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Leader behaviour and the natural resource curse

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We discuss political economy mechanisms which can explain the resource curse, in which an increase in the size of resource rents causes a decrease in the economy's total value added. We identify a number of channels through which resource rents will alter the incentives of a political leader. Some of these induce greater investment by the leader in assets that favour growth (infrastructure, rule of law, etc.), others lead to a potentially catastrophic drop in such activities. As a result, the effect of resource abundance can be highly non-monotonic. We argue that it is critical to understand how resources affect the leader's 'survival function', i.e. the reduced-form probability of retaining power. We also briefly survey decentralized mechanisms, in which rents induce a reallocation of labour by private agents, crowding out productive activity more than proportionately. We argue that these mechanisms cannot be fully understood without simultaneously studying leader behaviour.

JEL classifications: O13, D72, Q32, Q34.

1. Introduction

Between 1997 and 1999 oil prospectors found large oil deposits in the territorial waters of São Tomé and Principe. At the time of the discoveries *per capita* annual income in these West African islands was $510. The deposits are conservatively estimated to deliver a stream of revenue equivalent to a perpetuity paying $100m per year, or $500 per person.[1] Hence, *per capita* income has doubled. One might have expected the response to the find to take the form of jubilant crowds celebrating in the streets. Instead, foreign correspondents reported nothing but gloom and despondency (e.g. *Financial Times*, January 27, 2005). Why are São Toméans so wary of this immense gift?

[1] 'Democratic Republic of São Tomé and Príncipe: Selected Issues and Statistical Appendix', International Monetary Fund, 2006, http://www.imf.org/external/pubs/ft/scr/2006/cr06329.pdf

A possible answer is that they are looking across the Gulf of Guinea, which separates them from Nigeria. Nigeria has exported around $10bn worth of oil every year since the 1970s, making up a third of its GDP, yet it has been unable to use this revenue to stimulate growth: *per capita* income as of today is roughly on a par with its 1960 level. More stunningly, the fraction of the population living on less than $1 per day has gone from 36% to 70% (Sala-i-Martin and Subramanian, 2003). Hence, it is a fair assumption that for most Nigerians living standards have actually declined. This is clearly not a promising precedent for São Tomé and Principe. Other countries in the region provide even more anxiety-inducing scenarios: diamond-rich Sierra Leone, oil-rich Sudan, oil and diamond-rich Angola, and rich-of-everything Democratic Republic of Congo, are among the poorest countries in the world. Further afield, there are plenty of other sombre examples, and only a handful of tantalizing cases where resources seem at least not to have done harm, and may indeed have contributed to higher living standards.

These are the sort of casual observations that cause economists to talk of a 'natural-resource curse'. The first critical task for economists is to see whether these casual observations can be elevated to empirical regularities. As we understand it, this is a daunting task. It consists in documenting that resource windfalls (possibly under certain circumstances, to be established) lower living standards, i.e. that living standards are causally lower following a windfall than they would otherwise have been.[2] Establishing this with cross-country data involves formidable measurement, specification, and identification problems. Our own reading of the literature is that consensus has so far proved elusive.

The second, perhaps easier, task is to identify possible theoretical mechanisms through which the curse, if there is one, operates. It is appropriate that this effort takes place in parallel with the empirical work because explicit models of the resource curse can provide guidance in attacking the issues of measurement, specification, and identification we referred to above.

It is possible to distinguish three phases in academic theorizing about mechanisms of the resource curse: first, since the 1970s a series of 'rentier state' discussions of the phenomenon have been given by political scientists, saying that resource sectors and resource windfalls have a variety of negative effects on state capacity; second, during the 1980s and 90s, a number of economic explanations were given in which the resource sector crowds out other sectors more important for growth, this type of mechanism is generally called 'Dutch disease'; third, since 2000, several political economy models have been formulated, in the spirit of the rentier state, but exploring specific mechanisms, and confirming that the process can be individually rational for all actors.

[2] This is of course a much stronger proposition than to say that windfalls reduce the growth rate of the economy.

In this paper we describe and try to evaluate some of the possible political mechanisms that could lead to a resource curse, whether or not they have been previously formalized by others.

