links involved in the resource curse. Simply verifying that resource abundance is empirically linked to slow growth is of little practical value. Policy makers in poor countries and in the international development community would need to know the transmission mechanism in order to do anything useful with the information. Telling countries to lock up their resource wealth is neither credible nor useful. On the one hand, if the resource curse is simply a statistical artifact and not a causal phenomenon, then leaving resources unexploited in order to avoid a growth slow-down will fail to have the desired effect and will succeed only in wasting a valuable opportunity. On the other hand, if the resource curse is real, and for example operates through political institutions, then understanding the mechanism may allow a country to reform its institutions and exploit its resource wealth while avoiding the curse.

[5] Bulte and Damania (2003, pp. 3–6) provide an efficient review of much of this literature and related work on economic growth, emphasizing theoretical contributions. Ross (1999) describes two other approaches to understanding the resource curse based on noneconomic reasoning. One stresses the role of cognitive malfunctions resulting from resource booms and another argues that resource booms enhance the political clout of private individuals who favor growth-impeding policies. He also reviews the rentier state theory, which contends that resource wealth frees rulers from the task of levying direct taxes and consequently makes them less accountable to the societies they govern.

[6] Stevens (2003) and Rosser (2006) have surveyed much of the early resource curse literature. The present review's emphasis on political economy theories and their testing differentiates it from recent reviews by Frankel (2010) and van der Ploeg (2011), both of which treat market-based explanations for the resource curse in detail.

A second reason for focusing on integration of theory and empirics is that the resource curse is a potentially fruitful venue for testing political economy theories generally. The presumed causal factor or outcome variable, depending on the direction of causation, is generally observable. In theories that attribute political outcomes to resource wealth, the causal factor is the arrival of a resource windfall and such windfalls can generally be documented. In theories that attribute resource extraction outcomes to political institutions, the outcome variables can generally be observed, for example, in exploration activity, production rates, nationalization events, etc. Often, one can pin down the arrival time of a resource windfall, as when a discovery is made or when a resource price jumps, enabling research designs that examine within-country behavior before and after an event while controlling for untreated observations.

The remainder of this section gives an overview of the broader economic literature on the resource curse, explaining how interest first arose and summarizing the market-based and political economy theories developed to explain it. After these preliminaries, the focus tightens to political economy research on the resource curse.

1.1 Market-based Theories of the Resource Curse

Sachs and Warner (1997, 2001) reported early cross-country evidence suggesting a resource curse. They related growth in per capita income to the importance of primary products in a country's exports, which they interpreted as natural resource abundance, controlling for initial income, openness to trade and the investment to GDP ratio.[7] The resource abundance effect was negative and substantial — seemingly a resource curse. A one standard deviation increase in the primary products export share reduced a country's predicted growth rate by 0.6 to 1.5 percentage points. Sachs and Warner (1997, 2001) emphasized the "Dutch disease" as an explanation, a market-based theory to

[7] Primary products include food, agricultural goods, fuels, and minerals, so the goods are heterogeneous. Further, the export share is both a flow variable, rather than abundance, and is clearly determined by economic behavior, that is, endogenous. These points have been emphasized by critics.

explain the poor economic performance of the Netherlands following the discovery of North Sea oil.[8] The Dutch disease theory postulates that a natural resource boom causes a country's exchange rate to appreciate, making its manufacturing exports less competitive. If manufacturing exports are the engine of growth and resource exports are not, as Dutch disease adherents claim, then a resource boom that crowds out manufacturing will retard growth.[9] Bulte et al. (2005) conclude that the Dutch disease theory has little empirical support, however, noting that terms of trade effects generally are not significant in economic growth regressions. They also emphasize the varied experiences of resource rich countries and the abundance of exceptions to the curse.

The Dutch disease is one of several conventional explanations based on a "crowding out" phenomenon, whereby a windfall diverts economic activity in counter-productive ways. In Gylfason's (2001) view a resource boom can cause a nation to regard its natural resource wealth, not human capital, as the key to its future and to neglect educational investment as a result.[10] Torvick (2002) sees the resource curse arising because a resource boom diverts entrepreneurial talent away from wealth creation which could modernize an economy, and toward seeking resource rents from the public sector.[11]

Early arguments for slow growth in resource intensive economies were structuralist in nature. One claimed a natural tendency for resource exporting countries to experience declining terms of trade and reduced ability to import the capital goods needed for modernization.[12] Subsequent empirical analysis failed to support this explanation.[13] Another structuralist explanation stressed volatility in natural resource

[8] This paragraph and the next introduce these arguments and briefly explain how they work, without commenting in any detail on evidence for or against them.

[9] van der Ploeg (2011) provides a detailed summary of Dutch disease theory and other market-based explanations for the resource curse. Different variants of the Dutch disease model are cited in Stevens (2003).

[10] Birdsall et al. (2001) also stress a link between resource abundance and low educational investments, but see the effect operating through a political channel.

[11] Torvik's (2002) model is actually based on a political economy argument. It is elaborated and extended in Mehlum et al. (2006a); this extension is discussed in detail later in this review.

[12] Stevens (2003) describes several of the leading market-based arguments and related empirical evidence.

[13] Bulte et al. (2005).

prices and argued that such volatility aggravates investor uncertainty and makes it difficult to follow prudent fiscal policies (Stevens, 2003).[14] In support of this explanation, van der Ploeg (2011) cites evidence from the empirical macroeconomics literature that exchange rate volatility is indeed bad for investment and growth.[15] Other structuralist explanations argue that a volatile exchange rate *directly* hinders exports and prospects for export-led growth (Gylfason et al., 1999).

1.2 Political Economy and the Resource Curse

The recent emphasis on political explanations stems partly from econometric findings that resource abundance is most likely to be a curse when the resource is concentrated rather than dispersed and when the host country's political institutions are initially weak. Over a decade earlier, however, evidence from Gelb's (1988) study of six oil exporters hinted that conventional economic arguments could not fully explain the growth performance of oil-rich states following the price shocks of the 1970s. The oil windfalls were mainly spent on investment, which conventional growth theory predicts should accelerate growth, yet growth in these countries lagged. Government and politics clearly had the potential to play important roles in these outcomes, as 80% of the windfalls accrued to national governments and the oil-financed investments were largely for public infrastructure that yielded meager returns. In short, decision-making by government was a significant factor.[16]

A substantial body of case study evidence linking the resource curse to politics gives additional motivation to explore political drivers. After surveying outcomes in six resource rich countries, Karl (1997) concludes that resource wealth and resource rent windfalls can alter the political climate in the host country, particularly if it starts from a weak institutional base. She finds that having wealth concentrated in minerals, with mineral rents accruing to the State, alters the framework for

[14] Sachs and Warner (1997) allowed for the effect of export price volatility in their empirical analysis but did not find a negative effect on growth.

[15] van der Ploeg and Poelhekke (2009) report evidence linking slow growth and low investment to unanticipated volatility in output.

[16] See Gelb (1988), Sections 3 and 5.

decision-making and the locus of authority in government and influences the types of institutions and policies adopted. Mineral resources tend to be concentrated in space and the European colonists who first exploited them found that they could extract rents by controlling only specific mining and export sites, without extending civil authority and the rule of law to the countryside (Karl, 1997, pp. 60–61). In the case of Venezuela the dominance of oil in the economy and its control by the state after nationalization promoted a rent-seeking culture and a patron-client system of governance. A secondary effect was that those with entrepreneurial talent were enticed away from wealth creation and into rent-seeking. A hardwood timber price boom in Southeast Asia had a similar effect on governance in the Philippines, in Indonesia and in the Malay states of Sarawak and Sabah (Ross, 2001). Timber became a dominant economic force in all three countries and political elites altered institutions to acquire greater control over resource rents. Corruption increased and political power became more concentrated as elites channeled these newly created rents to political supporters.

Recently, evidence of a different kind of resource curse has emerged — a link from natural resource wealth to political instability and armed conflict. The presumed motivation for such a link is twofold: resource wealth may be captured by rebels and used to finance a rebellion, and the possibility of controlling resource wealth if the rebellion succeeds strengthens the case for initiating a conflict. A detailed treatment of theoretical work on this phenomenon is outside the scope of the present survey. Empirical evidence is briefly reviewed in Section 5.[17]

The remainder of this review examines theories and empirical evidence on the link between political conditions and perverse responses to resource booms. Certain aspects of the strategy taken in this review should be noted at the outset. Most of the discussion is directed to detailed examination of a handful of political economy models and to empirical evidence directly linked to these contributions. The review does not dwell on descriptions of a large body of purely empirical contributions unless they provide evidence that bears on the tenability

[17] Ross (2006) surveys much of this work. Collier and Hoeffler (1998, 2004) have made key empirical contributions and van der Ploeg and Rohner (2010) provide a model of resource-based conflict.

of a particular political economy theory. Among the purely empirical studies reviewed, some are discussed in greater detail than others. One particular genre of empirical work, based on cross-country cross-sectional data and using the ratio of primary product exports to GDP as a measure of resource abundance, is described only summarily.[18]

The following section draws together some common threads from the broader political economy literature and identifies the degree to which political power is concentrated as a key determinant of government performance in the models reviewed subsequently. Political economy theories of the resource curse based on rent-seeking are reviewed in Section 3; these models treat policy outcomes as the result of competing private interests without actually incorporating political institutions. Section 4 reviews political economy theories that incorporate institutions explicitly. Reviews of theoretical work emphasize the empirical implications of individual models and empirical evidence on these implications. For expositional reasons empirical work linked to specific theoretical models is reviewed along with the model discussions rather than in a separate section. Papers offering general empirical findings without developing new theory are covered in Section 5. Conclusions are presented in Section 6 and focus on strengths and weaknesses of the existing literature, whether empirical analysis has successfully corroborated or refuted predictions from theoretical analysis, opportunities for future empirical research, and the question of whether or not the resource curse is a "real" phenomenon.[19]

[18] In recent years this voluminous body of work has come under criticism for reasons outlined in Section 5.

[19] Certain political economy aspects of resource use are excluded in order to keep the discussion focused. These include the effect of political instability on resource use and the effect governance has on whether resources are managed to deliver broadly dispersed benefits or concentrated payoffs to politically powerful groups. The former question is addressed on Bohn and Deacon (2000) and Deacon (1994); for a review, see Deacon and Mueller (2006).

2

Political Economy Precursors

A distinguishing feature of government is its monopoly on sanctioned coercion. This monopoly power can be used either to enhance the welfare of society at large or to enrich the specific individuals who control government's actions. Government's coercive power benefits society at large when it is used to collectively organize public good provision or to solve coordination problems, for example, by formulating traffic laws and penalizing noncompliance. Government's coercive power can also be used to benefit specific individuals by transferring wealth accumulated by others to those who control government's actions. When government coercion is used in this fashion it generally diminishes the incentive to accumulate wealth in the first place. While government behavior has many dimensions, focusing on just two alternatives, public good provision versus transfers to elites, can be illuminating.

Several theories of the resource curse build on a prominent argument in the broader political economy literature: the degree to which government focuses on providing public goods versus transferring wealth to powerful groups largely depends on the degree to which political power is dispersed versus highly concentrated. The basic reasoning is straightforward. In order to control government, a potential leader must

capture more of the political power or influence in a country than any rival can.[1] If political power is dispersed and competition for office is vigorous, a successful political strategy must use government's coercive power to confer benefits that are also broadly dispersed. The economies of scale inherent in providing public goods to large numbers imply that public good provision is an effective way to gain office in this circumstance. Spending the public budget on transfers to specific groups in exchange for political support is relatively unattractive because the large size of the group whose support must be won dilutes the transfer each member would receive. Alternatively, if political power is concentrated among a few individuals or groups, making focused wealth transfers to a subset of these elites is an effective way to gain and hold office; providing nonexclusive public goods such as impartial law enforcement would be ineffective because most of the benefit would accrue to nonelites.

This basic intuition plays a key role in political economy theories of the resource curse reviewed in Sections 3 and 4. It is also important in the broader political economy literature. It drives McGuire and Olson's (1996) predictions on public good provision under different governance systems. It is parameterized in Grossman and Helpman's (1994) "protection for sale" model of government policy outcomes.[2] It also motivates theoretical predictions on public good provision under dictatorial versus democratic political systems and agrees with empirical tests of these predictions.[3] The fundamental forces that shape the distribution of political power are not well understood, but arguably could include a country's history, climate, geography, and religion (Acemoglu et al., 2001). Certain political economy treatments of the resource curse regard government behavior as endogenous, subject to change if a resource windfall arrives.[4] While regarding government behavior

[1] See Putnam (1993), Bueno de Mesquita et al. (2003), and Acemoglu and Johnson (2005).
[2] Grossman and Helpman (1994) characterize government policy as choices made to maximize a weighted sum of social welfare and the utility of government decision-makers and choosing the weights appropriately allows one to characterize choices by autocracies, democracies, and variations in between.
[3] See Deacon (2009).
[4] On the importance of history, Putnam (1993) traces differences in the concentration of political power in various regions of modern Italy to events that occurred centuries earlier.

as endogenous, these models still take government's basic character, that is, the underlying distribution of political power, as given. Their predictions concern how a resource windfall will play out in observable aspects of governance, for example, in the prevalence of corruption or the likelihood of violence, given an underlying distribution of political power.

Alternative theories of government's role in an economy stress factors other than the distribution of political power. According to a contracting theory the State's main beneficial role is to enable the creation of property rights by providing a legal framework in which private parties can carry out exchange. Acemoglu and Johnson (2005) recognize this point, but argue that the distribution of political power affects government actions and economic outcomes at a deeper level because it regulates the vertical relationship between ordinary private citizens and the politically powerful. An economic theory of governance put forth by Demsetz (1967) and North (1981) holds that institutions are created when the social benefits from creating them outweigh the transactions costs. An implication is that countries with great material wealth stand to gain more from governments that provide public goods and protect assets from theft than do impoverished societies, which

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In some countries political influence flows entirely from control of a military force, as in the Dominican Republic under Trujillo. Both recently and in the distant past, concentrated political influence has resulted from extraordinary religious authority, credible adherence to a political doctrine or membership in a royal family. Some observers regard basic cultural factors, particularly the degree of trust and tolerance present in a society, as key determinants of how a government performs; see (LaPorta et al., 1999; Putnam, 1993). Societies lacking trust and tolerance are considered less likely to develop governments focused on providing public goods broadly and more likely to develop governments that serve the interests of narrow elites. Some trace trust and tolerance, in turn, to such factors as religion and historical experience.

In democratic systems, where political power is generally regarded as broadly dispersed, variations in concentration can arise due to different voting rules. Those who study such systems derive predictions on public good provision versus transfers that mirror predictions from the broader literature. Lizzeri and Persico (2001) examine provision of a pure public good versus pork-barrel transfers under majoritarian versus proportional voting systems, regarding the former as relatively power-concentrated and the latter as power-dispersed. Milesi-Ferretti et al. (2002) test similar predictions with cross country data on spending for targeted versus broadly dispersed public goods.

broadly agrees with cross-country evidence. The same correlation is consistent with causation running in the opposite direction, however.[5]

The importance political scientists assign to the concentration of political power in determining government behavior is indicated by the central role this factor plays in the Polity database (Marshall and Jaggers, 2000). The Polity scores assigned to countries for autocracy and democracy largely reflect the presence of constraints on executive authority, the degree of political competition and the openness of executive recruitment. Operationally, countries tend to receive higher scores for democracy (and lower scores for autocracy) when the power of the legislature is strong vis a vis the executive, when groups in society are not excluded from participating in government and when competition for the control of government is vigorous. High democracy scores are consistent with a relatively uniform distribution of political power because they indicate fewer barriers to entry into political life, greater popular control of executive decisions (often by effective, popularly elected legislatures) and less exclusive control by political elites.[6]

[5] Tests of these alternative theories have generally relied on cross country panel data. Acemoglu and Johnson (2005) found pervasive links between unequal political power and unfavorable outcomes for investment, economic growth, and wealth. In tests of the contracting theory the same authors found that variations in legal systems are significantly linked to economic performance, but these effects are largely confined to financial markets. Comparative empirical tests of political, economic and cultural theories of governance reported by LaPorta et al. (1999) indicate that political factors such as legal origins and ethnic heterogeneity are strongly linked to public good provision and political freedom. The same study found evidence consistent with the economic theory of governance — that good institutions arise when demand is sufficient — but causation was questionable, as strong economic performance clearly could be a direct consequence of good government. Support was also reported for a link between good governance and cultural factors as indicated by religious affiliation.

[6] Given the economic costs of poor governance and corruption, it is natural to ask why Coasian bargaining does not arise to capture the gains that could be realized by providing public goods such as legal institutions and public safety. Under the required bargain a powerful, elite-dominated government would create a system of legal rights leading to wealth creation in exchange for a share of the added wealth. Acemoglu (2003) and Acemoglu and Johnson (2005) see the fundamental impediment as one of commitment — the elite's promise to fulfill the terms of the exchange is not credible if they are not constrained by pre-existing legal institutions. In fact any wealth creation would only add further incentive to confiscate. In addition, the groups seeking property rights protection would need to solve a coordination problem in striking a deal with the sovereign because the rights system is a public good to those it protects. Government's commitment problem is prominent in the political economy model reviewed in Section 4.1.

3

Models of Rent-seeking and the Resource Curse

This section and the next are organized around two broad strategies used to model links between resource abundance and political institutions.[1] The present section focuses on models based purely on rent-seeking, the process whereby competing political interests expend economically valuable resources to obtain government favors. Models of rent seeking trace the size and distribution of transfers among politically powerful groups to the distribution of political influence in a country. Government institutions are typically not incorporated in these theories and "the government" is not an explicit agent. Rather, government policy is treated as the equilibrium outcome of rent-seeking competition. The transfers could take the form of government jobs with excessive salaries, bribes collected for providing public services or for overlooking violations of laws and regulations, or theft from public funds or resource extraction contracts. Presentations of certain models in this section and in Section 4 include sketches of theoretical developments for readers who are interested in this level of detail. Readers needing only an intuitive understanding can skip these theoretical sketches.

[1] J. Boyce and Herbert Emery (2005) explain how a weak version of the resource curse can arise in an ordinary, non-political model of resource extraction; their argument is summarized later.