We propose a first distinction among political mechanisms which generate a resource curse, between centralized and decentralized mechanisms. Centralized mechanisms focus on the incentives and constraints faced by the political elite. The elite is the direct recipient of resource revenue and its problem is how to allocate this revenue (and its energy) between its own enrichment, activities that increase the elite's chances of retaining power, and investments that can increase the economy's capacity to produce non-resource income. This kind of model clearly fits authoritarian regimes best, but with appropriate reinterpretations it can offer insights into the workings of (more or less full) democracies as well.

We use a very simple reduced-form framework to illustrate a number of possible ways in which an increase in resource abundance affects the decisions of the elite. Broadly speaking, an increase in resource revenue affects the elite's decision problem through two main channels. First, since the elite is the direct recipient of the resource revenue, an increase in that revenue increases the value of staying in power, and hence the return to activities and expenditures that shore up the elite's political control. There are two broad scenarios under which an increase in the value of staying in power can lead to a resource curse. In one, the leader faces a binding budget or time constraint. When the return to staying in power increases he thus substitutes away from productive activities into activities that preserve him in power. In our reduced form model this is the case of the 'busy leader'. In another, the activities undertaken by the leader to stay in power have a negative spillover on the private sector, so a resource curse can emerge even if the leader is unconstrained. We discuss this mechanism under the heading of 'patronage' below.

Interestingly, however, the vice of an increased desire to stay in power may easily turn into a social virtue. One way to increase one's hold on power is to make citizens happy, i.e. to provide plenty of opportunities in the private sector. Hence, an increased desire to stay in power may lead to greater investments in productive inputs for the private sector (see the 'strategic leader' below). Even if the primary means chosen by the leader to reinforce his power is through unproductive spending, such as a more pervasive security apparatus, the indirect effect is to lengthen the leader's planning horizon. This also may induce him to spend more on productive activities as well (the 'repressive leader'). In such cases, resource windfall are blessings, rather than curses.

The second main way a resource windfall affects the leader's problem is by increasing the likelihood that he will face a challenge for his political control. Since leadership brings control of resources, potential challengers will be more aggressive and more motivated when power brings greater spoils. The direct effect is to shorten the leader's horizon, and hence his perceived returns from developing the non-resource economy (the 'fatalistic' leader). This effect can be exacerbated if the leader responds to the greater probability of a challenge by

shifting more resources into wasteful self-preservation schemes. On the other hand, in some cases a more efficient response would be to counter the increased incentives of outsiders to mount a challenge by improving the outside option offered by the private sector. In this case once again the curse turns into a blessing. We briefly sketch a model below that combines the increased probability of a challenge with incentives to both increase repression and increase productive investments.[3]

There are two additional ways that resource windfalls affect the government problem, but we argue that they are of secondary importance. One is that a resource windfall relaxes the government's budget constraint. In our view this effect is unlikely, *per se*, to generate a curse. More resources allow the government to spend more on everything, including productive investments. This is illustrated to a certain extent by our already-mentioned 'repressive leader' model.[4] The other is a wealth effect. An increase in resource revenue lowers the leader's marginal utility of consumption, and thus calls for more leisure. If the increased leisure comes at the expense of time and energy devoted to productive policy-making it is once again possible to generate a curse. We downplay this mechanism, that we call the 'lazy leader', because we suspect it is unlikely to be of first-order importance (though several discussions in the literature seem to point at it).

Returning to our two main triggers (increased value of staying in power, and increased likelihood of a challenge) we conclude that they both have inherently ambiguous effects on non-resource GDP. In particular, each of them has individually the potential of pushing the leader's investment in pro-growth policies either down or up. Clearly, then, when both effects are taken together the ambiguity increases exponentially. We argue that the key unknown in generating this ambiguity is the shape of the reduced-form function that links resource abundance, self-preserving unproductive spending, and pro-growth productive investments by the leader. In other words we need to know how responsive is the supply of challengers to changes in resource revenue, and how effective is government pro-growth spending at keeping that supply down. Furthermore, we need to know how effective is self-preserving expenditure (particularly repression) in stifling opposition. The net effect of the mechanisms we emphasize will depend on these

[3] One mechanism we don't discuss in detail is that potential rebels find it easier to pledge future natural resource revenues to their financial backers than to pledge future tax receipts from the non-resource sector, as seems famously to have been important in Laurant Kabila's rebellion in (then) Zaire.