3.1 The Political Response to Windfalls: Voracity, Growth and the Resource Curse

The "voracity" model applies to a polar case of bad governance: government's coercive power is used solely to transfer wealth from the private sector to powerful interests. The transfers are accomplished by taxes or some other policy that has the same effect, for example, theft, bribe demands, forced participation, nationalization or expropriation.[2] Government is simply a conduit for such transfers and does not appear as a separate entity. Instead, politically powerful groups independently transfer private sector wealth to themselves, constrained only by the transfers of other groups and by non-negativity constraints. In a model with a single asset the consequences of such transfers are intuitive. The private sector capital stock is effectively a common pool. Wealth appropriation diminishes the incentive to accumulate capital, which in turn lowers the economy's growth rate and its present value utility relative to the first-best outcome. The first-best outcome would be attained if there were only one group since a single group would internalize the negative effects of wealth transfers. If the elasticity of intertemporal substitution is sufficiently low, economies with many powerful groups will experience slower growth and lower welfare than economies with few such groups. These predictions agree with intuition about common pools.[3]

The model's key results emerge with the introduction of a second asset that is less productive than the first, but immune to appropriation. In a developing economy the second investment option could be capital accumulated in the "informal" economy, the sector that is hidden from tax authorities. Alternatively, the second sector might be the capital market in a foreign wealth haven, a country whose governance system protects assets from arbitrary appropriation. To fix terms, the respective sectors are called "formal" (vulnerable to transfers) and "informal" (less productive but immune from transfers) in

[2] The initial description of the model's setup follows Tornell and Velasco (1992); additional features introduced in Lane and Tornell (1996) and Tornell (1999) are discussed later. Other aspects of this model have been developed in Tornell and Lane (1999) and Tornell and Lane (1998).

[3] See Tornell and Velasco (1992, Eq. 4c).

what follows. When this wealth haven is introduced capital flows from the formal to the informal sector. Because the informal sector has a lower rate of return the economy's growth rate and present value welfare are sub-optimal. Depending on parameter values, introducing the informal sector may or may not improve welfare.[4]

Surprisingly, an increase in the return to formal sector capital (due to enhanced productivity or a higher output price) causes transfers by elite groups to increase by *more* than the productivity gain, resulting in a smaller formal sector capital stock. Tornell (1999) call this phenomenon the "voracity" effect.[5] Its strength depends on the number of competing groups. Each group, i, chooses a share of formal capital to transfer to itself, taking as given the shares all other groups choose to transfer to themselves and knowing that its own transfer share will reduce the net (after-transfer) rate of return perceived by other groups. If i's transfer demand causes the net rate of return faced by other groups to fall below the rate of return in the informal sector, then other groups will demand to transfer the entire stock of formal capital. This knowledge disciplines the transfer group i demands, but the discipline is relatively modest when there are only a few groups. With a small number of groups each knows that it will get back a relatively large fraction of what is transferred in aggregate; each group also knows that the same is true for other groups. This allows the formal capital sector to keep operating even if the share transferred exceeds what would be required to equate net rates of return.

Conversely, when the number of groups is large the fraction of aggregate transfer each gets back is small, and this effect is diminished. This implies that when there are many interest groups, so political power is diffuse, the negative effect of wealth transfers on growth and welfare are diminished, which agrees broadly with the political economy theories summarized in the preceding section.[6]

[4] The key parameters are the elasticity of intertemporal substitution and the productivity difference between the two sectors.

[5] From this point forward the discussion primarily follows Tornell (1999). Lane and Tornell (1996) develop a simpler one-sector model in which the voracity effect can still emerge under certain parameter values.

[6] The number of groups must be at least two for this effect to be present. An economy with one group would internalize all effects and reach a first-best outcome.

The negative growth response to an increase in productivity is what connects the voracity model to the resource curse. If formal capital consists mainly of natural resource wealth, a resource price boom or a new discovery would raise the formal sector's rate of return.[7] According to the voracity effect this should cause capital to flow to the less productive sector and growth should slow. Voracity only operates in the absence of institutional barriers to rent seeking, however. By implication, a resource productivity windfall should increase growth and welfare if barriers to such transfers are present. As elaborated shortly, this provides an explanation for why economic performance following the oil boom of the 1970s was so different in, for example, Norway versus Nigeria and directs empirical researchers to allow for different resource boom effects in different institutional contexts.

3.1.1 A Sketch of the Voracity Model

A streamlined version of this model can illustrate its underlying assumptions and basic structure.[8] Aggregate capital in the formal sector, $k(t)$, produces output valued at p per unit and has a net physical rate of productivity α. Absent transfers from the stock it would grow according to $\dot{k}(t) = p\alpha k(t)$. There are n politically powerful groups in society. They act independently and each can transfer a portion of the aggregate stock to itself. Groups are identical and in equilibrium each demands the same transfer, $r(t)$, from the stock in any period. From the perspective of a single group the rate of return on a unit of capital left in the formal capital stock is

$$p\alpha - (n-1)r(t)/k(t) \equiv p\alpha - (n-1)x(t), \tag{3.1}$$

[7] The degree to which the voracity model fits what actually happens in resource booms is discussed later.

[8] The following sketch omits numerous details and assumptions present in Tornell and Velasco (1992) and Tornell (1999). It also adopts some slightly different notation in an attempt to provide consistent notation across several of the models surveyed. van der Ploeg (2010) develops a voracity model in which the common pool stock is an exhaustible resource rather than produced capital. He develops results on the extraction paths chosen by independent groups and compares them to the familiar Hotelling and Hartwick rules for exhaustible resource extraction.

where $x(t)$ is the equilibrium share of capital each group transfers to itself. When figuring the private rate of return to formal capital, a group does not deduct the share it receives itself because this is not lost to others.

Individual groups form strategies regarding transfers and consumption by maximizing constant relative risk aversion utility functions with constant discount rates. To simplify comparisons we focus on the case where the elasticity of intertemporal substitution is 1, so the utility function for each group is $U = \int_0^\infty \log(c(t))e^{-\delta t}dt$, where $c(t)$ is a group's consumption in period t and δ is the discount rate. The solution concept is Markov perfect equilibrium and strategies are restricted to be functions of the two payoff relevant state variables, the formal and informal capital stocks. Each group chooses a transfer demand taking as given the transfer rules of other groups. Each group therefore internalizes the effect its own actions have on the common pool capital stock (a payoff relevant state variable) and on the transfer demands of other groups. In an economy with only one asset the equilibrium growth rate of the formal (common pool) capital stock is $p\alpha - n\delta$.[9] This implies that each group's present value utility in the one asset economy equals

$$U^1 = \log(k(0)\delta)/\delta + (pa - n\delta)/\delta^2.^{10} \tag{3.2}$$

With only 1 group the first-best growth path is attained and (recalling $\sigma = 1$) capital grows at rate $p\alpha - \delta$.

The key results emerge with the addition of a second capital sector, which has productivity $\beta < p\alpha$ but is immune from transfers.[11] The authors focus on "interior" equilibria, outcomes in which no group chooses to appropriate the entire formal capital stock all at once. Depending on parameter values there may also be "extreme" equilibria in which each group demands transfer of the entire formal capital stock at each point in time.[12] When the second sector is introduced

[9] The results in this sentence and the next are from Tornell and Velasco (1992, p. 1213) for the $\sigma = 1$ case, where the price of output, p, has not been normalized to unity.

[10] The negative relationship between present value welfare and the number of groups, n, is intuitive in light of the common pool analogy, but it depends on the $\sigma = 1$ assumption.

[11] From this point forward the discussion primarily follows Tornell and Lane (1999).

[12] Lacking a theory of what might limit such extreme demands they dismiss these extreme equilibria as uninteresting.

capital flows out of the common pool formal sector and into the less efficient but secure informal sector. If the number of groups is relatively small the aggregate transfer is large and the after-transfer rate of return on formal capital is driven down to equality with the informal sector's rate of return. Capital is accumulated in both sectors in this case. With a larger number of groups, transfers of formal capital are smaller and equilibrium is reached before rates of return on the two stocks are equalized. Transfers from the formal capital stock are entirely consumed in this case. In both cases the equilibrium rate of return is lower than $p\alpha$ so the growth rate and present value utility are lower than levels attainable in the first-best outcome.

The voracity effect describes what happens when the return to formal sector capital increases. It is most easily seen where n is small and capital is accumulated in both sectors. After tax rates of return are equalized in equilibrium in this case so

$$p\alpha - (n-1)x = \beta. \tag{3.3}$$

(Recall that x is the common share of k transferred by each group in equilibrium.) To demonstrate the voracity effect, suppose the terms of trade in the formal sector increased by $\Delta p > 0$. To maintain equality in after-tax rates of return between formal and informal sectors, the share of k each group transfers to itself must increase by $\Delta x = \Delta p\alpha/(n-1)$. The aggregate share of formal capital transferred, nx, therefore changes as follows:

$$n\Delta x = \Delta p\alpha \cdot n/(n-1) > \Delta p\alpha. \tag{3.4}$$

On balance, the aggregate k transferred out of the formal sector exceeds what is generated by the productivity increase. The same effect would result from an improvement in the formal sector's physical productivity, α.

This is the "voracity effect." If the formal capital stock's productivity increases, each group demands a larger transfer and the increase in aggregate transfers exceeds the value of the productivity gain. Capital flows from the formal to informal sector following the productivity increase, which reduces the growth rate of the formal capital stock. The welfare effect of this slowdown depends on whether the number

of groups is greater or smaller than a critical value $\tilde{n}$. If $1 < n \leq \tilde{n}$, the economy accumulates positive capital stocks in both sectors and both stocks earn the informal sector's rate of return, β. The productivity gain shifts capital between sectors but leaves the rate of return perceived by each group unchanged. Each group's consumption and investment decisions are therefore also unchanged and the economy stays on the same growth path as before, so present value welfare is unchanged.[13] If $n > \tilde{n}$, the windfall-induced transfers of formal sector capital are not large enough to drive the after-transfer rate of return on k down to the informal rate of return. The transfers resulting from the windfall are entirely consumed in this case, so capital accumulation and consumption growth are both reduced and each group's present value welfare falls.

The number of powerful groups thus plays an important role. Windfalls cause more damage for "large n" economies than "small n" economies, but the former always perform better than the latter. Comparing two economies that differ only in the number of such groups, the one with the larger n always achieves a higher growth rate and greater present value utility. Tornell and Lane (1999, p. 42) interpret the salutary effect of a larger n as follows: "... if the shift to democracy brings with it the destruction of entrenched interest groups, and power becomes more diffused, then growth performance and adjustment to windfalls will improve." While their interpretation is reminiscent of arguments from political theories that emphasize the importance of widely dispersed political power for "good" governance, the reasoning embedded in the voracity model is entirely different.

3.1.2 Voracity and Natural Resource Stocks

When imagining a resource windfall that sets off a feeding frenzy it is difficult not to think of either petroleum or diamonds. *Non-renewable* resource stocks do not exactly fit Tornell and Lane's (1999) description of formal capital, k, however, since they are not physically productive and are drawn down over time rather than accumulated. In the case of

[13] The windfall due to the formal sector's improvement is just offset by the loss that occurs when capital is shifted from the more productive to less productive sector.

oil a better fit for k is the capital invested in resource extraction such as production wells, pumping equipment, pipelines and port facilities. This capital is physically productive and a new discovery or oil price increase would increase its rate of return. In countries prone to rent-seeking it is plausible that a portion of any windfall will be captured by powerful political interests. With this characterization the voracity model gives sharp predictions for resource-based economies. First, absent barriers to rent-seeking, investment in resource extraction capital and its after-transfer rate of return will be suboptimal. More specific to voracity, a productivity windfall will cause transfers of such capital that exceed the value of the windfall, resulting in a net reduction in formal capital devoted to resource extraction. Depending on the number of groups a windfall may lower the after-transfer rate of return, the economy's growth rate and present value welfare.

A *renewable* resource stock located in a country with weak institutions arguably fits the voracity model directly. An example is a forest with biomass k that regenerates according to $\dot{k}(t) = \alpha k(t)$, where the growth rate (α) is assumed to be locally constant. If special interests can use the political process to transfer a portion of the stock's value to an untaxed informal sector the analogy is complete. Transfers might take the form of fraudulent harvest concessions, outright theft of timber from government forests or diversion of timber revenues to political allies. The situation in Indonesia during the timber boom described by Ross (2001) fits this description reasonably well.

3.1.3 Evidence on Voracity

Tornell and Lane (1999) provide somewhat informal tests of the model's key predictions: a resource price or productivity increase in a country lacking institutional barriers to rent-seeking will cause increased transfers from the formal sector, a fall in the growth rate of formal capital and formal sector output, and a reduction (or no change) in the return on formal capital. They focus on the response of transfers and economic growth rates to oil price shocks, and compare economic performance in 1970 to performance during the oil price peak of the early 1980s in three oil rich states: Nigeria, Venezuela, and Mexico. All three countries

had notoriously low institutional quality during this period, indicating few barriers to transfers. Government transfers as a share of GDP in each country more than doubled between 1970 and the early 1980s, which agrees with the voracity effect if these transfers are indeed payments to powerful interests.[14] In the same period GDP growth rates in all three countries were well below predicted values from a cross-country growth regression and were actually negative in Nigeria and Venezuela.

In Lane and Tornell (1996) the focus is on the institutional conditions required for the voracity effect to operate, the presence of powerful rent-seeking groups and an absence of institutional restraints on transfers. Arguing that industrial interests often are politically powerful and are most likely to be influential when highly concentrated, they construct a dummy variable for a concentrated manufacturing sector. A second dummy variable, based on data from the International Country Risk Guide, is defined to indicate weak institutional barriers to rent-seeking. Interacting these two variables yields a dummy variable, labeled *Power*, which takes the value 1 when manufacturing interests are concentrated and institutional barriers are weak and is zero otherwise.[15] The format for testing is a standard cross-country cross sectional regression equation in which the dependent variable is, alternately, per capita income growth and the average investment share of GDP over 1970 to 1990.

A central prediction is that countries vulnerable to voracity ($Power = 1$) will experience slower or unchanged growth in output and formal sector investment following a windfall while nonvulnerable countries should experience faster growth in both terms following a windfall. The authors equate windfalls with positive terms of trade shocks and their empirical model controls for initial income, education and continent fixed effects. They find that positive terms of trade shocks yield significant growth improvement in non vulnerable

[14] In Mexico, government's share of GDP rose to 250% of its 1970 value during the oil price peak of the early 1980s.

[15] *Power* equals 1 when at least 50% of manufacturing value added is concentrated in 3 or fewer 3-digit sectors *and* when the ICRG score reported by Knack and Keefer indicates weaker institutions than the sample median.

countries, but not in voracity-vulnerable countries. They also report that investment responds negatively to positive terms of trade shocks in voracity-vulnerable countries, but this evidence is less robust.[16]

This evidence was recently extended in an analysis of panel data for 145 countries during 1970–2007 (Arezki and Brückner, 2010). The driving variable in this work is commodity price indices for individual countries, which are used to capture formal sector price booms. A distinctive feature is the treatment of ethnic "polarization," measured to represent how close a distribution of ethnic groups is to a bimodal distribution with two groups. This indicator is maximized when there are two equal size groups, which matches well with the voracity model. When examined using panel data with fixed effects for countries and years, the results agree well with voracity predictions. In nonpolarized countries commodity price booms increase foreign asset holdings and domestic investment, consistent with conventional predictions on current account responses. Price booms in highly polarized countries, however, leave foreign investment largely unchanged and are followed by significant *decreases* in domestic investment. Links to a political explanation are readily verified; in highly polarized countries commodity price booms are followed by increases in government expenditures, corruption and expropriation risk. No such effects are observed in less polarized countries.

3.2 Rent-seeking and the Misallocation of Entrepreneurial Talent

Spain's appropriation of gold and silver from the new world in the 16th century was arguably the most spectacular natural resource windfall documented historically. Spain's boom and bust cycle during that century and the next — with eight declarations of bankruptcy between 1557 and 1680 — could be considered a resource curse of epic proportions. One observer (Karl, 1997, p. 35) attributes Spain's downfall in

[16] They also find that voracity-vulnerable countries had significantly slower growth and lower investment than non vulnerable countries during 1970–1990.

part to a diversion of entrepreneurial energy from wealth creation to rent-seeking:

> "[The monarchy] consolidated the loyalty of the lesser aristocracy through political favoritism, especially by selling patents of nobility and ecclesiastical appointments. This practice dramatically expanded the size of a parasitic noble class ... while simultaneously siphoning off the most productive talent from business and commerce. ... The state bought the talents of those who might have become small entrepreneurs through awarding of offices ..."

This specific mechanism, whereby a resource windfall becomes a curse by diverting entrepreneurial talent away from wealth creating industrialization and toward rent-seeking, is formalized in Torvik (2002) and Mehlum et al. (2006a,b). They characterize the potential gains from entrepreneurship and industrialization by adapting a model of Murphy et al. (1989) in which use of a "modern" technology yields increasing returns to scale and greater efficiency in production. Such modernization raises income and demand, which facilitates adoption of modern production methods elsewhere in the economy. This positive externality, which operates through demand, can be exploited by adopting a "big push" policy as described by Murphy et al. (1989).

The key assumption in Mehlum et al. (2006a) is that a fixed number of individuals have entrepreneurial skills that can be used in only one of two alternative activities, operating modern enterprises that can generate positive growth externalities or engaging in unproductive rent-seeking.[17] A resource rent boom makes rent-seeking more attractive and causes some producing entrepreneurs to abandon modern production. Switching continues until the private returns in the two pursuits are

[17] The following discussion focuses on Mehlum et al. (2006a) although many of the ideas and some of the results in this article can be found in Torvik (2002). The latter article does not incorporate two features that are prominent in Mehlum et al. (2006a), the notion that property rights to produced wealth are eroded by rent-seeking and an explicit growth mechanism. Mehlum et al. (2006b) reports their central theoretical argument and key empirical results.

equalized. Absent the demand-linked externality from modern production the net result would be exact dissipation of the rent that set the reallocation in motion. With the demand externality, the net effect of a resource boom is to *reduce* economy-wide income. Abandoning one modern firm reduces demand for all remaining modern firms, which induces additional entrepreneurs to switch to rent seeking and lowers income even further. Since the net loss in income exceeds the resource rent that started the process, the result is indeed a curse.

Mehlum et al. (2006a) incorporate a role for institutional quality by specifying that the payoff to rent-seeking depends both on the size of the resource rent and on the quality of a country's institutions. Given a level of resource rent, sufficiently high institutional quality will prevent a resource curse from occurring because rent-seeking never becomes sufficiently lucrative to attract entrepreneurs away from modern production. If institutional quality is below a critical level, however, the same resource rent will divert entrepreneurial talent and the resource curse will ensue. The institutional threshold required to escape the curse depends on the size of the resource rent, so a large enough resource boom could cause an otherwise well-functioning country to slip below the threshold and end up in a rent-seeking equilibrium.

To convert an essentially static analysis to a model of growth, Mehlum et al. (2006a) assert that a fixed number of new potential entrepreneurs is added to the pool each year and the existing stock is reduced according to a fixed, proportional rate of mortality. In resource-poor countries the new arrivals tend to enter modern production and generate growth-inducing externalities. In resource-rich countries new arrivals gravitate toward unproductive rent-seeking. In this fashion the static prediction that resource rich countries tend to be poor is transformed into a prediction on growth.

3.2.1 A Sketch of the Diverted Entrepreneurship Model

Consider an economy that has N individuals with entrepreneurial talent, each of whom may be drawn into one of two activities: operating a "modern firm" that uses an increasing return to scale technology and earns a profit or competing in the political arena to grab a portion of

a natural resource rent. A modern firm's profit measured in units of labor (the numeraire) is $\theta y - F$, where $\theta(>1)$ is a constant determined by the modern production technology, F is a fixed cost, and y is the firm's rate of output. Labor is supplied inelastically in amount L so any payment it receives is a rent. In addition, the economy's natural resource generates a rent of R per period. If there are n_p entrepreneurs operating modern firms, total rent is

$$Y = (\theta y(n_p) - F)n_p + L + R. \tag{3.5}$$

Output per modern firm is an increasing function of the number of modern firms, $y = y(n_p)$, due to the externality argument described earlier.[18] Clearly, the economy's net rent is an increasing function of the number of modern firms and is maximized when $n_p = N$.

The number of entrepreneurs who choose modern production rather than rent-seeking is determined by an equilibrium condition — that both activities earn the same private return. We express the equilibrium condition with the following notation. Let r be the resource rent per potential entrepreneur ($r \equiv R/N$). Let $\lambda \in [0,1]$ be an increasing indicator of institutional quality, such that $\lambda = 0$ when all resource rents are captured by rent-seekers and $\lambda = 1$ when rent-seekers and producers both receive the same share. Finally, let $s = s(n_p, \lambda)$ be a multiplicative factor that indicates the fraction of resource rent an individual rent-seeker captures. Obviously, $s(n_P, \lambda)$ is increasing in the number of productive entrepreneurs, n_p, since having more productive entrepreneurs means that fewer individuals compete against one another in the rent-seeking process. Also, $s(n_P, \lambda)$ is decreasing in institutional quality, λ, since higher quality institutions prevent rent-seekers from grabbing R entirely. With this notation, the equilibrium condition is

$$\pi_P \equiv (\theta y(n_P) - F) + r\lambda s(n_P, \lambda) = rs(n_P, \lambda) \equiv \pi_G,^{19} \tag{3.6}$$

where π_p is the return to productive entrepreneurship and π_G is the return to rent-seeking. After rearranging, (3.6) implies that the number

[18] The authors invoke a technical condition guaranteeing that the modern firm's output is large enough to cover its fixed cost.

[19] Notice that productive entrepreneurs and rent-seekers receive equal rent shares when institutional quality is high, $\lambda = 1$, whereas all rents go to rent-seekers when institutional quality is low, $\lambda = 0$.

of potential entrepreneurs engaged in rent-seeking will increase if and only if

$$(\theta y(n_P) - F) < (1 - \lambda) r s(n_P, \lambda). \tag{3.7}$$

The left-hand side of (3.7) is the profit an entrepreneur foregoes by abandoning modern sector production and the right-hand side is the gain in rent captured by switching from production to rent-seeking. Given any n_p, an increase in r clearly shifts talent toward rent-seeking, reducing n_p. In turn, the decrease in n_p reduces the left-hand side of (3.7) and increases the right-hand side, reinforcing the initial effect. With perfect institutions $\lambda = 1$ and there is no return to rent-seeking, so all potential entrepreneurs choose to produce. The link from this static prediction to a prediction on growth was described verbally earlier; the growth extension is not formally outlined here.[20]

3.2.2 Empirical Implications and Testing

The authors make a point that echoes a key result from the voracity effect: resource wealth is a curse only in the absence of institutional barriers to rent-seeking. When institutional barriers are present a resource rent windfall should raise national income. They test this implication by adding an interaction between institutional quality and resource abundance to standard Sachs-Warner type cross-country growth regressions. Institutional quality is represented by an index that combines ratings on corruption in government, risk of contract repudiation, risk of expropriation, bureaucratic quality and rule of law.[21] In keeping with their model, resource abundance is correlated with slow growth when institutional quality is low. Significantly, they find no evidence for a Sachs–Warner resource curse in countries with high institutional quality. Their

[20] Dal Bó and Dal Bó (2009) offer a model with similar intuition. They extend a standard two-sector general equilibrium trade model by including a third "appropriation sector" that uses labor to extract output from the other two. If the return to labor in productive activity falls (relative to the return to capital) labor shifts into appropriation, increasing what the authors call "conflict." Such a reallocation could result from a positive price shock in the capital intensive sector. If petroleum or mineral production is capital intensive the result would be a resource curse of sorts. Their model does not necessarily imply a reduction in output, however.

[21] The underlying data are from Political Risk Services, measured in 1982.

resource abundance measure is the ratio of primary exports to GDP, which indicates resource dependence or sectoral composition rather than resource rent.[22] In light of this, the lack of a significant growth effect from resource abundance in countries with strong institutions is unsurprising.[23]

A country's institutional quality, λ, is an immutable parameter in Mehlum et al. (1996), presumably determined by deep cultural forces. While the authors do not spell out these determinants they might include a country's historical experience, colonial origin, legal tradition, ethnic composition, religious makeup and so forth. According to their model a sufficiently large infusion of resource rent can overwhelm institutional quality and tip an otherwise "good government" country into a rent-seeking equilibrium. In this sense, the model treats rent-seeking activity such as bribery, selective law enforcement, expropriation, and so forth as endogenous, determined in part by resource abundance. The empirical model treats similar rent-seeking variables as exogenous controls for institutional quality, however, implying that estimated effects may be biased. Arguably, a country's *susceptibility* to rent-seeking, λ, would be better represented by variables not determined by resource rents, for example, one or more of the cultural factors described earlier.

Two of the model's predictions are not tested: that the rent-seeking actions just described respond positively to a resource boom and that the curse is caused by a shift in production away from modern, increasing-returns technologies and toward more primitive methods. Other researchers (reviewed later) have found support for the first of these predictions. Regarding the second, if the large output reductions estimated by the model are actually transmitted through this channel it should be possible to observe the effects of a resource boom playing out through shifts in sectoral activity away from high-growth, technology-intensive sectors and toward less progressive, less capital- and technology-intensive modes of production.

[22] The adequacy of this ratio as a measure of resource abundance is discussed further in Section 5.

[23] What is surprising is that institutional quality alone has no effect on growth when resource intensity is low. This disagrees with results from the empirical growth literature.

3.3 Rent-seeking, Institutional Decline and the Number of Competing Claimants

Historical accounts of responses to natural resource windfalls often report that rent-seeking among competing claimants dissipates all or part of the resource rent, and that intensified rent-seeking erodes the country's political institutions. The latter point is a strong theme in Ross's (2001) examination of the hardwood timber boom in Southeast Asia and in Karl's (1997) description of events in oil producing states following the price shocks of the early 1970s and 1980s. Hodler (2006) develops a formal model that generates these phenomena as equilibrium outcomes and concludes that the rent dissipation and institutional decline resulting from a given windfall is likely to be greater in fractionalized than in homogeneous societies.

The agents in Hodler's (2006) model are interest groups that compete for a rent that each regards as exogenous. Each group has a fixed endowment of effort that it can allocate between producing a private good and a rent-seeking activity, which Hodler calls "fighting." Effort spent fighting produces no output but does allow a group to capture rent. The resource rent is effectively a "common pool" and the share a group captures equals the share that its fighting effort represents in the fighting effort of all groups.[24] A larger rent naturally leads to more fighting in equilibrium and greater waste. The mechanism for economic decline is therefore very straightforward. There is no shift away from investment to consumption or away from an efficient sector to an inefficient one; rather, productive inputs become engaged in an activity, fighting, that generates no output. With identical independent groups the degree of rent dissipation depends positively on the number of groups and approaches 100% as the number increases. This is a standard common pool result.[25]

[24] While the term "fighting" is used as a label for actions taken to acquire resource rents, this is not a model of war, instability, etc. The model and empirical analysis are directed toward understanding how diverting effort away from production and toward rent-seeking leads to low income and institutional decline.

[25] See Dasgupta and Heal (1979; Section 5). This is analogous to the way competition among Cournot oligopolists dissipates the monopoly profit all could share if they acted as a joint monopoly. As the number of independent firms increases the market outcome approaches the competitive equilibrium and equilibrium profit approaches zero.

In Hodler's specification the intense rent-seeking brought on by the windfall spills out and erodes property rights in the non-resource sector. This institutional erosion provokes a true resource curse — an actual decline in welfare resulting from a windfall. Specifically, when agents in the economy allocate a portion of aggregate effort to fighting for natural resource rents an equal proportionate share of the nonresource output is assumed to be transferred to the common pool where it is allocated on the basis of fighting effort. This is the institutional erosion mentioned earlier and it diminishes the incentive to produce ordinary output in two ways: the payoff to producing is reduced since only a portion of the output will be kept by the producer, and the payoff to fighting effort is increased since the size of the common pool prize is greater. This result rests on two key assumptions: (i) natural resource rents are allocated *only* by rent-seeking (whereas other forms of wealth are allocated on the basis of productive effort) and (ii) part of the nonresource output is transferred to the common pool when rent-seeking ensues.

The outcome is characterized as the Nash equilibrium of a one-shot, simultaneous move game. With identical groups and the functional forms adopted, very clear predictions are generated: if the number of groups is greater than 2 an increase in the natural resource windfall reduces both societal income and the security of private property rights and these perverse effects are worse the larger is the number of groups.[26]

3.3.1 A Sketch of the Model

A streamlined version of the model is sketched using the following notation. R is the fixed resource rent, K is the number of groups, and x_i is group i's fixed endowment of effort, which can be allocated either to fighting (rent-seeking), f_i, or to labor, l_i. The marginal product of labor in producing the private output is constant and normalized to 1. We initially ignore the effect of fighting on property rights to the produced good, and add that consideration in later. The share of rent captured by group i equals the share that i's fighting effort represents in aggregate fighting effort. Group i's net payoff to rent-seeking is therefore

[26] If the number of groups equals 2 the windfall has no effect on societal income. If there is only 1 group the outcome is first-best.

$\left[f_i/\sum_{j=1}^{K} f_j\right]R - f_i$ and its optimal fighting effort satisfies

$$\left[f_{-i} \Big/ \left(\sum_{j=1}^{K} f_j\right)^2\right] R = 1, \tag{3.8}$$

where f_{-i} indicates the aggregate fighting effort of all groups other than i. With identical groups, each group's fighting effort in a symmetric Nash equilibrium satisfies $R(K-1)f^*/(Kf^*)^2 = 1$, which implies a preliminary result:

$$Kf^* = R(K-1)/K. \tag{3.9}$$

The left-hand side of (3.9) is aggregate fighting effort; it equals aggregate dissipation of the resource rent. The right-hand side indicates that aggregate rent dissipation approaches 100% as the number of groups rises toward infinity; with only 1 group there is no fighting or dissipation.

Fighting for the resource rent erodes property rights to the produced good, rendering a portion of it vulnerable to rent-seeking. This opens the possibility of a true resource curse. Formally, the fraction made vulnerable in Hodler's model equals $P = \left(\sum_{j=1}^{K} f_j\right)/X$, where X is the economy's aggregate effort endowment. For example, if one-third of the economy's effort is used for rent-seeking then one-third of its produced output is relegated to the common pool where it is allocated by rent-seeking. The combined effects of rent-seeking on income can be seen by writing out group is income, c_i, as follows:

$$c_i = \left[1 - (1/X)\sum_{j=1}^{K} f_j\right] l_i + (f_i/X)\sum_{j=1}^{K} l_j + Rf_i \Big/ \sum_{j=1}^{K} f_j \,. \tag{3.10}$$

The first term on the right-hand side of (3.10) is the portion of group i's output that the group retains for its own consumption; clearly, fighting by all groups diminishes each group's incentive to produce. The second term is the share of other groups' output that group i captures by rent-seeking. Both of these terms imply an amplified payoff to rent-seeking and the driving force of the resource rent, R, in determining the equilibrium rent-seeking effort is evident from (3.9). The third term is just the share of the resource rent group i captures by rent-seeking.

3.3.2 Implications, Testing and Interpretation

Data from a cross section of roughly 90 countries are used to test the model's central predictions, that natural resource wealth leads to reduced income and less secure property rights and that these effects are most damaging when the number of groups is large. Unlike the preceding two theories Hodler's (2006) does not entertain the possibility that institutional constraints could limit rent-seeking. The key variables are per capita income, property rights security, natural resource rents and the number of independent groups competing for rents.[27] The number of groups is represented by separate variables indicating ethnic, linguistic and religious fractionalization. Each fractionalization variable is the probability that 2 randomly drawn individuals have a specific trait in common — ethnicity, language or religion.

Key empirical findings are that greater resource wealth is associated with lower income when fractionalization is high regardless of how fractionalization is measured. When fractionalization is low, resource wealth is positively correlated with income, though the effect is not always significant.[28] Greater natural resource wealth and greater fractionalization are also associated with weaker property rights.[29] Strictly speaking the model implies that resource wealth interacts with the number of groups in determining property rights [see Hodler (2006), Equation 3.9] but this prediction is not tested. With only one observation per country it is impossible to control for unobserved heterogeneity across countries. As is the case with much empirical work on the

[27] The national income data are from the World Development Indicators, institutional variables are reported by the Frazer Institute and Heritage Institute and natural resource wealth is from the World Bank. The years of measurement are as follows: 2000 for gross national income per capita, 2003 for both property rights and economic freedom, and 1994 for natural resource wealth. The World Bank's natural resource wealth variable has come under criticism by van der Ploeg and Poelhekke (2010) for use in resource curse empirics as explained in Section 5.

[28] The effect of resource wealth on income is the partial derivative of income in the empirical model with respect to resource wealth. The derivative's value is a linear combination of estimated coefficients and the fractionalization measure, and these partial derivatives are not reported.

[29] These effects could be accounted for by omitted geographic variables. The author notes that including latitude in the property rights regressions causes the effect of fractionalization to become insignificant.

resource curse, the paper's empirical results may be driven by unobserved country-specific factors.

Certain aspects of the model and its empirical implications deserve further discussion. First, the model asserts that natural resource wealth can never be protected as private property regardless of a country's constitutional structure, whereas property rights to produced output would be perfectly secure if there were no resource rent even in a highly heterogeneous country. This difference in treatment leads directly to a resource curse and is adopted without detailed justification. Second, the model attributes the income loss to a transfer of effort away from production and toward rent-seeking. Given the large income losses Hodler estimates, the implied transfer of effort away from productive pursuits might in principle be observable in data on employment by occupation or industry. Because several theories predict a link between lower income and resource wealth, examining such data would enable a sharper test of this particular resource curse mechanism.

A separate issue is the task of empirically identifying groups in a way that fits with the model. Results in Hodler's (2006) model are linked to the number of players participating in a noncooperative game and the model's players are groups rather than individuals.[30] For a collection of individuals to be regarded as a group in this sense its members must agree on a single objective function and the collective must be able to subordinate its members' individual interests to the group's objective. Intuitively, agreeing on a single objective and acting in concert is most likely when members have homogeneous preferences. Further, coordinating members' actions requires low transactions costs *within* the group. One form of corroborating evidence that a particular collection of individuals is a valid group in this sense would be the presence of effective political organizations that represent the group's collective interests, for example, political parties that represent the interests of ethnic, religious, or language groups.[31] Additionally, when the solution

[30] The number of groups plays a similar role in Grossman and Helpman (1994).

[31] The observation that a collection shares a particular attribute does not imply that they are a "player" in this sense. Hodler's (2006) finding that ethnic, linguistic, and religious fractionalization leads to bad governance and poor economic outcomes is consistent with other explanations that do not regard resource abundance as a driving force. For example

concept is Nash equilibrium each group must take the strategy choices of other groups as given, which requires that transactions costs *across* groups are sufficiently high that different groups cannot coordinate with one another.[32] Intuitively, this condition seems most likely to hold when different groups represent different ideologies, language groups or religions or when they represent economic interests that are diametrically opposed, for example, rich landowners versus poor tenants.

3.4 Resource Rents and Violent Conflict When the Rule of Law is Absent

Struggles to control spatially concentrated resources such as diamonds, oil, and metallic minerals have been blamed for civil wars in Angola, Nigeria, Sierra Leone, and Zaire. Two related reasons for this connection readily come to mind: (i) rebel groups that capture concentrations of diamonds, cocaine and timber could use the proceeds to finance their activities and (ii) the presence of resource wealth generally raises the payoff from capturing control of a country's government. Cross-country empirical evidence has linked the probability and duration of civil wars to resource abundance, measured as the share of primary products in a nation's total exports (Collier and Hoeffler, 1998, 2002).[33] Regional concentrations can also set off regional conflicts, as in Nigeria where a concentration of resource wealth in one area and attempts by other regions to capture a share of it contributed to the breakup and eventual re-establishment of centralized political power. Such conflict also raises investor uncertainty over claims to future returns, which in turn affects resource extraction decisions.[34]

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see Alesina et al. (1999) and Mauro (1995, 1998). Hodler does find, however, that the negative effect of fractionalization on economic performance is confined to resource abundant countries.

[32] In principle, one can always find a system of side payments among groups that causes the joint-payoff-maximizing outcome to be Pareto preferred to the Nash outcome. Such coordination arguably is least likely, and the Nash assumption is most plausible, when the costs of identifying Pareto improving side payments and agreeing on a division of the gains is high.

[33] Evidence on the link from resource abundance to politically motivated violence is examined in Section 5.

[34] See Bohn and Deacon (2000) for theory and evidence on this point.

The driving force in the models surveyed to this point is the effort rent-seekers devote to capturing resource wealth or windfalls when property rights are insecure. If this competition is not constrained by the rule of law one can imagine that it might lead to armed insurrection or civil war. van der Ploeg and Rohner (2010) develop a two-agent, two-period model in which resource wealth can only be captured by fighting, literally rather than metaphorically. As in Hodler (2006) fighting effort reduces labor spent in production and this reduces income. Because fighting causes uncertainty over future payoffs from resource extraction, the authors treat resource extraction policy and violent conflict as simultaneously determined.