[4] It may be worth mentioning the positive effect of resource wealth predicted by the Solow growth model. In this model poor countries are generally represented as slowly converging, through accumulation of capital, upwards towards their steady-state levels of wealth. A country experiencing an isolated windfall should therefore experience a large permanent positive wealth effect, but, as a side-effect, a lower subsequent rate of growth.

elasticities and how they vary with the level of resource revenues and other country characteristics.

Our main focus in this paper is on centralized (leader's behaviour) mechanisms, which seem to have received relatively less attention so far. However, we make some comments on decentralized responses as well. Decentralized mechanisms are essentially rent seeking stories. Resource rents directly change the incentive structure for private individuals, causing them to reallocate effort from productive to unproductive activities. As is well known, rent seeking can generate a resource curse only if the productive sector operates under increasing returns to scale, or if the rent-seeking activity has direct negative spillovers on the productivity of the productive sector. We highlight some open issues with rent-seeking mechanisms. Among these, establishing that the externalities exist and are of sufficient size; and explaining how externalities can exist without creating scale effects, i.e. falsely predicting that smaller countries will be less wealthy. Most important, however, may be to explain why no actor (particularly the state) can internalize or contract around the externalities. Rent seeking models rely on some form of market failure, which the state has failed to prevent. What makes the state unable or unwilling to do so? It seems that this brings us back to the importance of centralized explanations.

When assessing the various potential mechanisms for a curse we are mostly motivated by the cases of the mineral-rich countries, including of course oil. Some commentators have occasionally included cash crops as a possible source of a resource curse. Whether windfalls in the form of price increases for cash crops seem in some instances to have reduced overall living standards is an empirical matter that we view as not settled. However, the mechanisms we highlight below may potentially explain such an outcome, at least in the short run. In particular, if the physical output of the cash crop sector is fairly inelastic to taxation, a large increase in the price of cash crops may directly lead to a large expansion in the resources controlled by the government. A similarly cautious assessment applies to foreign aid.

2. How to turn a blessing into a curse

Our premise in this paper is that in order to be properly described as a curse, natural-resource abundance must lower living standards for the average person. Leaping as usual from living standards to average income, the problem is the following. Consider an economy that is made up of a resource sector and a non-resource sector. The value-added of the resource sector is α, while the value-added of the non-resource sector is ν. Hence, GDP y is

$$y = \alpha + \nu. \tag{1}$$

Natural resources are a curse if and only if

$$\frac{dy}{d\alpha} < 0. \tag{2}$$

Put another way, we say that there is a curse if an increase in natural-resource income causes a more than proportional decline in non-natural-resource activity, $dv/d\alpha < -1$.[5]

Note that this definition implicitly treats natural-resource GDP, α, as exogenous. This assumption deserves some comment. In most of the developing world natural-resource extraction and commercialization takes place under one of two typical arrangements. The first arrangement is that the government issues a concession to a foreign company to extract and sell. The flow of royalties for the concession is, as a first approximation, in the short run and in normal circumstances, a proportion of the value of sales, and can therefore reasonably be treated as exogenous. In the long run, however, the share of the home country in sales revenues is the result of negotiations between the government and its foreign counterpart, and will depend both on the bargaining power and on the incentives of the country's leadership to secure a favorable deal. It is not difficult to see that both bargaining power and incentives may depend on the form of government and on the leaders' accountability. Furthermore, they will change as the volume of known reserves and/or their market price change, so one effect of resource windfalls may well be to induce the government to renegotiate or even revoke existing agreements, with possible knock-on effects on the political equilibrium, and further feedbacks onto the relationship with the foreign companies. Some of these scenarios have recently been playing out in, e.g., Russia and Bolivia.

The alternative common arrangement is one where the resource-rich country exploits its reserves through a government owned company.[6] The efficiency and transparency with which the state-owned resource-extraction corporation operates, as well as its access to capital, freedom to retain profits for the purpose of reinvestment, economic- vs. patronage-driven nature of its personnel policy, and the very decision to opt for this form of extraction instead of giving concessions to foreign companies are all influenced by the political equilibrium. Since in turn the political equilibrium is likely to be affected by resource windfalls, we conclude that a potentially important channel of causation from windfalls to economic outcomes is through the type of arrangement for collecting resource revenues chosen by the government and through its ability and incentives to make the most of them. As far as we are aware, however, there has been very little work on this particular issue.[7]

[5] There is actually a bit of a problem with averages here. We would also say that there is a curse if natural resouces increase average income, but reduce the income of a large majority of the population. So perhaps a more relevant requirement for a curse is that it lowers living standards for the median individual. Our discussion below focuses on the more stringent criterion of average income, but future work should tackle distributional effects more explicitly.