The model has two agents, an incumbent government in power in period 1 and a rebel group that will assume control in period 2 if it wins the fight. The prize for winning is a direct benefit from holding office (a "bribe") and control over the rent from resource extraction. In period 1 the incumbent government chooses a resource extraction policy; this policy determines the level of second period rents, for the winner and affects the incentive to fight. Both players expend fighting effort in period 1 and their relative effort levels determine each group's probability of success.[35] The outcome of conflict is known by the start of the second period and the winner collects the available payoff. The sequence of play is shown in Figure 3.1, which is presented in lieu of a sketch of the model.

To make extraction policy depend on the level of conflict the incumbent government is assumed to choose among three extraction plans. One involves nationalizing the resource and producing it in a balanced way over time. This is technically efficient (yields a higher total rent than government extraction), but it encourages fighting by leaving a relatively large second-period rent to the winner of the contest. The second option is to nationalize and produce rapaciously. While technically inefficient this strategy reduces the second-period (post-conflict) rent and lowers both contestants' incentive to fight. Under the third option the government contracts with a private extraction firm and receives

[35] The probability that one party wins equals the ratio of its own fighting effort to total fighting effort, a typical contest function.

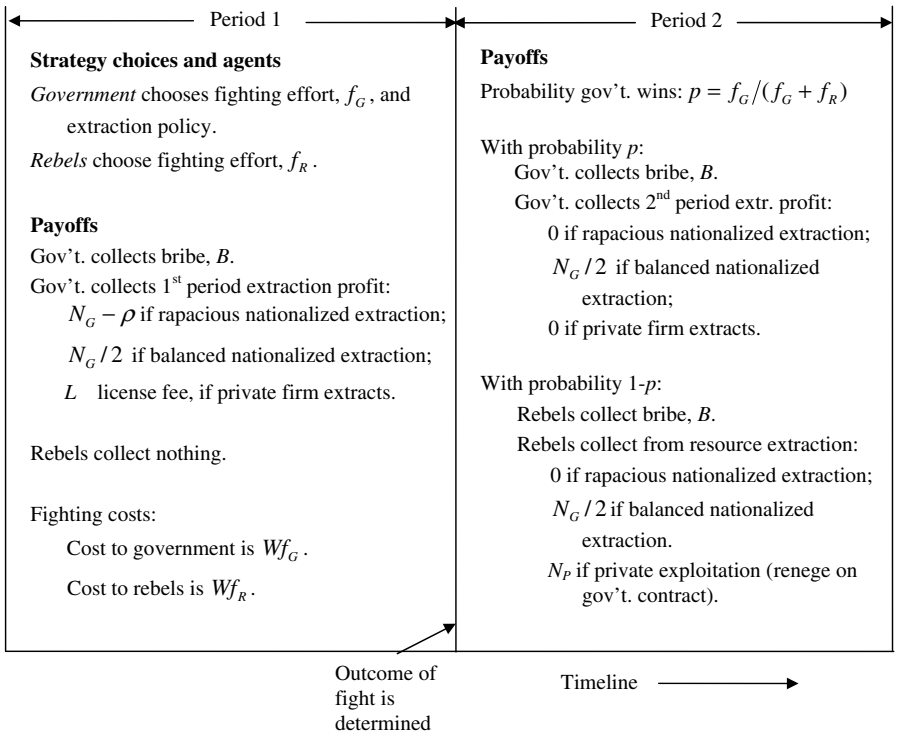

Fig. 3.1 Strategies and payoffs in van der Ploeg and Rohner (2010).
Notes: $L > N_G > N_G - \rho$. W is the wage, opportunity cost of fighting effort.

a license fee payment in the first-period, before the contest is decided. If the government wins the contest it honors this contract and collects nothing post-fight; if the rebels win they expropriate the firm's entire profit.[36] By assumption the private firm must make an investment and pay a license fee to the government in the first period. If the government wins the firm earns an extraction profit in the second period; if the rebels win the firm receives nothing in period 2.

3.4.1 Interpretation and Implications

All substantive decisions are made and payoffs are determined in the first period before the outcome of the fight is known so in this sense the

[36] The firm understands the risks and will not take the contract unless it is structured appropriately.

model boils down to a one-shot, simultaneous play game.[37] Since the government's first period choice of an extraction policy determines the possible second period rents, it determines the levels of fighting and success probabilities for both players. Naturally, fighting is least intense with rapacious extraction since the second period rent captured by the winner is zero with this policy. The efficient, balanced extraction policy leaves more rent in the second period which encourages fighting. Under the private extraction policy the firm pays a license fee to the government before the fight begins knowing that its property will be nationalized if the rebels win.[38] The rebels' second period payoff exceeds the government's in this case since the rebels will expropriate the firm's second period profit if they win but the government must abide by its promise. Consequently, the rebel group's incentive to fight and equilibrium probability of success are higher than the government's under this extraction policy.[39]

The reward from holding office, B, can be interpreted as an indicator of corruption; a higher bribe from holding office equates to a more corrupt regime. With this interpretation the model predicts that corrupt countries will be plagued by intense fighting and low output. The size of the resource rent also affects the incentive to fight; in summary high resource rents, violent conflict, and rapacious exploitation are predicted to accompany one another. The government's choice of extraction policy presumably depends on the size of the resource rent, the "bribe" and other model parameters, but this relationship is not spelled out.[40]

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[37] Technically the rebel faction decides on expropriating the mining firm's second period profit in the case where the government chooses private firm exploitation and the rebels win the fight, but since there are no future periods this decision is inconsequential.

[38] The firm's first period license payment equals its expected profit from extraction, i.e., extraction profit times the probability that the government wins the fight minus a first period investment outlay.

[39] van der Ploeg and Rohner (2010) also demonstrate that the government could diminish the incentive rebels have to fight and thus increase its own probability of remaining in office by committing to pay subsidies to rebels after the fight is concluded. They do not explain how this promise could be made credible, however.

[40] There is no explanation of why the government can commit to not expropriate a private mining firm's capital if it wins the fight, while the rebels cannot. Also, different structures for the private extraction contract are possible and could lead to different outcomes.

The model introduces a different resource curse than has been described so far — violent conflict induced by a desire to control resource rents. A conventional resource curse is also present because effort spent fighting is diverted from productive employment, which depresses output. Reduced investment, slow growth and capital flight are not a part of the story, however. While van der Ploeg and Rohner (2010) do not provide tests, evidence linking resource abundance to violent conflict has been presented in some of the literature reviewed shortly.

4

Models of Political Institutions and the Resource Curse

The situations examined in the preceding models are anarchic in the sense that policy results from a contest among private interests unconstrained by political institutions, constitutional restrictions or the discipline of elections to ensure that outcomes do not totally ignore the welfare of the masses. Except in van der Ploeg and Rohner (2010), government is not present as a distinct policy-making agent with its own goals and constraints.

Many observers regard institutions as pivotal in determining policy outcomes, however, and in any case it is of interest to develop models in which political institutions play a role if only to frame empirical tests regarding their importance. A simple way to incorporate political constraints that mitigate exploitation of the citizenry is to assert that policy is made by a *government* and that government pays attention to both the welfare of ordinary citizens and the rent it can capture by gratifying organized rent-seekers.[1] A range of political systems can be nested within this general approach by specifying that government decisions are made to maximize a weighted sum of the average citizen's

[1] One can interpret the "grabber friendliness" parameter in Mehlum et al. (2006a) as capturing such institutional constraints.

welfare and contributions from organized political interests and then varying the weights. The models described to this point are at the end of the range where all weight is placed on organized interests. Democracy is at the other extreme where all weight is on general welfare. This approach was pioneered by Grossman and Helpman (1994) and has been widely adapted to characterize policy choices.

A second way to introduce governance institutions is to specify that control of policy is determined by political competition in an electoral setting where individuals make voting decisions by judging both their prospective utility under each candidate's policies as well as their idiosyncratic preferences for each candidate's attributes. Lindbeck and Weibull (1987) developed this framework to examine equilibrium transfers under majority voting. Political influence is perfectly dispersed in this system in the sense that each person casts one vote and the majority rules. The same approach can be extended to represent systems in which political influence is concentrated, however. In nondemocratic systems the strength of political influence may be correlated with membership in a royal family, a high-ranking military position, a particular ethnic identity or adherence to a particular religion. Rather than casting votes, individuals pledge their political influence to one candidate or another and control of government goes to the candidate who receives the most support.[2] With this generalization the distribution of political influence in society determines the policies candidates will adopt when seeking to control government. The models reviewed next adapt these political economy approaches to the resource curse setting.

4.1 Public Employment as a Political Commitment Mechanism

In political systems where politicians need popular support to gain office both politicians and their citizen-supporters face a credibility problem. On the politician's side the actual performance on a promise made to attract support generally is not realized until after the political contest is decided. What assurance do supporters have that the promise

[2] Deacon (2009) provides such a generalization.

will be kept once the new leader is in office? On the citizen's side the act of giving support often is not verifiable at the individual level, as with voting, and actual support may only come after the candidate's promise is announced. If the politician's promise is indeed a commitment, what ensures that the citizens who benefit will follow through with political support? Robinson et al. (2006) address these commitment problems directly and develop a model in which the solution is public employment. In their model the contest between candidates is decided by an election. An incumbent's pre-election offer of public employment to potential supporters represents a commitment to post-election payoffs if the incumbent wins because (by assumption) firing public employees is costly and the range for renegotiating public sector wages is limited. Citizens who receive public sector jobs have an incentive to support the incumbent even if their support cannot be verified individually because they know their post-election jobs will be secure only if the incumbent prevails. The policies at issue in this model are resource extraction, public employment, taxes and transfers.

Robinson et al. (2006) cast policy choices as equilibrium outcomes of a 2-period game. An incumbent, A, and a challenger, B, both offer proposals on each policy variable in a pre-election period. By virtue of incumbency, A chooses how much of a natural resource stock to extract in the pre-election period and this determines how much remains for the winner to extract in the second period. The extraction time path A chooses clearly depends on the probability of retaining office and on the resource price in both periods. The resource rent in either period can be used by the office holder for personal consumption or for patronage (hiring public employees). Due to incumbency, A, can hire voters as public employees before the election. Critically, public employment will carry over into the post election period if the incumbent wins the election because it is costly to the incumbent to fire public employees. The challenger bears no such cost, however. Voters are not naïve. Realizing there is no future beyond the second period they rationally ignore any promises made with respect to post-election taxes and transfers; consequently, these policy variables play no substantive role. The actions available to each player and the sequence of play are shown in Figure 4.1.

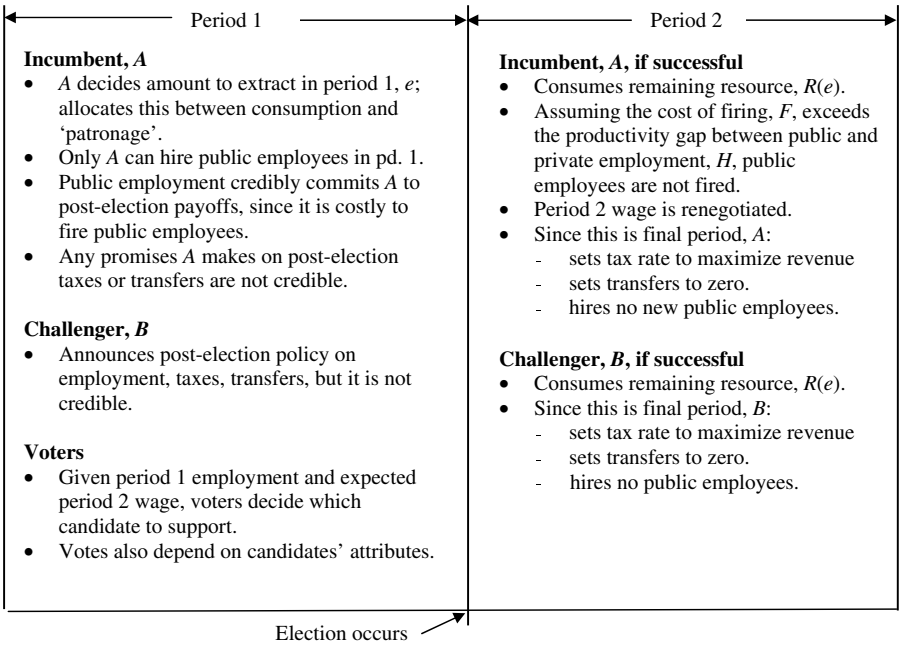

Fig. 4.1 Events and strategies in Robinson et al. (2006).

Politicians identify with groups, also indexed A or B, in a benevolent way. Each politician seeks to maximize a weighted average of the politician's expected private income and his/her group's income. Politicians care nothing for the welfare of the opposing group. As a consequence incumbent A will offer public employment only to members of his own group. Voters have idiosyncratic preferences for the two candidates, which they combine with expected incomes under the candidates' respective policies in deciding which candidate to support. After policies are announced there is an election. Voters' choices between A and B are characterized by the probabilistic voting model of Lindbeck and Weibull (1987).[3]

[3] After the election is decided the winner and any public employees who are members of the winner's own party negotiate a new wage. The outcome of this negotiation is a Nash bargaining solution where the threat points are the net cost of firing a public employee (the politician's threat point) and the wage the employee could earn in the private sector.

Because it is costly to fire a public employee, hiring public sector workers before the election is a commitment mechanism — it imposes a cost on the politician for taking the second period action that would otherwise be a best response. Due to benevolence, only members of a candidate's own group are hired; consequently, members of group A are most likely to vote for the incumbent even though their idiosyncratic preferences for the two candidates are not biased in that direction.

4.1.1 Key Empirical Implications

The model's key results are as follows. First, the resource is over-extracted in the first period relative to the extraction policy that would maximize 2-period income. This is unsurprising given the incumbent's uncertain election prospects. Second, a higher resource price in both periods results in greater public employment, an increased probability that the incumbent will retain office and a more efficient resource extraction policy. Intuitively, a higher price in both periods makes the resource more valuable and this makes the incumbent more willing to sacrifice current income in order to stay in office. This can only be done by hiring more public employees in the first period, which generates the employment result. Expanded public employment also raises the probability of re-election and this causes second period rent to be discounted less heavily. As a result the extraction path becomes more efficient. An expectation of a higher resource price in the second period has essentially the same effect.[4]

The possibility of a resource curse arises from the relative inefficiency of public employment. A higher resource price makes the incumbent more willing to hire public employees in order to retain office, and this by itself tends to reduce output. The higher resource price also raises resource rent, however. If the former (inefficient labor allocation) effect outweighs the rent increase, the result is a resource curse; if the relative magnitudes are reversed, a "resource blessing" results.

[4] The model predicts a negative employment response if the resource price rises temporary in the first period, which is counter-intuitive. The temporary price boom raises first period extraction and lowers second period extraction, which is unsurprising. Lower future extraction reduces the gain from staying in office, however, which makes the incumbent less willing to hire public employees before the election.

As Robinson et al. (2006) note, political systems that do not allow incumbents to alter their reelection probability by hiring public employees are immune to the resource curse. As with other political economy models, the question of whether a resource windfall turns out to be a blessing or a curse hinges on the quality of the host country's governance institutions.

A politician's benevolence toward his or her own group plays an interesting role. Greater benevolence raises the value the incumbent places on his/her group members' welfare and inclines the incumbent toward greater pre-election public sector employment even though it reduces the politician's personal payoff. Two implications of this observation are that greater benevolence (i) increases the incumbent's probability of retaining office (via the public employment effect) and (ii) reduces national income due to the relatively low productivity of public sector employment.

This benevolence link also carries over to the effect of resource price booms: a resource boom is more likely to reduce overall income and therefore be a curse when the incumbent is "highly benevolent" toward members of his or her own group. The cost of firing public employees, F, may also reflect factors linked to benevolence, for example, the strength of social ties, networks, etc. A high value of F strengthens the commitment mechanism and makes public sector employment more attractive to the incumbent. This, in turn, accentuates the negative effect of the resource curse. As the authors note, an institutional feature that forced public sector employment to depend on merit rather than patronage would eliminate the resource curse in this model.[5]

4.2 A Model of Rent-induced Regime Transitions

Certain historical accounts indicate that a natural resource windfall can concentrate political power among those who control resource stocks

[5] The authors carry out no formal empirical analysis but do offer anecdotal evidence on various implications of their model. The most compelling corroboration comes from accounts of public employment patterns during resource price spikes. Case study evidence of expanded public employment in Nigeria, Venezuela, Mexico, Ecuador and Trinidad and Tobago during the oil price spikes of the 1970s and 1980s agrees with the model's main conclusion. Supportive evidence on public employment in Zambia during a copper boom is also cited.

and that this can shift the criterion for political success away from satisfying broad segments of the population and toward gaining control of resource wealth.[6] In extreme cases competition to control resource wealth can become violent. As mentioned earlier, civil wars in Angola, Nigeria, Sierra Leone, and Zaire have been attributed to competition to control oil, diamonds, and metallic minerals. Political economy models based entirely on rent-seeking cannot address how and why government institutions break down or shift since they are essentially institution-free. Political economy models that compare each participant's welfare under alternative political institutions and link these payoffs to resource rents offer a natural way to approach such questions.

Aslaksen and Torvik (2006) examine the possibility of a windfall-induced shift from democracy to anarchy by elegantly combining well-known models of these two alternative regimes. As they cast the situation two rival politicians or political factions participate in a repeated game. Each period, each rival must decide whether to "cooperate" which means accepting the outcome of a democratic election, or "defect" which means rejecting the electoral outcome and initiating conflict. Each player can base the decision on the history of play in prior periods and trigger strategies are allowed. Once conflict begins it persists into the indefinite future, so rejecting the democratic outcome amounts to pulling a trigger. A natural resource is the sole source of rent in the economy and political competition amounts to a contest to control this rent. The authors develop results linking the size of resource rents and the strength of ideological preferences to the viability of sustained democracy and to equilibrium welfare.

4.2.1 A Sketch of the Model

Aslaksen and Torvik (2006) cast their analysis as a two-person repeated game and in each stage the rivals either announce policies and stand for an election or fight one another to control the government. In either case the winner gains access to a resource rent controlled by the government. In the conflict regime the two rivals compete for control by devoting

[6] Karl (1997) cites the dominance of oil in the Venezuelan economy and its control by the state after nationalization for its patron-client system of governance.

productive resources to fighting and the rivals' probabilities of winning are determined by their relative fighting efforts. If the contest is by election the loser can either accept her loss and try again in the next period or initiate conflict immediately. Aslaksen and Torvik (2006) allow their agents to play history-dependent strategies and focus on conditions under which democracy, that is, an absence of conflict, can be sustained as a Nash equilibrium when agents play Nash reversion (trigger) strategies. In this context "cooperation" means acquiescing to the electoral outcome at a particular stage of play and "defecting" means initiating conflict which, if initiated, persists indefinitely. The possibility of multiple equilibria in such games is well known and the authors focus on characterizing the "best" trigger strategy equilibrium.[7]

Consider a country that is initially democratic, with policy outcomes decided according to a probabilistic voting model (Lindbeck and Weibull, 1988). Two candidates, A and B, compete by promising rent transfers to individual voters. The number of voters is normalized to unity. Voter i's utility under a particular candidate's policy equals the sum of two terms: the log of income, which depends on the policy the candidate offers, and an additive term that indicates candidate's ideological attributes relative to the voter's preferences. Candidates know the distribution of ideological preferences up to a "relative popularity" parameter, δ, that is not revealed until the election is over.[8] Both individual ideology and the relative popularity parameter are uniformly distributed with mean zero and densities ϕ and ψ, respectively. The density of the relative popularity term, ψ, plays an important role in what follows. It can be interpreted as an inverse indicator of the strength of ideology in voters' preferences. A small ψ indicates that the range of ideological preferences is broad and that voters at the extremes of the distribution are willing to sacrifice large amounts of income to get a good ideological match, and vice versa.

Under democracy both candidates make campaign promises that amount to rent transfers to individual voters. Individual i's utility if

[7] By "best" the authors apparently mean maximum joint utility.

[8] The relative popularity parameter indicates a candidate's general appeal to all voters and the post-election realization of δ determines which candidate wins.

candidate B wins is

$$\omega_B^i = W_B^i + \sigma^i + \delta, \tag{4.1}$$

where W_B^i is i's utility from income, σ^i is i's ideological preference for B relative to A and δ is the relative preference parameter for B over A revealed to politicians after the election. From the definitions, i's utility if A wins is W_A^i. Voter i will vote for candidate A if

$$\sigma^i < W_A^i - W_B^i - \delta \tag{4.2}$$

and vote for B otherwise.

The winning candidate controls a resource rent, R, which can be allocated between personal gratification, X^I, and income transfers to voters, $R - X^I$, where I indexes the candidates.[9] Voters earn wage income, w, from private sector employment. A voter's total income under candidate I's policy is therefore $w + R - X^I$ and the utility from income, $W^I(w + R - X^I)$, is assumed to take the log form. Criterion (4.2) can now be filled out by taking the log of voter i's income and adding in i's candidate-specific preference term. The number of votes cast for candidate A, NA can then be found by integrating the distribution of σ^i for all values satisfying (4.2). Given the form of the utility function and the uniform distribution of σ, A's vote total has a simple closed form solution as does A's probability of winning the election. Candidate A chooses a transfer policy, $R - X^A$, to maximize expected rent, $\Pr(N^A > \frac{1}{2})X^A$, taking B's policy as given.

The candidates' objective functions are symmetric and the rent retained by the winning candidate in a symmetric equilibrium has a simple expression:

$$\tilde{X}^I = \frac{w + R}{2\psi + 1}. \tag{4.3}$$

Each candidate's *ex ante* expected payoff from winning the election is one-half of $\tilde{X}^I$ per period. Introducing the discount factor, $\beta < 1$, the expected present value payoff under perpetual democracy is

$$V^I = \frac{1}{2} \cdot \frac{\beta}{1 - \beta} \cdot \frac{w + R}{2\psi + 1}. \tag{4.4}$$

[9] Each voter is offered an identical transfer under the policies announced by each candidate.

As (4.3) and (4.4) show, the willingness of voters to trade off income in the form of promised transfers for a good ideological match allows politicians to keep a portion of the resource rent for themselves without ensuring a loss at the polls. Further, the more important is ideology (the smaller is ψ) the greater is the rent the winning candidate retains.[10] Equivalently, politicians' rents under democracy tend to be small when ideology doesn't matter and politicians are forced to compete on the basis of rent transfers.

A regime change from democracy to conflict occurs if either party refuses to accept the result of the election. Once conflict begins it persists forever so initiating conflict amounts to "pulling a trigger." The decision of whether or not to accept an electoral loss is determined by comparing the loser's present value utility under continuing democracy with a one-half probability of winning any future election to the same individual's present value utility under perpetual conflict. The former payoff is simply the right-hand side of (4.4) postponed one year, or βV^I. Determining the latter payoff requires a model of outcomes under conflict.

In the conflict regime rivals compete for control of government and the resource rent by committing resources to fighting. Each rival incurs a fixed cost of F units of effort if conflict is initiated. Each contestant's probability of winning in any period equals the ratio of her fighting effort to total fighting effort for both parties. With symmetric agents each contestant deploys identical fighting resources each period and the probability of winning is one-half for each. The opportunity cost of each unit of effort devoted to fighting equals the private sector productivity, w. With these assumptions each rival's per period expected utility from conflict is $(R/4) - wF$ and the present value payoff under perpetual conflict equals

$$U_C^I = \frac{1}{1-\beta}\left[\frac{R}{4} - wF\right]. \tag{4.5}$$

An outcome in which each candidate adheres to democracy is viable only if the losing candidate earns a larger payoff from continued

[10] This finding echoes one of Lindbeck and Weibull's (1988) principle results.

democracy, that is, if $\beta V^I > U_C^I$. This criterion is satisfied if

$$\frac{\beta}{2(2\psi+1)}[w+R] > \frac{R}{4} - wF. \tag{4.6}$$

Equation (4.6) links the viability of continued democracy to the size of the resource rent that politicians seek to control. Democracy cannot be sustained over time unless $\beta > \psi + \frac{1}{2}$ regardless of other parameter values. If this condition is satisfied, democracy is more likely to survive from one period to the next if R is small relative to w, which amounts to a political resource curse. Democracy is also more likely to persist if ψ is small so ideological preferences are relatively strong, and if the discount term, β, is relatively large so future returns are not discounted too heavily.

4.2.2 Untested Empirical Implications and Possible Extensions

Politicians in this model choose political institutions endogenously and this leads to novel predictions. The authors show that self-enforcing democracy is possible regardless of resource rents if ideology is important relative to income in deciding the outcome of elections and if future payoffs are not discounted too heavily. The role of the discount factor is obvious since the opportunity cost of defecting and resorting to conflict is the expected present value payoff under continued democracy. The reason for the surprising ideology result is that greater emphasis on ideology yields greater expected rent for politicians under democracy and therefore less incentive to reject an electoral loss in favor of conflict.

The model implies a political resource curse since continued democracy is less likely to be sustained when resource rents are large relative to the wage. While greater resource rent raises expected utility under both regimes, it adds more to the present value reward a candidate receives under conflict than under democracy.[11]

The model demonstrates how a resource boom could cause a transition from democracy to conflict, but is silent on forces that might cause

[11] This is true if the viability condition for democracy is met, $\beta > \psi + \frac{1}{2}$. If not, the country is doomed to conflict regardless of resource rents.

transitions in the other direction. Of course, these reverse transitions are sometimes observed and a more complete treatment would allow for such cases. Within the model's repeated game structure the same individual politicians look forward to competing against one another each period into the indefinite future under continued democracy. The condition for continued democracy is more difficult to satisfy, however, if there is a probability that either individual will not be a viable candidate some future contest since future returns will be discounted more heavily. This consideration might open a role for political parties as players in the game rather than individuals since parties presumably are more long-lived than individual players.

4.3 Political Institutions and the Resource Curse: Alternative Treatments

The remainder of this section outlines three additional theoretical contributions. Each introduces political institutions in a way that is distinct from the models already examined and each carries distinct empirical implications.

4.3.1 Protection for Sale, Political Competition and the Resource Curse

Government subsidies to favored economic sectors are commonly observed in developed and developing countries alike. In the developing world these can take the form of interest-free loans, tax holidays and subsidized infrastructure. Many observers see a political motive in these policies and some see a link to natural resource use.[12] Bulte and Damania (2008) incorporate the perverse subsidy phenomenon in a model of the resource curse by adapting the influential protection for sale paradigm. In their view, producers in natural resource extraction and manufacturing sectors comprise two organized political interests. Bulte and Damania (2008) extend the Grossman–Helpman approach to incorporate competition between political interests. Many regard this as a key element in determining political outcomes but it is missing in

[12] See Bulte et al. (2007).

the Grossman–Helpman framework. As in Torvik (2002) and Mehlum et al. (2006a) the mechanism that diminishes income and implies a resource curse is a potential misallocation of labor and entrepreneurial talent between a modern manufacturing sector that enjoys increasing returns to scale and a more primitive resource extraction sector.[13]

Government's role in this setup is to direct economic activity between sectors by supplying a quasi-public input to the individual sectors in return for contributions. The government-provided input is quasi-public in the sense that it is available to all firms in a specified sector, but is excludable between sectors. As in Grossman–Helpman each political interest group offers a schedule linking its political contributions to public input levels. The government then chooses its public input policy to maximize receipts from political contributions, bribes, and the like. Each sector chooses a contribution schedule to maximize its group's profit taking as given the other sector's contribution schedule and knowing that government will choose a policy that maximizes its own objective function.[14]

Political competition is introduced by postulating a challenger who will assume power if he can deliver higher aggregate welfare to the country than the incumbent, *irrespective of what the organized political interests may prefer*.[15] Regime change imposes a cost on society which subtracts from any aggregate welfare a challenger's policy would otherwise provide, however. In order to remain in office the incumbent must provide a welfare level at least equal to the highest feasible aggregate welfare net of transition cost that the challenger can offer. An incumbent who fails to meet this lower bound will be replaced and in this fashion political competition disciplines the incumbent and enhances

[13] On political competition see Aslaksen and Torvik (2006), Robinson et al. (2006), and the more general political economy paradigm of Bueno de Mesquita et al. (2003).

[14] In Grossman–Helpman the policy variable that political interests seek to control is a tariff or import quota; here it is a level of public input provision. Policy outcomes in Bulte and Damania (2008) are realized only after contributions have been committed so the organized interests must be confident that the government will honor the promised policy. No particular commitment mechanism is specified.

[15] Unlike the incumbent the challenger seeks no contributions from economic interests but rather seeks only to maximize aggregate welfare because this is a necessary condition for regime change. The outcome of the challenge is decided only after the promise is made so there is a commitment issue here as well.

equilibrium welfare. If the incumbent's policy choice set includes an element that matches or exceeds this lower bound, he will never be deposed.[16] Nevertheless, this "transition constraint" forces the incumbent to place some weight on aggregate welfare when making a policy choice.

The interaction between incumbent and challenger is a single play multi-stage game. A resource boom, characterized as an increase in the resource price, raises the resource sector's profit and its willingness to make political contributions in exchange for subsidies. If the transition constraint is not binding this shifts policy in favor of the less efficient resource sector, generating a resource curse. If the transition constraint binds, however, the incumbent may be blocked from any shift that would lower welfare and the curse is avoided. Consequently, a resource boom is always a curse in an autocratic country where political competition is absent, but can be a blessing if political competition is present and transition costs are relatively low.

The model's empirical implications are similar to Mehlum et al. (2008) with the proviso that the disciplining force is the possibility of regime change rather than the regime's inherent friendliness to rent-seekers.

4.3.2 Public Goods Supply and the Perils of Unearned Income

A key insight of the "selectorate" model of Bueno de Mesquita et al. (2003) is that government's inclination to spend funds on public goods rather than transfers to political allies depends on the size of the group whose support is needed to hold power. In the terminology of this model the "selectorate" is the group of individuals eligible to become members of a "winning coalition" and a winning coalition is a group capable of choosing the country's leader. The critical parameter in the selectorate paradigm is the size of the winning coalition relative to the selectorate, and its value depends on a country's basic political culture,

[16] It is unclear why the incumbent cannot offer a policy that more or less matches the challenger's. Considering the role of transition costs it seems that regime change would never occur in this case.

for example, whether it is a military dictatorship, a monarchy, an oligarchy or a democracy. In some countries the winning coalition might be tiny, for example, a majority of the military's high ranking officers, in which case the sensible political strategy is to spend public funds on targeted payments to its members. If a winning coalition must be large to succeed, for example, a majority of voters in a democracy, an effective way to gain the necessary broad support is to spend government funds on public goods.

A second prominent feature of the selectorate model is an informational asymmetry. Membership in the incumbent leader's winning coalition is known prior to selection of a leader since this group has been in power and its members identified. By contrast, the challenger's potential supporters do not know whether or not they will be included as members of a challenger's winning coalition if the challenge succeeds. This gives the incumbent an inherent advantage in attracting support and dissuades existing members of the leader's coalition from defecting. Both of these incumbency advantages are amplified in small winning coalition systems.

Smith (2008) extends the selectorate model to entertain potentially adverse outcomes from resource windfalls. The logic of Smith's (2008) model implies that unearned income such as a resource windfall will benefit the average citizen more under a large coalition system than under a small coalition system because a large coalition system will spend the additional resources on public goods rather than targeted transfers. A resource windfall thus raises the average citizen's payoff from converting a small coalition system to a large coalition system. This raises the threat of revolution and reduces political stability in small coalition systems.[17]

Additional empirical implications stem from the way provision of specific public goods responds to a windfall under different forms of

[17] Smith focuses on equilibria in which the incumbent leader always retains office, so revolutions never succeed. A key assumption is that challengers credibly commit to replace the former regime with a large coalition system, that is, a democracy, if their revolution succeeds. This enhances the payoff from revolution to an average citizen. The free-rider problem inherent in mounting a revolution is not addressed. The use of history dependent strategies such as Nash reversion is ruled out.

government. In a large coalition system the leader's best response to a resource windfall is to increase public good provision. Greater public good provision increases income and raises the average citizen's welfare under in the incumbent's rule, which enhances the probability of retaining office. The net effect is a positive association between resource rents and income in large coalition systems. The outcome is entirely different in small coalition systems, however, where the leader must contend with the possibility of revolution. The difference in responses under different degrees of political power concentration is familiar from earlier discussions of political economy; this is not unexpected as the selectorate model is built on the same principles. Smith (2008) argues that this risk affects the choice of public goods to be supplied. He argues that certain public goods could help rebels coordinate activities, for example, communication infrastructure and freedom of assembly, and these naturally will be suppressed.[18] The same services make the economy more productive, however, so suppressing them reduces income. If the latter effect swamps the resource windfall, the result is a resource curse.[19] An additional implication is that resource windfalls will bias public good provision in small coalition systems as described above, implying a political resource curse.

4.3.3 Political Competition, Entry Barriers and the Resource Curse

Entry barriers and the incentives firms have to erect them in order to deter competition are familiar concepts in the theory of markets. Tsui (2010b) adapts these notions to a political context and draws implications for the effect natural resource wealth has on economic performance and political institutions. In Tsui's view rival candidates compete to hold office, motivated by the potential to capture rent that accrues to the public sector. Citizen support for either candidate depends on the income citizens anticipate under their announced policies and an incumbent can be replaced if her popular support declines

[18] No such bias in public good provision is predicted for large coalition regimes.

[19] Smith's (2008) model is too elaborate to develop in full detail here. The author presents no empirical analysis in this review.

relative to the challenger's. An incumbent can diminish this threat by erecting entry barriers. The political equilibrium is characterized by: the incumbent's policy choices on public goods, entry barriers and tax rates (chosen to maximize expected present value of the rents of office); budget balance in the public sector; and zero expected rent (net of entry barriers) for political "entrants." In Tsui's (2010b) setup greater natural resource wealth has both economic and political implications.

What makes resource wealth "special" in this world is an assumed inelasticity of supply which allows a resource rich country rich to tax with relatively low deadweight costs. With low-cost public funds the country can provide public goods in abundance and this enhances productivity and income. When no political effects intervene, added resource wealth is a blessing because, due to the public good effect, it increases income beyond the direct income gain attributable to the resource.

Greater resource wealth raises the reward from holding office, however, which encourages entry into political competition. The incumbent's logical response is to raise entry barriers, for example, by expanding the military or engaging in repression. Erecting entry barriers consumes resources and induces potential political entrants to spend additional resources overcoming such barriers. Both effects tend to diminish output, generating an economic resource curse if the effect is strong enough.

Tsui (2010b) argues that the transaction cost for extracting rent and the cost of erecting entry barriers both are higher in democratic systems than in nondemocratic systems. Consequently, the incentive to raise entry barriers is relatively small and the degree of competition relatively high in democratic regimes.[20] He regards an "ideal" democracy as a regime in which entry barriers and rent-extraction cost are both prohibitive so few barriers are erected and little rent extracted. There is no political resource curse in such regimes and political competition is brisk. In nondemocratic regimes a windfall can lead to repression, an outcome most would regard as a political resource curse. It is

[20] Tsui (2010b) also concludes that the incumbent's expected longevity in office depends both on the income the incumbent produces for constituents relative to challengers and on entry barriers the incumbent erects.

unclear whether resource wealth increases or decreases regime turnover in Tsui's model since it both attracts challengers and leads to higher barriers.

4.4 Linking Theory to Empirics

The rent-seeking and political economy models reviewed have several key predictions in common. If institutions are initially weak in the sense of placing few barriers against the appropriation of rents from the public sector, then a resource windfall will lead to slow growth and may cause institutions to deteriorate further. When institutions are strong at the start, however, a resource boom need not impair institutions and generally will enhance wealth. Perhaps this broad agreement should come as no surprise, since case study evidence of these phenomena has been in the literature for well over a decade (Gelb, 1988; Karl, 1997; Ross, 2001) and formal empirical results have pointed to some of these regularities since at least 1999 (Leite and Weidmann, 1999). No doubt much of the theoretical literature has been motivated by a wish to find explanations for these outcomes.

Alternative theoretical models of the resource curse generally emphasize different transmission mechanisms, however, which often imply divergent predictions. This presents opportunities for testing theories against one another. These concern effects on public employment, investment in private capital, entrepreneurial activity and so forth. The theoretical papers generating these predictions generally have not included extensive empirical analysis; in particular, they have provided little evidence that would test a proposed model against alternatives. Before drawing conclusions on the kinds of empirical analysis needed to advance our understanding of the resource curse, it is necessary to review the large body of purely empirical literature on this phenomenon.