[6] Of course we are focusing on the two corner solutions. In reality the typical case features a combination of the two forms of exploitation as well as joint ventures between state-owned and foreign companies.

[7] Ross (1999). There is more data on ownership in Jones-Luong and Weinthal (2006).

Another complicated conceptual issue is whether α should be treated as GDP to start with. Let's take an unrealistic but useful extreme case for the sake of argument. Imagine that the extraction and commercialization process uses no capital and no labour whatsoever. Is it correct to treat the sale on the world market of some of these resources as value added? An alternative view is that the total amount of resources available to the country represents an asset, and a sale of some or all of these resources is just a portfolio reallocation, from, say, oil, into (foreign) currency. When extraction is costly, perhaps the sales revenues should be netted out of their purely portfolio component before being added to GDP. In sum, the conceptually correct way of treating resource revenue from a theoretical standpoint is not fully clear to us. There is an interesting literature on 'genuine saving' that relates to this (e.g., Hamilton and Clemens, 1999), but overall perhaps this is another area that deserves more attention.[8]

Having dutifully put in our plug for more work on these two issues, we set them aside and return to eqs (1) and (2). As mentioned in the introduction, a number of political mechanisms have been proposed that have the potential of generating a resource curse as defined above. We classify these mechanisms into two broad classes: centralized mechanisms and decentralized mechanisms. Centralized explanations for the resource curse focus on the choices of the country's leaders, while decentralized ones focus on the responses to a windfall by a (potentially large) number of agents who are not necessarily part of the governing elite. We begin with the former set of explanations.

3. Centralized mechanisms

Explanations for the resource curse that focus on the behaviour of leaders tend to share the following two basic features.

First, non-resource GDP depends in part on some inputs provided by the leader, broadly construed as the political elite. The obvious example is the provision of public goods, such as law and contract enforcement, infrastructure, and possibly health and education. When public provision of these inputs falls the non-resource sector becomes less productive and less efficient. Private investments may also decline in response. In order to provide these productive inputs to the non-resource sector the leader must spend some of the government's revenues on them. In addition, effective government spending on public goods may depend on investments of the leader's time and effort. Hence, a centralized political resource curse occurs if an increase in resource revenues causes the leadership to

[8] A more mundane, but nonetheless important issue is whether we should be concerned with GDP or GNP. Seen from the point of view of the resource sector the appropriate measure seems clearly to be GNP, as the share of the value of sales accruing to foreign companies is both large and irrelevant for the purposes of domestic efficiency and welfare. However from the point of view of the non-resource sector most of the mechanism for a resource curse operate through a weakening of this sector's productive capacity, so it seems more natural to focus on GDP.

reduce its investments of money or effort in productive public good provision to such a large extent that the non-resource sector shrinks by more than the resource sector expands.

Formally, we have

$$v = v(i, l) \equiv f(i, l) - i,$$

where i is government spending, l is leader's effort in providing public goods, and $f(i, l)$ is private-sector GDP. We assume that $f(i, l)$ is neoclassical and obeys the Inada conditions. Explaining the resource curse then means explaining why

$$\frac{\partial v}{\partial i}\frac{di}{d\alpha} + \frac{\partial v}{\partial l}\frac{dl}{d\alpha} < -1.$$

Second, the leader is self-interested. In choosing i and l the leader maximizes his own utility, and this is not always achieved by maximizing aggregate GDP. This maximization problem faces the following budget constraint:

$$c = \alpha + \tau f(i, l) - i,$$

where τ is the tax rate on the private sector. Hence the revenue accruing to the government from natural resources is an essentially inelastic endowment-like flow. Instead, the government cannot capture all of the private GDP because taxing private GDP has distortionary effects. In particular, non-resource tax-revenue is subject to the usual Laffer curve effect, as it depends in part on the incentives of agents other than the dictator to exert effort and invest. In what follows we take the tax rate τ as exogenous for simplicity, and because it does not play an important role.[9] The government budget also takes into account spending on public goods.