5

Empirical Contributions

The rapid expansion in the economics literature on the resource curse was kicked off by Sachs and Warner's (1997) (SW) original working paper.[1] Their analysis was entirely empirical; theoretical underpinnings and interpretations were discussed but were not treated formally. Their cross country dataset generally included 70–90 observations and the specification followed Barro's (1989) cross country approach to studying the determinants of economic growth. Growth in per capita GDP during 1970–1990 was specified to depend on 1970 GDP per capita (as implied by the convergence hypothesis), the share of primary product exports in 1970 GDP (or in total exports) as a resource abundance measure and other control variables. SW found strong evidence for convergence and a strong, negative resource abundance effect. They included a "rule of law" variable (1982 values) as a control and found it affected growth positively. It did not eliminate the resource abundance effect, however, and from this evidence SW concluded that the resource curse is not an essentially political phenomenon.[2]

[1] An initial version of SW's analysis was circulated as a working paper in 1995.

[2] A more refined presentation of SW's analysis appeared in Sachs and Warner (2001). As we have seen, subsequent theoretical treatments of the resource curse have largely converged

Much of the subsequent literature followed the SW lead by providing only empirical contributions, often retaining the same general specification and relying on much of the same data. While specifications vary from paper to paper, the common theme is a focus on making purely empirical contributions rather than presenting new theories. Several of the theoretical papers reviewed earlier included empirical analysis directed toward the models they developed; these empirical contributions were reviewed along with the corresponding theories for expositional convenience. The present section examines prominent selections from the remaining empirical literature. Though not linked to specific theoretical contributions, these purely empirical exercises contain potentially valuable information on associations between resource abundance and a range of political phenomena and can help to illuminate the kinds of political economy theories that are tenable.

The presentation organizes this work into three broad categories. The first group includes papers on the general link between growth (or welfare), governance and broad measures of resource abundance. Much of this work is focused on the economic growth effects of resource abundance and treats governance issues only in passing. These entries make contributions by refining or extending the empirical data and methods used to examine the "economic resource curse" and its links to political forces. The second group focuses on *oil* as a resource and its potential link to governance. The third group focuses on connections between politically motivated conflict and abundance of oil, diamonds and other resources. Since the third category of research deals with political economy only tangentially it is reviewed briefly.

Each group includes papers that can be described as skeptical assessments of whether or not the empirical links claimed to hold between resource abundance and various political phenomena are valid. These are examined as part of the literature in each category. Within

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on the view that a correct specification should include an interaction term between resource abundance and institutional quality, which is missing from the SW specification. SW efficiently summarize early thought on the natural resource curse phenomenon, including the Dutch disease idea emphasized in their own analysis and the Prebisch hypothesis of negative growth effects from declining relative prices of raw materials. SW also point out Gelb's (1988) early emphasis on political economy explanations for the resource curse.

each group it is also useful for organizational purpose to group items on the basis of the empirical approach used, for example, cross-country cross sectional analyses, panel data cross country analysis, empirics linked mainly to time series data, and so forth.

5.1 General Empirical Research on the Resource Curse

One of the first thorough attempts to identify a political link in the resource curse connection between growth and resource abundance was carried out by Sala-i-Martin and Subramanian (2003) (SS). Their general empirical strategy followed SW in certain respects: the vehicle for estimation was a cross section of countries (with 71 usable observations) and their empirical growth model was essentially the SW specification. To focus on the potential for an institutional link, SS formulated a second equation linking governance (a rule of law index) to a set of potential determinants that includes historic resource abundance plus other measures gleaned from the literature on growth and institutions.[3] The second equation allowed them to examine whether or not a "political resource curse" appears in the data. The institutional quality variable predicted from this equation could then be inserted into the second stage growth regression, along with resource abundance and other exogenous determinants. With this setup SS could examine two questions: (i) Does resource abundance have an indirect effect on growth, transmitted through governance? (ii) After controlling for this potential indirect effect, is there an additional direct association between resources and growth? If resource abundance has no significant association with growth once the effect on institutions is taken into account, this would lend support to the view that the resource curse is essentially a political phenomenon. Summarizing, SS concluded that the answers to the two questions just posed are "yes" and "no," respectively. Resource abundance is a curse for economic growth, but the entire effect operates through institutions; once the indirect institutional effect is controlled, no further direct effect is evident.

[3] These include a country's ethnic composition and fractionalization, mortality rates among colonial settlers and various economic variables; See Acemoglu et al. (2001).

An early study by Isham et al. (2003) used a similar strategy, but tested empirically for links from resource abundance to several measures of political institutions. Their analysis is also notable for finding that different types of resources affect institutions differently: resources that are concentrated in space, so-called "point" resources, tend to impair institutions while "diffuse" resources do not.[4] This observation is consistent with political economy theories of rentier states. These theories conclude that when resource rents come from concentrated sources, rulers can mollify potential dissenters without extending government control throughout the countryside, and this forestalls development of mechanisms of political accountability. The importance of point versus diffused resources was confirmed in subsequent analysis by Boschini et al. (2007). They regard resources as politically "appropriable" if they are (i) easily transported and concentrated in value (i.e., point resources) and (ii) if the political system does not support secure property rights. The vehicle for empirical analysis is a cross country, cross sectional specification in which GDP shares in various resource-related categories indicate resource abundance.

Bulte et al. (2005) (BDD) sought to determine if a resource curse applies to broader economic development and welfare measures than per capita GDP, and if so whether the effect operates through governance channels. The empirical strategy used mirrors SS, with welfare or development measures replacing current period per capita income. Welfare/development outcomes were indicated with two negative measures, the % population undernourished and % of population lacking access to safe water, and two positive measures, life expectancy and the Human Development Index. Institutions were characterized by

[4] To be more accurate, Isham et al. (2003) found that countries with high export shares of minerals, fuels and plantation crops tend to have lower quality institutions, while this is not the case for countries with high export shares of agricultural or manufactured products. In an earlier paper Leite and Weidmann (1999) followed a similar two stage strategy, but with a few key differences. A single institutional variable, corruption, was assumed to affect growth. Resource abundance was postulated to determine corruption, but not the rule of law and political instability which were treated as additional exogenous determinants of corruption. (The rationale for this difference, treating some institutional factors as causal factors and others as outcomes, is unclear.) Anticipating Isham et al. (2003) and SS, Leite and Weidmann (1999) disaggregated resource types and found corruption effects for point resources (fuels and ores) but not for diffuse resources (agriculture and food).

"rule of law" and "government effectiveness" indicators. Not surprisingly, their findings on the determinants of institutional quality agree with SS and Isham et al. (2003): point resource abundance is associated with worse governance. Regarding development and welfare, greater resource abundance was found to be associated with poorer outcomes. Significantly, this association operates (with one exception, access to safe water) entirely through the effect on institutions; after accounting for the institutional effect, resource abundance has no direct link to the welfare and development indicators examined.[5]

5.1.1 Critical Appraisals and Modifications

This entire body of work is open to criticism for regarding the share of primary products (or primary product exports) in GDP (or total exports) in an historic period as a measure of resource abundance. As Norman (2009) points out these variables clearly are flows; the most sensible concept of abundance in the context of the resource curse is a stock. Further, primary products production corresponds to extraction and is an endogenous choice variable as Norman (2009) and Brunnschweiler and Bulte (2008) (BB) both emphasize. Norman (2009) constructed a proxy for historic stocks for individual minerals by summing the present period reserve base and past annual extractions between the present year and an historic base year (1970).[6] The underlying reasoning is straightforward: the reserves remaining at present clearly were part of the stock in 1970,

[5] Another contribution in this vein is Anderesen and Aslaksen (2008). These authors adopt reasoning from Persson and Tabellini (2000, 2003) and argue that presidential regimes are likely to favor powerful minorities in formulating policy while parliamentary systems will cater to broader constituencies. Interpreting targeted policies as special interest politics, they informally reason that presidential systems are more inclined to be vulnerable to the resource curse. Anderesen and Aslaksen (2008) dismiss institutional measures used by others such as corruption or rule of law indicators as invalid determinants due to endogeneity. Instead, they focus on a set of countries rated as relatively "free" according to the index published by Freedom House and regard these as democracies. Among democracies, they separate countries by electoral system. Following the SW growth equation format and using much of the SW data, they find support for this interpretation in the cross country growth rates of roughly 70 countries over 1970–1990 period.

[6] 'Proved reserves' are not a perfect measure of mineral wealth, because "proving" mineral deposit requires costly exploration, and these investments are generally more extensive in developed countries than developing countries. This could bias the growth effect of mineral wealth upward. I am indebted to Ragnar Torvik this observation. The same observation implies that proved reserves are endogenous.

as were the amounts extracted in the intervening years. The only historic period stocks excluded by this procedure are deposits not yet discovered or booked as reserves in the present period. Stocks of different minerals were then combined into a single measure by applying 1970 prices and aggregating.

Norman (2009) applies an estimation strategy similar to SS and finds that nonrenewable resource stocks (fuels plus mineral stock values in 1970 relative to 1970 GDP) are negatively associated with growth rates over 1970–2000 and with present period rule of law. The growth effect is not entirely robust, however. She then adds the SW flow resource measure to both models to test the robustness of earlier empirical work. When her resource stock variable is included, the SW flow measure does not enter significantly in the institutional equation; it is found to be significant (and negative) in the growth equation, however.

While Norman (2009) questioned the correct resource abundance variable to include in empirical analysis, BB leveled a more comprehensive critique against the empirical resource curse literature, arguing that the alleged stylized facts may well be a "red herring," that is, a misleading clue that diverts attention from the real determinants of growth and institutional quality. There are two key aspects to BB's complaint: first, that the standard SW resource measure is more an indicator of dependence on natural resource sectors, and hence an indicator of economic backwardness, than a measure of abundance; and second that the institutional variables normally included in empirical studies (corruption, rule of law, government effectiveness, political instability) are actually policy responses by governments rather than the "deep and durable characteristics of societies" likely to influence economic growth. To establish these claims BB follow a two stage empirical strategy similar to SS, but adopt different indicators of key variables: (i) they use the World Bank 1994 value of subsoil natural assets as a resource abundance variable and (ii) use the parliamentary versus presidential nature of a country's electoral system as the fundamental political determinant of economic growth and of endogenous governance outcomes.[7]

[7] On the latter point, Deacon (2009) observes that the presence and structure of elections may make little difference to a country's political power structure. Looking across electoral practices during 1950–2000 among country-year observations regarded as nondemocratic

In OLS regressions BB find that two measures of institutional quality (rule of law and government effectiveness) are *positively* associated with the World Bank natural assets variable, which seems contrary to the findings of others. The authors speculate that resource booms and discoveries may actually facilitate introduction of *superior* institutions. BB's main results are from a two stage model that regards institutional quality as endogenously related to resource abundance and treats GDP growth as dependent on natural assets, institutional quality and resource dependence (the SW measure).[8] Here again BB obtain results that are at odds with the findings of others: in most specifications resource abundance has a *positive* overall association with economic growth.[9] Accordingly, they conclude that resource abundance leads both to better governance and more rapid economic growth.

The critical claims of BB have been questioned by van der Ploeg and Poelhekke (2010). These authors point out shortcomings of the data BB used: income was measured in current rather than real dollars and BB's resource abundance variable, the World Bank natural assets series, is essentially proportional to current resource rents and therefore itself endogenous. van der Ploeg and Poelhekke (2010) also take issue with aspects of BB's specification, pointing out that some well accepted growth determinants were omitted from BB's growth regressions. The authors agree with BB that the resource export share of GDP (the SW resource variable) is not exogenous, but argue that the instrumental variable approach BB use to fix for this problem in their growth equation suffers from a weak instrument. Amending BB's specification and data in light of these issues, van der Ploeg and Poelhekke (2010) find that resource dependence (the share of primary product exports in GDP) is no longer significantly associated with growth.[10]

(judged by a low Polity score), over one-half of these non-democratic countries held elections for the chief executive and roughly 70% held elections for members of the legislature.

[8] Resource dependence is treated as an endogenous function of the country's electoral system and the economy's openness. Latitude is used as an instrument for institutional quality.

[9] Brunnschweiler (2008) offers a very similar analysis. The BB analysis also treats the primary product export share (SW's resource abundance measure) as an endogenous indicator of resource dependence and examines its links to resource abundance and political institutions.

[10] van der Ploeg and Poelhekke (2010) briefly outline their own theory for why resource abundance might hamper growth. It is based on the notion that resource dependent

It is now widely recognized that the key resource abundance measure SW first used, the share of primary products exports in total GDP (or total exports), suffers from fatal shortcomings. While it presumably is influenced by resource abundance, it also indicates a country's lack of success in developing more technologically advanced sectors. If this failure is due to weak institutions and institutions are persistent, the result will be a negative correlation between the primary products share of GDP and both present day income and institutional quality. Such a finding is neither mysterious nor paradoxical.[11]

5.2 Governance and the Short- versus Long-run Responses to Resource Booms

A shortcoming in the studies just reviewed is reliance on cross-country cross-sectional data, which rules out using fixed effects to account for unobserved country-level heterogeneity. Few of the papers even include fixed effects for continents or regions of the world. The cross sectional approach also rules out differentiating between short- and long-run responses to discoveries or price booms. Collier and Goderis (2009) use time series methods and data to address both issues. They represent resource windfalls by commodity price shifts and assemble commodity export price indices for individual countries with data on each country's commodity exports and international price series.[12]

Their empirical results strongly confirm the resource curse as a long run phenomenon that applies specifically to nonagricultural commodities (metals and fossil fuels) in countries with weak governance. Higher

economies suffer from volatile growth rates which in turn tends to slow growth on average. They offer econometric results in support of this explanation. Their growth equation includes no role for governance, which is surprising in light of the theoretical and empirical literature described earlier in this review.

[11] An additional, purely econometric complaint with the SW measure is that it is endogenous, determined in part by variables that determine a country's initial period GDP such as institutions.

[12] They use panel cointegration methods to untangle short and long run effects and include country fixed effects and regional time dummies to account for unobserved heterogeneity and include an error correction term to capture short-run responses to shocks. Country-specific commodity price indices are constructed using each country's 1990 export levels and treating these as fixed. They regard institutions as fixed, unaffected by resource price booms.

commodity prices for metals and fuels significantly reduce long run real GDP in countries with weak governance, while effects in strong institution settings are generally positive but insignificant. Short run GDP effects are generally positive overall, but last only about 2 years. Price booms in agricultural commodities are generally beneficial for both weak- and strong-governance countries. To illustrate the magnitudes involved the authors simulate the effect on Nigeria of the post-2000 run up in commodity prices, primarily oil for this country, relative to a counter factual scenario with prices constant at 1999 levels. They estimate that the sharp spike in oil prices in 2000 more than doubled the country's GDP growth rate, but this lasted only 2 years. Over the longer term, and assuming 2009 price levels remained indefinitely, the boom lowered Nigeria's long run GDP by more than 30%.[13]

5.3 Oil, Corruption and Democracy

Several theoretical treatments predict a link between resource abundance and the prevalence of corruption and/or absence of democracy. "Voracity" models (Tornell, 1999) and "diverted entrepreneurship" models (Torvik, 2002; Mehlum et al., 2006a) imply that a resource boom will increase theft of private assets by rent-seekers. Aslaksen and Torvik's (2006) model of regime transition links a surge in natural resource rents to an increased likelihood of regime shift from democracy to a rent-seeking equilibrium.

These predictions are potentially testable with data on governance indicators and resource booms. It is natural to focus on petroleum price jumps as a source of resource windfalls, due both to the economic importance of oil as a natural resource and to the fact that price jumps have been pronounced in the past and are readily observed.

[13] Haber and Menaldo (2011) use similar methods and annual panel data to test for an association between a country's Polity score and various measures of the income it generates from fossil fuel and minerals production. Because international prices are controlled separately by year fixed effects, the resource measures largely capture within-country variations in output. They find no significant association. To address concerns that mineral output is endogenous, they use measures of reserves as instruments for output. For addressing the "resource curse," however, reserves arguably are a better measure of resource abundance than output, in which case they belong in the second-stage regression that determines Polity.

Because price booms occur at specific points in time and only for oil-endowed economies, empirical tests can exploit "before versus after," and "with versus without" comparisons, freeing empirical researchers from reliance on the cross-country, cross-sectional approach that is a weakness in much of the empirical literature. Oil discoveries are a separate source of resource booms and are advantageous because they are usually discrete and are often economically dramatic and geographically isolated. With geographic isolation, comparisons to control groups in the same country that are unaffected by a discovery can help to identify the effect of interest. The three empirical studies described next exploit these strategies.

5.3.1 Oil and Municipal Corruption in Brazil

Brazil has become an important oil producer since production began in the 1940s and now accounts for 2% of world output (Caselli and Michaels, 2009). Increasingly since 1970, new discoveries and production have come from offshore fields. The quasi-private national oil company, Petrobras, is obliged by law to distribute 3% of its gross revenue to municipalities in the form of royalty payments plus lesser amounts from output taxes. Distributions are based partly on proximity to oil fields and partly on the geographic placement of oil infrastructure and on population size. These revenues represent up to 30% of revenue for top oil producing municipalities.

Caselli and Michaels (2009) regard oil revenues as a resource windfall indicator and test for effects on municipality level income, public service provision and governance quality. To defend using oil endowment revenue as a "quasi-treatment" (exogenously assigned conditional on attributes of municipalities), they demonstrate that their outcome variables did not differ between oil-endowed and nonendowed municipalities prior to oil discoveries. They find that oil revenue has no effect on local GDP or the composition of output beyond its direct contribution to petroleum sector output, so resource wealth does not a curse on purely economic grounds, but it is not an extraordinary blessing either.

They also find that oil revenues translate directly into increased spending on education and culture, health, sanitation, housing,

transportation, and social transfers. They find no evidence, however, that this spending leads to higher per capita income, better housing or improved delivery of public services.[14] This naturally prompts them to investigate what the added municipal expenditures actually purchased. While there is some evidence of increased staffing for education and health services, the amounts are miniscule; social transfers for unemployment and poverty assistance actually are *negatively* associated with oil receipts. While unable to track exactly where "missing money" goes, Caselli and Michaels (2009) do present circumstantial evidence that significant amounts are diverted to private use by government officials. They find that municipal employees in oil-endowed communities live in larger homes than in non-endowed communities; they also find that reported municipal corruption is more common where oil revenues are large. The Caselli and Michaels (2009) results thus support the governance-linked predictions from the voracity and rent-seeking models.

5.3.2 Results from a Natural Experiment in Africa

During 1997–1999 news stories began circulating of a possible major oil discovery in the small African island state of Sao Tome and Principe (STP).[15] In late 1998 Exxon/Mobil was granted preferential exploration rights and speculation about an important resource boom gained credibility. When the first round of auctions for production rights was held in 2003 the highest bids amounted to nearly 240% of STP's annual GDP. In 2005 and 2006 Vicente (2010) conducted retrospective surveys of STP citizens regarding perceived corruption before and after the discovery was announced, enabling a before and after comparison. Simultaneous surveys of corruption perceptions were also carried out in the neighboring island nation of Cape Verde (CV) and these responses are used as a control group. Oil has never been found in CV and petroleum geologists regard a future discovery as unlikely, so the oil boom shock

[14] The measures examined are rooms at home per occupant, percent of population living in favelas, percent with electricity, percent of population with piped water, garbage collection or sewer connections and paved road mileage per capita.

[15] Except where otherwise indicated all of the information in this subsection is taken from Vicente (2010).

was confined to STP. Comparing changes in corruption in the two countries before and after the STP discovery allows a difference-in-difference estimate of the discovery's effect on corruption in STP.

To defend the use of CV as a control group the author points out that the political histories of the two countries are very similar: both were Portuguese colonies for roughly 500 years, both gained independence in the mid 1970s, both had autocratic socialist regimes until 1989, both countries conducted their first multi-party elections in 1991, and in each country the incumbent was defeated. In the years since, both have experienced similar electoral cycles and changes in party dominance. Geographically, both are small island nations located in close proximity to one another and populations have flowed back and forth between the two states in recent decades. Both have been granted similar programs of IMF and World Bank sponsored aid and have faced similar conditions from these agencies.

Vicente's (2010) empirical analysis relies on responses from a survey of roughly 2000 individuals on corruption perceptions in the two countries. As preliminary evidence, a simple visual comparison of corruption trends in the two countries before and after the discovery using a World Bank corruption indicator reveals a striking difference. As Figure 5.1 shows, trends in the two countries tracked one another prior

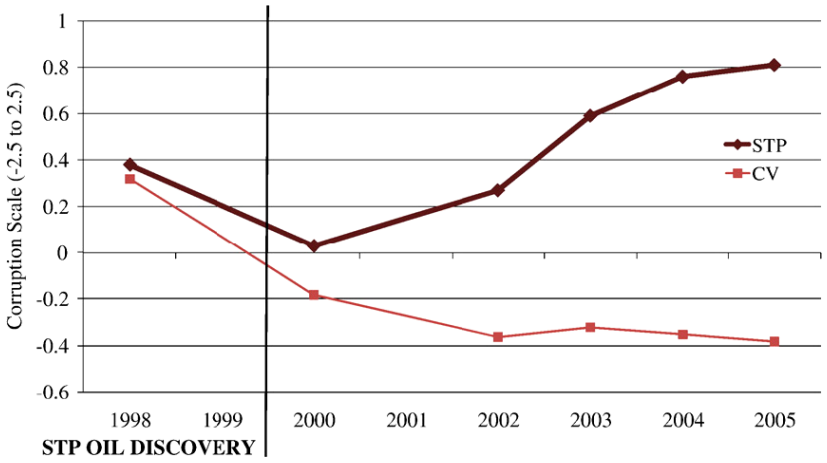

Fig. 5.1 Corruption trends in STP and CV before and after the STP oil discovery.

to the discovery, but departed steadily after the strike was announced. Unfortunately, a previous downward corruption trend in STP was reversed.

Vicente's (2010) formal statistical analysis is based on a survey in which citizens were asked to rate the corruption they perceived in past periods in the courts, application of customs laws, allocation of college scholarships, financing of schools, public investments in infrastructure, health care provision, public procurements, vote buying and other areas. Difference in difference estimates of corruption between STP and CV reveal significant post-discovery increases in STP corruption for vote buying, customs and several other corruption categories. Hypothesizing that the perceptions of highly informed citizens would be more accurate than those of the general population, Vicente (2010) developed indicators of whether or not citizens are highly informed and estimated triple-difference estimates — the coefficient of dummy variables on the interaction between post-discovery (versus pre-discovery), STP (versus CV) and informed (versus uninformed). This generally corroborated and strengthened the difference in difference results, with particularly strong effects estimated for corruption linked to state subsidies, courts, schools and vote buying.

5.3.3 Oil Discoveries and Trends in Governance

Tsui (2010a) reports on an empirical exercise that also relies on the timing of major oil discoveries to indicate "resource booms" and looks for subsequent changes in governance, but covers a broader set of countries. The governance dimension Tsui examines is the Polity IV "Democracy" index. The timing and size of oil-linked resource booms are gleaned from a dataset on oil discoveries by country and year. The goal is to test a stylized prediction from several theoretical models, that the trend in democracy following an oil discovery will turn downward in countries that are relatively non-democratic initially, but not in countries that start out as strong democracies.

This approach requires collection of time series datasets on oil discoveries in all countries where oil has been discovered and identification of *when* the most important discoveries were made as well as

their size.[16] In the primary regression model the dependent variable is the 30 year change in a country's democracy index following its year of major oil discovery. This is explained by variables including the amount discovered and its quality, plus interactions between these variables and the pre-existing democracy level; the trend in democracy prior to discovery in included as a control.[17] The resulting dataset is therefore a cross section of observations on individual countries.

For countries with low pre-discovery democracy scores, the democracy score 30 years after discoveries are found to be 10–20 percentage points below prior trends. No negative trend is evident for countries with relatively democratic governance pre-discovery, however.[18] This is consistent with the common political economy argument that a resource rent boom gives dictatorships more to lose from democratization and therefore causes them to resist reform more aggressively. Including fixed effects for decades (to reflect temporal effects that may cause democracy shifts worldwide) and for large oil producing middle eastern states affects the size of the estimated effects but they remain statistically significant.[19]

5.3.4 The Effects of Oil Discoveries: Income Levels Versus Income Growth

The standard economic model of a nonrenewable resource (Hotelling, 1931) predicts that a resource discovery will generate a stream of rents that is large immediately following the find, but declines (under

[16] Bohn and Deacon (2000) have shown that oil discoveries are sensitive to political conditions, as political turmoil can increase investor uncertainty and slow exploration. Tsui recognizes the endogeneity of discoveries and uses a two stage procedure in which the first stage involves estimating total discoveries as a function of social and political attributes of countries, political trends prior to discovery and a measure of geologic abundance which he uses as an instrument for discoveries.

[17] Oil quality (depth and physical characteristics) are included to control for variations in the value of oil discovered, as the underlying hypothesis on corruption involves *rents* derived from petroleum extraction.

[18] Adding variables for oil quality to the democracy interactions roughly doubles the estimated negative effect of discoveries on democracy trends.

[19] Using some of the same resource data, however, Cotet and Tsui (2011) report a mild positive association between a country's initial oil endowment and its economic growth in years following peak discovery. The empirical context is a cross-country cross section regression.

plausible conditions) as extraction proceeds. Extending this result, Boyce and Herbert Emery (2005) point out that the *optimal growth path* for an economy that discovers a nonrenewable resource deposit will exhibit a jump in income just after the find, followed by slower growth as depletion proceeds. During depletion the economy's growth rate is actually less than it would have been absent the discovery, but it is on a higher income path. Clearly, this is not a curse.

Alexeev and Conrad (2009) point out that this has important implications for how empirical results in much of the resource curse literature should be interpreted and for how empirical models should be structured. Ever since the original Sachs and Warner (1997) study it has been commonplace to include per capita GDP in an historic period, typically 1970, as an explanatory variable in models of income growth. This practice is motivated by the "convergence hypothesis" of economic growth; countries that experience relatively low income in any period, for whatever reason, are expected to grow at a relatively rapid pace.

Setting aside the convergence argument, Alexeev and Conrad (2009) point out that natural resource wealth surely did not appear exogenously in the year abundance is measured, but presumably was discovered at an earlier date. Following Boyce and Emery's (2005) reasoning, the original discovery should have caused a higher post-discovery income level but a diminished growth rate. If one includes historic income as a regressor, the positive effect a resource discovery should have on post-discovery income is "held constant" in the regression. If one then observes a diminished growth rate in resource rich countries, it would be natural to draw the incorrect conclusion that resource wealth is a curse.

Their response is to drop historic period income from the growth regression, so the resulting model explains the current (year 2000) GDP level rather than growth. Alexeev and Conrad (2009) include levels of resource abundance or exploitation that are roughly contemporaneous with income (year 1993 or 2000) rather than historic measures. Their estimates indicate that high current levels of resource abundance (fuels or minerals) are associated with high per capita income. Cognizant of claims that resource abundance is a curse only in countries with weak institutions, they follow up by adding interaction terms between current

resource abundance and current institutional quality. Here, they find that added resource abundance boosts output in strong institution countries, but has no significant effect, positive or negative, in countries with weak institutions — apparently, resources are neither a blessing nor a curse in weak institution countries.

Using the same general approach, Alexeev and Conrad (2009) reexamine the empirical link between current period resource abundance and governance quality. When they include 1970 income and a current year resource measure in a model of current "rule of law," they find the negative impact on institutions others have reported; however, when they drop 1970 income or replace it with fitted values from a first-stage equation that excludes resource abundance as a determinant, the negative institutional impact of resource abundance becomes insignificant.

The resource curse phenomenon described in case studies and characterized in some theoretical treatments is a story that unfolds over time: a resource discovery leads to rent seeking, which over time leads to declining institutional quality, diminished investment and lower long run income. Alexeev and Conrad's (2009) empirical model is not set up to test for this phenomenon. Rather, they test for correlations between current income and current (or recent past) levels of resource extraction or abundance. While their observations on the Hotelling model's predictions are compelling, they do not attempt to verify these predictions by examining the trends that unfold over time in resource rich countries.

5.3.5 Oil and Institutions: Evidence from Panel Data

Evidence from cross section empirical studies that use countries as observations can be criticized because countries obviously are heterogeneous along many dimensions and this heterogeneity cannot be completely controlled by including observed attributes. A widely used empirical fix is to employ panel data and include fixed effects for countries to soak up the influence of unobserved country-specific effects. This approach is not entirely satisfactory for data that persist over time within countries, such as oil abundance and institutional quality, since

little within-country variation is observed for these variables. Aslaksen (2010) takes an approach, the system GMM estimator, which relies partly on within country variation but does not entirely ignore cross-country variation. In effect, this approach combines observations on within-country first differences with observations on cross country levels and uses this combined dataset in estimation.

Aslaksen (2010) used this approach to estimate a model in which institutional quality is a country's 'democracy score' (alternately from Freedom House or Polity) and the dependent variables include lagged democracy, the 5-year lagged oil share of GDP and additional controls. Aslaksen (2010) generally finds a significant, negative correlation between oil income and democracy, even after controlling for country attributes such as religion, lagged income, education and latitude. Her model does not include two features often prominent in theoretical treatments, however: the notion that historic resource abundance affects the evolution of institutions over time and the possibility that oil's effect depends on institutions in the period when resources first became abundant.[20]

5.4 Resource Abundance and Politically Motivated Conflict

A study mentioned earlier (Collier and Hoeffler, 1998) (CH) sought to identify the general economic determinants of violent conflict and found a strong, curvilinear association between the SW measure of resource abundance (the share of primary product exports in GDP) and the onset and duration of civil wars. The resource abundance measure was not included to test a civil conflict version of the resource curse, for no such theory had been articulated. Rather it was included as an indicator of a country's taxable base along with other measures. CH's

[20] In a related contribution, Bhattacharyya and Hodler (2010) examine panel data (5-year averages) over 1980–2004 on corruption, democracy and measures of resource abundance. Their main abundance variable is the 1970 value of the primary product export share of GDP, but they also generate results for income from mining, subsoil wealth and natural capital. Corruption is measured by the Political Risk Services "corruption" index. Their specification includes time and region fixed effects and a democracy variable that amounts to the length of a country's history with democratic institutions. They find that resource abundance is positively associated with corruption in countries that do not have an extensive history of democratic institutions, but not otherwise.

estimate of the correlation between resource abundance and civil war was dramatic: setting the resource abundance variable at its "worst case" level (the peak of the curvilinear relationship) resulted in a predicted civil war probability of 56%, as opposed to 12% for a country without natural resources. This finding set off a subsequent empirical literature too lengthy to review in detail here; prominent entries include Collier and Hoeffler (2002, 2004), Ross (2001, 2004) and Smith (2004). The following review examines the original CH results and gives a broad overview of work that has followed in a similar vein.

In Collier and Hoeffler's (1998) view a rebel group initiating conflict aims either to capture the state or to secede from it, and its prospect for success depends both on the capacity of the state to defend itself and on the rebel group's capacity to sustain its activities. Both factors, CH argue, depend on the country's taxable base as well as other variables. CH regard a country's primary product exports as a fraction of its GDP, the SW resource abundance measure, as an indicator of taxable base. They included this variable (measured in 1965) and its square in a cross country probit regression for the probability that a nation experienced a civil war sometime during the period 1960–1992. A companion equation examined the duration of civil wars as a function of the same variables using Tobit estimation.[21] The estimated relationships are non-monotonic, first increasing and then decreasing; overall, however, the predicted effect of natural resources is to make things worse unless the primary products sector is extremely large.

Only 6 years after CH's findings were published, a review article by Ross (2004) could report results from 14 papers investigating empirical links between civil wars and natural resource abundance. Given the availability of Ross's (2004) review and a subsequent, more recent review focused on the role of oil and diamonds (Ross, 2006), it would be redundant to give a detailed account of the methods and results found in individual empirical studies. Further, this work generally is not aimed at using a potential empirical link between civil war and resource abundance as a vehicle for testing political economy theories

[21] Both equations included additional conditioning variables such as income, population and ethnolinguistic fractionalization.

or for examining growth implications of resource abundance, so the connection to this review's central concern is tangential.[22] In the remainder of this section the general empirical literature on resources and civil war is discussed only briefly; the reader seeking more detail is directed to the review papers by Ross (2004, 2006).

Following the original finding, contributions by CH and others (e.g., CH, 2004, 2005; Humphreys, 2003; Fearon and Laitin, 2003; Collier et al., 2006) presented evidence that resources are correlated with some types of wars but not others, that correlations between civil war and resource abundance are also observed with other resource measures (specifically, the World Bank resource wealth series) and that the original CH claim is also observed in cross-country panel data.[23] Ross's (2004) review summarizes much of this work and identifies four regularities in the reported results: (i) oil increases the likelihood of civil conflict, especially separatist conflict; (ii) lootable resources such as drugs and gemstones do not make the onset of conflict more likely, but do make conflicts last longer once initiated; (iii) legal agricultural commodities are not linked to conflict; and (iv) there is no robust empirical link between conflict and the primary products share of GDP when defined broadly to include agriculture.[24] In a subsequent review Ross (2006) reported that the likelihood of civil war in countries producing oil, gas and diamonds rose sharply in the 3 decades following 1970 and presented evidence on the channel through which oil and diamond production is linked to the onset of civil war. He cautions, however, that the correlations identified are based on a small number of civil wars — roughly 40 in total.[25]

[22] Smith (2004) is an exception in that he sought to investigate three political economy theories of why resource abundance and politically motivated conflict might be linked. His analysis is reviewed in somewhat more detail.

[23] For other contributions on this topic, see Lujala (2009) and Lujala et al. (2005) and the reviews provided by Ross (2004, 2006).

[24] Ross (2004) provides a useful tabulation of results from these studies, as well as resource variable definitions and samples used.

[25] Lujala et al. (2007) argue that national level data is too coarse to test whether or not mineral deposits encourage or prolong conflicts for control of territory or governments. Using a spatially disaggregated dataset on individual oil deposits, they find that the presence of oil in a region prolongs conflicts over control of government but, surprisingly, has no effect on conflicts over territory.

Empirical analysis of resource wealth and conflict has largely proceeded without specifying explicit theoretical models. An exception is Besley and Persson (2008), who postulate a model of conflict as an equilibrium outcome of rational behavior and test it with cross country panel data on the incidence of civil war. They characterize the probability of civil conflict as depending on: the opportunity cost of fighting, proxied by income; the prize claimed by the winner, which depends on resource rents and institutional constraints on claiming them; and on the technology for fighting. With panel data they are able to control for unobserved cross-country and temporal heterogeneity with fixed effects and to estimate what amount to within-country links from causal factors to civil war conflicts. The key empirical findings are that civil conflict is made more likely by (i) higher resource export prices, which their model interprets as a prize for emerging as the winner, and by (ii) higher commodity import prices, which their model interprets as lowering real income and, hence, the opportunity cost of engaging in conflict. The latter finding is has no precedents in this literature.[26]

A shortcoming in the empirical literature is the general absence of tests that would discriminate between competing explanations for a link between resource wealth and conflict. Smith (2004) is somewhat exceptional in this regard both in attempting to test different political theories of the resource-conflict link and in finding results that contradict the received wisdom. He examines three political phenomena, regime failure, political unrest and civil war, and attempts to discriminate among three alternative political transmission channels. The channels are: the rentier state thesis, that resource rich states can thrive without taxing and therefore need not extend their influence into the countryside, which subjects them to potential overthrow; a repression thesis, which argues that resource rich rulers have both the means and the incentive to invest in military and other apparatus that will maintain their grip on power; and a rebellion thesis which argues that oil rents

[26] Though not exactly theory-based, Ross (2006) estimates a generic model of the onset of civil war with cross country country-year data and abundance measures for specific resources and infers support for or against broad hypotheses regarding the source of the conflict-resources connection from the pattern of regression coefficients for resource abundance.

increase the likelihood of rebellion by tempting potential rebels with a large payoff and by sowing dissatisfaction over the way incumbent rulers divide the rents.