Given the budget constraint above a consumption-maximizing leader will under-invest: the GDP maximizing condition for i is $df/di = 1$, while the leader's revenue maximizing condition is $\tau df/di = 1$, meaning that he will cease investing before reaching the efficient level, i.e. the level at which the marginal product of investment is equal to its cost. However so far we have not introduced any mechanism which can explain a decrease in investment following a resource windfall, the following sections go on to do that.

[9] The reader who is unhappy about this may become slightly happier by thinking about the following version of the model. The production function is

$$v = v(i, l, \tau),$$

with v_3 negative; and government revenue is

$$T = \alpha + \tau v(i, l, \tau).$$

Cursory calculations suggest that in our various models below this version gives qualitatively identical results to the ones in the main text.

3.1 A simple reduced-form framework

In order to discuss possible causal mechanisms linking a change in resource revenue α with changes in resources i spent by the leader on activities that enhance the productivity of the private sector we found it useful to develop the following simple two-period framework.[10] In the first period, the leader begins by collecting an exogenous flow of revenue α. He then proceeds to allocate this revenue between own first-period consumption, c_1, pro-growth investments, i, and self-preserving activities, b. For the time being we interpret the latter as pure repression, though later we will explore the extent to which b can be reinterpreted as patronage.

The key assumption is that the leader faces some probability of losing power. In particular, the leader will still be in power in the second period only with probability π. If he does hold on to power, he collects once again α. Furthermore, he collects a fraction $\tau < 1$ of private sector income, $f(i)$. We assume that the tax rate on private income is less than one to account for (without explicitly modelling) the distortionary potential of such taxes. The tax rate τ can be thought of the tax-revenue maximizing tax rate. Private-sector GDP is a function of i because i reflects the provision of public inputs (such as infrastructure, or the rule of law) that increase productivity. Second-period consumption by the leader is $c_2 = \alpha + \tau f(i)$. Without loss of generality we assume that the leader does not discount the future (other than through the probability of staying in office).

The properties of the model will crucially depend on what we assume about π. First, π is likely to depend negatively on α. This is because an increase in α increases the value of being in power, thus emboldening potential challengers. More, or more aggressive, challengers clearly spell danger for the leader of period 1. Second, π will depend positively on repressive spending, b. Clearly the more powerful the security apparatus the safer the leader's position. Third, π depends on i. This works again through the potential challengers' incentives. Potential challengers' outside option is to be active in the private sector, perhaps as entrepreneurs. The more productive the private sector, the better the outside option, the lower the likelihood that a challenge will be cast. Hence, for the most part we assume that π is increasing in i.[11] In sum, we can write $\pi(b, i; \alpha)$, where the semicolon separates variables that depend on the leader's decisions from variables that are exogenous inputs to that decision. The model is summarized in the following simple time-line.

Period 1			Period 2		
α	(i, b)	$c_1 = \alpha - i - b$	$\pi(\alpha, i, b)$	$\alpha, f(i)$	$c_2 = \alpha + \tau f(i)$

[10] A referee has pointed out that in this dynamic game the Laffer-curve justification of our tax rate may not apply, because in the final period the leader will have no reason not to set the tax rate at 100%. So, in lieu of a more sophisticated dynamic model, we assume that the leader can commit to a tax rate in advance.

[11] An increase in private-sector productivity will also make it more expensive for potential challengers to recruit supporters.

3.2 The busy leader

First, suppose that π depends on the effort put in to maintain power, and that the dictator has only a fixed supply of effort that they can supply, which they allocate between maintaining power and overseeing non-resource development. If we represent development effort as i, and survival effort as $(1 - i)$, the objective function will now look like:

$$u = \alpha + \pi(1 - i)[\alpha + \tau v(i)]$$

Note that in this version of the model $f(i) \equiv v(i)$ because i is measured in terms of time, so does not alter the value added. The first-order condition is:

$$\frac{du}{di} = -\pi'(1 - i)[\alpha + \tau v(i)] + \pi(1 - i)\tau v'(i) = 0$$

Faced with this trade-off the dictator will always lower effort in non-resource development when α increases, though total second-period output could be either increasing or decreasing in α:

$$\frac{di}{d\alpha} = \frac{\pi'}{\tau(\pi v'' + \pi'' v - 2\pi' v') + \alpha\pi''} < 0$$

$$\frac{dv}{d\alpha} = \frac{v'\pi'}{\tau(\pi v'' + \pi'' v - 2\pi' v') + \alpha\pi''} \gtrless -1$$

If f and π are both linear then a curse will occur if and only if τ is less than 1/2.