Smith's (2004) empirical format for testing is a cross country panel dataset covering 40 years (1960–1999) and roughly 100 developing countries. Separate models are estimated for regime failure (as indicated in the Polity data set), civil disorder (anti-state protests), and civil war, and in each case the value of a country's current oil exports relative to GDP is included as a determinant. Generally, Smith (2004) concludes that the oil share of GDP share is negatively associated with regime failure, negatively associated with civil war and negatively associated with civil protests. The second of these conclusions is, of course, at odds with what CH, Ross and others have found.[27]

Brunnschweiler and Bulte (2009), now familiar from their critique of empirical work on the standard resource curse, take issue with the empirical literature that purports to link resource abundance to civil wars and their complaints largely follow the earlier logic. As they rightly point out, the now famous SW primary product export share is neither appropriate as a resource abundance measure nor plausibly exogenous when used as a right hand side variable in a regression equation. They deal with both of these issues by following the same steps in BB (2008), first modeling the SW variable as an endogenous indicator of "resource dependence" and using the World Bank natural capital series as a measure of resource wealth. Once BB (2009) deal with endogeneity they find no evidence for the famous CH result, that is, resource dependence is not associated with civil war activity. As in their earlier paper they find that the World Bank natural capital series is positively associated with income, and higher income is associated with less frequent civil wars — so again, it appears to BB that resource abundance is a blessing. However, these findings apparently are vulnerable to the same

[27] A number of comments on Smith's (2004) pooled OLS estimation strategy are in order. The variable that represents resource wealth, the ratio of current oil revenue to GDP, clearly is endogenous. The data are a cross country panel composed of annual observations, but fixed effects are not included to deal with the unobserved heterogeneity among countries. The assumption (implicit in the estimation strategy) that successive observations from individual countries are independent can also be questioned.

critiques that van der Ploeg and Rohner (2010) leveled at BB's (2008) earlier analysis of the resource curse.[28] Econometric issues aside, BB's (2009) central result, that the SW measure of resource dependence (primary products exports relative to GDP) does not affect the onset of civil wars, does not address an hypothesis of central interest to political economy models of the resource curse. Such hypotheses arguably would involve measures of historic resource abundance or, better yet, windfalls. CH, BB and several others who have addressed the violence-resources question have relied on the resource dependence measure and thus not tested for resource abundance or resource windfall effects.[29]

[28] Problems raised with the earlier work concerned endogeneity of the World Bank natural capital series, which BB (2009) use as an exogenous measure of resource abundance and allegedly weakness of the BB's instrument for resource dependence (the SW measure).

[29] Regarding the prevalence of SW's resource measure in this empirical work, see Table 1 in Ross (2004).

6

Conclusions and Research Directions

Research on the resource curse addresses what many regard as the most important question in economics: Why do some countries grow while others stagnate or decline? The practical payoff from credibly identifying links that cause resource windfalls to retard economic growth is potentially enormous if this knowledge can lead to effective policy recommendations for host governments or international aid agencies. However, the governance effects found repeatedly in empirical work give reason for skepticism that such knowledge would cause host governments to change behavior. The leaders of these countries presumably have the intelligence to figure out what policies are socially efficient; indeed, the political economy models underlying this empirical work assume they understand exactly what they are doing.[1] The same models imply that resource windfalls give these leaders greater degrees of freedom to pursue self-gratification at the expense of the citizenry by weakening accountability. Perhaps the greatest potential for a positive social payoff from this research lies in understanding better how political institutions respond to resource windfalls, particularly if this knowledge leads to international aid strategies that help poorly

[1] I am indebted to Kevin Tsui for prompting me to make these points.

governed societies avoid further institutional decline when resource windfalls arrive.

Since the original SW papers of the mid-1990s the resource curse literature has expanded to the point where one could easily cite over 100 articles, books or chapters that address theoretical or empirical aspects of this phenomenon. The remainder of this section makes some general observations on the state of this literature and offers suggestions on the areas in which future contributions would be most useful. It also re-considers, somewhat incongrously, the most important question still in play: Is the resource curse real?

6.1 The Ongoing Empirical Literature

When SW adapted the cross-country, cross sectional growth regression approach pioneered by Barro (1991) to assess the role of natural resources, they laid out an empirical strategy that by now has outlived its usefulness.[2] Two aspects of the SW approach, though still fairly common, are difficult to defend at this point.

The first is the practice of regarding a country's primary product export share of GDP (typically measured in an historic year) as an exogenous indicator of natural resource abundance, and then interpreting this variable's coefficient as indicating how the application of a 'resource endowment treatment' will affect a country's economic growth or political institutions. It has long been recognized that this variable (*sxp* in SW's notation) is a poor measure of resource abundance. It is more accurately interpreted as a measure of resource dependence. With this interpretation there is nothing mysterious about finding that it is correlated with slow economic growth and weak political institutions. Any economy that ends up with weak institutions for whatever reason, for example, ethnic or linguistic heterogeneity, religious beliefs, historic misfortune, etc., is likely to suffer from low income and slow growth and, in particular, is unlikely to develop economic sectors other than primary products. Resource dependence can therefore be an unfortunate consequence of a hidden causal factor that hindered development

[2] To be sure, SW's original analysis was a path-breaking contribution at the time and the alleged shortcomings outlined here do not detract from its importance.

of good governance and retarded economic growth. The purely econometric critique that *sxp* is endogenous, though clearly correct, is beside the point as far as the resource curse is concerned. Better measures of abundance are available as is evident from empirical work by Norman (2009), and strategies can be devised for identifying the arrival of windfalls as in Tsui (2010a), Caselli and Michaels (2009), Vicente (2010), and Collier and Goderis (2009).

Second, the practice of relying on cross-country cross-sectional data, with one observation per country, to uncover the effects of resources on political institutions and economic growth arguably deserves to be abandoned. Because institutions often are observed only at the country level and because institutional failure may be most evident in the policies practiced by *national* governments, the use of country level observations is understandable. However, an empirical strategy that uses only one observation per country makes it impossible to control for unobserved cross-country heterogeneity and forces one to assume that all such differences can be captured by control variables.

An obvious alternative to the "one observation per country" approach is to use panel data and include fixed effects for countries, so patterns can be identified from within country variation.[3] Focusing on within-country, temporal variation necessitates shifting emphasis away from some historic measure of permanent resource abundance and toward natural resource windfalls as a potential causal factor. The key here is to correctly identify the timing and magnitude of resource windfalls and to document what happens to institutions and economic growth after the windfall arrives. Natural resource windfalls can result from price shocks or discoveries. The timing and magnitude of price-induced windfalls are generally easy to pin down and the event is often plausibly exogenous from the point of view of a single country. Further, countries lacking any reserves of the resource being studied constitute a natural control group. Discoveries can also be the source of windfalls; basing empirical work on discoveries requires that one identify the date of discovery as well as its size.[4]

[3] For example, see Collier and Goderis (2009).

[4] Vicente (2009) and Tsui (2010a) base their empirical analysis on discoveries. Complicating factors are that the size of a new resource deposit may not be known precisely until

The question of timing is largely an unsolved problem for empirical approaches based on *resource abundance* rather than windfalls. For nonrenewable resources, physical abundance is determined by geological conditions that presumably were in place eons ago. Existing theoretical approaches give no guidance on specifying when the effect of geologic abundance on economic growth or political behavior will be felt. For example, when trying to assess the effect of oil wealth on Nigeria's economy and politics, should one focus on known reserves in the present, during the UK colonial period prior to 1960, or at some time in between?

Purely empirical papers often overlook prominent predictions from political economy theories and supporting empirical evidence when formulating econometric specifications. One often neglected prediction is that resource windfalls will damage countries that are initially susceptible to rent-seeking or institutional erosion, while countries with strong institutions will ride out and prosper from resource booms. Mehlum et al. (2006a) made this point forcefully in a model of diverted entrepreneurship and provided corroborating evidence. This implies that empirical specifications should include an interaction between the resource variable and initial institutional quality. Empirical contributions often omit this interaction term.

6.2 The Resource Curse as a "Test Bed" for Political Economy Models

To seriously test a particular political economy model's explanation for the resource curse, empirical verification should examine *all* of the model's predictions. Finding correlations between resource abundance and slow growth was a contribution at one point in time, but numerous political economy models now make this prediction and different models attribute the connection to different channels. To be policy relevant, empirical research needs to identify the channels that transmit these effects and to reject political economy theories whose predictions are falsified. Because political economy theorizing

extraction has been in process for several years and that discoveries are endogenous events to a degree because they invariably require investments in exploration.

has proceeded more rapidly than empirical verification, there are now opportunities for empirical research to verify or falsify their postulated causal mechanisms.

First, several models predict that the presence or absence of institutional barriers to rent-seeking plays a key role in the existence and strength of a resource curse. When such barriers are present, the institutional decay and slow growth that would otherwise follow a windfall can be prevented. An ideal experimental design for testing this effect would separate countries into two types, those that have institutional barriers and those that do not. Both groups would then be subjected to a resource windfall and observed over time to see how rent-seeking and economic growth responds. Absent the opportunity to experiment, empirical researchers have relied on data from cross country data sets, either cross-sections or panels. A common empirical design in such work is to control for each country's rent-seeking *activity*, for example, frequency of bribes, quality of the bureaucracy, risk of contract repudiation, etc. To be a valid control, an institutional variable cannot be influenced by the treatment, the windfall. Yet the political economy theories that emphasize institutional barriers generally predict that a resource windfall will lead to increased *rent-seeking activity*. Clearly, rent-seeking activity levels cannot be valid instruments for institutional barriers. Instead, the following variables arguably merit consideration as controls for the presence or absence of rent-seeking barriers: a country's "stock of experience" with democratic governance; a country's religious makeup, linguistic or religious fractionalization, ethnic divisions; a country's colonial origins (if any) and legal tradition; a country's history of adherence to constitutional restrictions on government action.[5]

Second, prominent theoretical models and some historical accounts of the resource curse cite the diversion of entrepreneurial talent away from wealth creation and toward rent-seeking as a key mechanism whereby a natural resource windfall can be a curse, both politically and economically. According to this argument the arrival of a windfall that accrues to government causes economic activity to shift away from

[5] An empirical study that applies similar reasoning is Acemoglu et al. (2001).

a modern, increasing returns sector and toward more primitive sectors. These detailed implications seem potentially testable with data on changes in formation rates for new firms, shifts in production between sectors, shifts in employment between technical, high skill, high education occupations versus unskilled employment and (possibly) in university enrollment rates in technical, skill-intensive fields of study.

Third, Robinson et al. (2006) emphasize the commitment problems politicians and their supporters both face in distributing the rent from a resource windfall and explain how public employment can provide a solution. Their key prediction seems easily testable — public employment will expand following a resource windfall. The size of the effect is predicted to depend on the political leader's benevolence toward supporters, which may be difficult to test formally, but perhaps not impossible. According to their model the curse of slow growth follows because public employment is less productive than private employment. This generic prediction, which is a necessary condition for this model to generate a resource curse, seems potentially testable as a separate proposition. Robinson et al. (2006) do not postulate that a country's propensity to use public employment as a commitment device depends on its initial institutional setup, but one can make the case that it should. Countries with relatively "strong" governance arguably have alternative commitment devices such as constitutions, legislation or reputation-minded political parties that allow politicians to make credible promises. If such alternative commitment devices allow an incumbent to credibly commit to share post-election resource wealth with supporters, there is no need to expand public employment as a way to ensure reelection and the curse does not operate.

Fourth, the model of regime transitions developed by Aslaksen and Torvik (2006) predicts that the arrival of a windfall increases the probability of regime transition away from democracy and toward conflict. This should be testable with readily available data.[6] It also predicts that such shifts are less likely to occur in societies that place a strong emphasis on ideological attachments and less on purely economic

[6] Smith (2004), reviewed earlier, addresses the phenomenon of "regime failure" empirically, but not in a way that would shed light on the theory put forth by Aslaksen and Torvik (2006).

dimensions of policy. This is undoubtedly more difficult to test, but perhaps not infeasible.

Fifth, with regard to the voracity model of Tornell and Lane, it was argued earlier that the appropriate definition of formal capital in an economy dominated by a natural resource is capital invested in extraction. With this interpretation, the voracity effect implies that *resource extraction capital* will decline following a resource price windfall in economies that are vulnerable to rent-seeking and that the effect will be most pronounced when rent-seeking influence is concentrated in relatively few groups. In the case of petroleum, at least, this prediction seems testable with available data.

Two comments seem to be in order on the ways in which theory and empirical evidence can inform one another. The first concerns rent-seeking models that treat outcomes as equilibria of games played by independent agents, where these agents are characterized as groups. When the predicted outcome depends on the number of players, that is, groups, empirical testing requires an ability to identify separate groups in a way that agrees with their role in the theory. As independent players in a non-cooperative game, each group must be able to subordinate its members' interests to the group's objective, which requires a commonality of interests and low costs of coordinating members' behavior. At the same time, different groups must take actions independently from one another without cross-group coordination to eliminate wasteful competition. This requires that transactions costs between groups are relatively high, which seems most likely when the interests of different groups are in direct opposition. While these observations do not suggest a new opportunity for testing, they do imply criteria that can be applied when defining groups for use in empirical work.

The second comment concerns the common empirical finding that institutional decline tends to follow booms associated with concentrated, or "point" resources, but not those associated with diffuse resources.[7] This phenomenon has not been incorporated into any of the theoretical models reviewed; in fact, these models make few if any

[7] See Leite and Weidmann (1999), Bulte et al. (2005) and Sala-i-Martin and Subramanian (2003).

references to the physical attributes of the resources involved. The case study descriptions of Karl (1997) and others give highly suggestive discussions of why the concentrated versus diffuse nature of a resource might be relevant for its effect on governance and economic development. Incorporating this general point — that the physical attributes of the resource matters — into theoretical treatments seems both feasible and worthwhile.

6.3 Is the Resource Curse Real?

What constitutes convincing evidence is in the eye of the beholder, so different observers will no doubt reach different answers to this question. While the empirical findings linking resource abundance to slow growth are far from unanimous, the weight of evidence favors an affirmative answer in the opinion of this reviewer.[8] The effect is nuanced, however. Theoretical models of the resource curse have largely converged on the conclusion that a resource windfall generally will not impoverish a country with strong governance institutions; rather, a windfall will be a curse only when political elites rule and corruption or repression are already prevalent. Empirical findings that support the resource curse hypothesis generally corroborate this prediction. If one accepts this conclusion, then it seems to follow that the resource curse phenomenon operates through political or institutional channels. Leading political economy models reach different conclusions on how these effects are transmitted, however, and empirical analysis has not yet attempted to test these alternatives against one another. Of course, it is entirely possible that different transmission mechanisms are at work in different countries or for different resources.

To this reviewer, the most compelling evidence on a resources-governance link comes from within-country responses to resource booms, rather than evidence compiled by looking across differences in countries. Within-country evidence comes in two forms. The first is

[8] Corroborating evidence has recently been reported by World Bank (2006) in the form of a strong negative association between genuine savings (public plus private investment, minus depreciation, minus depletion of exhaustible resources, minus damage due to stock pollutants) and mineral rents as a fraction of national income.

from formal empirical studies that rely on the timing of resource discoveries, for example, Vicente (2009) and Tsui (2010a), or the timing of price shocks, for example, Tornell and Lane (1999), Lane and Tornell (1996) and Arezki and Brückner (2010). Individual studies can be criticized on various grounds. Vicente (2009) looks only at temporal patterns from two countries and on that basis might be considered to have only two "observations." Tsui (2010a) relies on the timing of resource discoveries, but identifies institutional effects entirely from cross country differences in responses. Tornell and Lane's (1999) evidence on government responses to petroleum price shocks in three countries, though tantalizing, is somewhat informal and preliminary.[9] Various authors have addressed these concerns, however, and still found evidence that the curse is real, perhaps most convincingly in the political realm; see Tornell and Lane (1996), Caselli and Michaels (2011) and Collier and Goderis (2009). While addressing "voracity" rather than the resource curse specifically, the empirical results of Arezki and Brückner (2010) are also strongly supportive.

The second form of within-country evidence comes from case studies and historical accounts. This extensive literature has not been reviewed here in any detail. While one cannot place confidence intervals on the effects described in these studies, the detailed accounts of how countries have responded historically to resource booms often resonate with the political economy stories portrayed in formal models. Some of the more compelling episodes are: Spain following the discovery of gold in the New World; Venezuela, which had precarious, formative governance institutions at the time its huge petroleum resources were first developed; Algeria, Nigeria, and other oil states during the price booms of the 1970s and 1980s; Indonesia, the Philippines and states in Malaysia during the tropical timber price boom of the 1970s; and even Peru during a boom resulting from the exploitation of bird guano during the mid-1800s.[10] It is worth noting that most of these case study

[9] Lane and Tornell (1996) use an empirical strategy similar to Tsui's (2010a), but examine shifts in a country's overall terms of trade, not just its resource exports, as the source of windfalls. As with Tsui (2010a), Lane and Tornell (1996) identify effects from cross-country differences in responses.

[10] More detail on these case studies can be found in Karl (1997), Ross (2001), and Gelb (1988).

accounts were developed by non-economists and many were articulated well before economists began developing political economy models to explain the seeming paradox popularized by Sachs and Warner.

Whatever academic researchers may believe, there is a common perception among the lay public that sudden, unexpected windfalls can cause institutions to erode in situations where the rule of law is not well established. A case in point was reported in June 2010 when the U.S. Geologic Survey announced discovery of at least $1 trillion in mineral wealth in Afghanistan.[11] The minerals are primarily iron, copper, cobalt, gold, and industrial minerals such as lithium that are critical for the manufacture of modern electronics. The dollar figure attached to the deposits represents $34,500 for every man, woman and child in the country, which is roughly 35 times the country's average annual per capita income. A New York Times news article (June 14, 2010) announcing the find pointed to widespread fears of a potential downside: "...the corruption that is already rampant in the Karzai government could also be amplified by the new wealth, particularly if a handful of well-connected oligarchs, some with personal ties to the president, gain control of the resources." There were also ruminations over the potential for warfare to erupt between the central government in Kabul and tribal and provincial leaders who may claim all or part of the resource wealth under the country's existing mining law.

One can easily envision policies for managing resource windfalls that would avoid institutional decline and promote economy-wide prosperity. If the political resource curse is widely regarded as "real," one might expect such policies to be tried. The key, of course, is to somehow constrain those in power from ignoring the policy; indeed, the absence of such constraints is the hallmark of institutional weakness. A seemingly sensible policy for managing resource windfalls is scheduled to be tried in Papua New Guinea, a country expecting that resource rents will soon flow from its extensive natural gas resources. In 2014 Exxon/Mobil is scheduled to begin shipping natural gas from "the most impoverished region of one of the world's poorest countries" (New York

[11] It is unclear to what degree this dollar figure represents "wealth" as opposed to the gross sales value of extracted minerals.

Times, Oct. 26, 2010). The revenue expected to accrue over the next three decades is roughly double the country's current annual GDP. At this point the rhetoric sounds promising: "Papua New Guinea officials are adamant [in stating] that the funds will be used for economic development and not siphoned off by the well connected. [The country's] finance minister said the government planned to channel the revenue into three sovereign wealth finds that would be overseen by a board of advisors [including international creditors.]" One former high-ranking government official remained doubtful, however, that this would serve as an effective constraint. When asked if he thought this strategy would be effective against the corruption that permeates the country's political establishment and bureaucracy, he was unsure: "Whether they will put the money into a revenue fund and steal it all in one go, I don't know."[12]

[12] New York Times, October 26, 2010.

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