Clearly this model is missing the important fact that labour and capital are substitutes in production, which allows the dictator to supply more capital to make up for the missing labour. To justify this simple model the ruler's labour and capital must be close to perfect complements in production. Or in other words, the ruler must be unable to delegate any of their oversight power to intermediaries. This interpretation has some plausibility: in countries without a strong rule of law, but with a strong incentive to contest power, delegation is very difficult; this fits with the frequently observed re-arrangement of political positions in dictatorial countries.

It is common in political science literature to say that a resource windfall distracts a state from tasks that are important for economic development, such as investment or tax collection.[12] Ross (1999, p.313) criticizes this line of thought because of its assumption 'that states are revenue satisficers, not revenue maximizers'. However the model given here could explain a rational neglect of activities as due to the inability to delegate. Another model presented below, the lazy leader, gives a similar way of rationalizing the description of leaders as distracted.

[12] For example, Birdsall and Subramanian (2004): '[a resource-rich] state is relieved of the pressure to tax and has no incentive to promote the protection of property rights as a way of creating wealth.' See Ross (1999) for more examples.

3.3 The repressive leader

Next we consider the case in which the probability of regime survival (π) depends upon repressive spending by the dictator (b). This could be interpreted as spending on the military or on secret police. Other interpretations of b, as well as other mechanisms involving b, are discussed in a later section. The objective function now becomes:

$$u = \alpha - i - b + \pi(b)[\alpha + \tau f(i)],$$

with first-order conditions:

$$\pi'(b)(\alpha + \tau f(i)) = 1$$
$$\pi(b)\tau f'(i) = 1$$

This gives us:

$$db[\pi''(\alpha + \tau f)] + d\alpha[\pi'] + di[\pi'\tau f'] = 0$$
$$db[\pi'\tau f'] + di[\pi\tau f''] = 0$$
$$di/d\alpha = \frac{-\pi'\pi'\tau f'}{(\pi'\tau f')^2 - \pi''(\alpha + \tau f)\pi\tau f''}$$

where the second-order condition is:

$$u_{11}u_{22} - u_{12}^2 = \pi''[\alpha + \tau f]\pi\tau f'' - (\tau\pi' f')^2 \geqslant 0$$

If the second-order condition is satisfied then the effect of resources on investment ($di/d\alpha$) is non-negative, thus there can be no curse. Intuitively, a windfall raises the returns to b, and because b and i are complements, spending on both increases. So, of two dictators, the one with the larger windfall will employ a larger political police force, because of the greater returns to keeping power; that dictator will also invest more, because they now have a greater probability of keeping power.

A curse can occur if we add to this model a budget constraint in the first period. When it binds first-period revenue will be divided between spending on investment and on repression, so that $b = \alpha - i$, and the objective function can now be written:

$$u = \pi(\alpha - i)[\alpha + \tau f(i)]$$

With first-order condition, total differential, and comparative statics:

$$-\pi'(\alpha + \tau f) + \pi\tau f' = 0$$
$$da[-\pi''(\alpha + \tau f) - \pi' + \pi'\tau f'] + di[\pi''(\alpha + \tau f) - \pi'\tau f' - \pi'\tau f' + \pi\tau f''] = 0$$
$$di/d\alpha = \frac{\pi''(\alpha + \tau f) + \pi' - \pi'\tau f'}{\pi''(\alpha + \tau f) - 2\pi'\tau f' + \pi\tau f''}$$

The final expression has an ambiguous sign: resource windfall raises the returns to repression (b), encouraging substitution away from investment, but it also has a positive income effect on investment (i). A curse can occur if, for example, $\pi(x) = Ax$ and $f(x) = Bx$, in which case $di/d\alpha = (\tau AB - A)/2\tau AB$, which produces a curse if $\tau B \leqslant \frac{1}{3}$.

If the windfall was only an anticipated windfall, so that α appeared only in the period-2 payoff, not in the constraint, then the income effect would disappear, and an increase in windfall would unambiguously decrease investment.

An interpretation of these results is that, as in the previous model, the leader must be under some kind of constraint in order for resource income to crowd out productive investment.

Note that this model has the potential of generating a non-monotonic relation between resource income and non-resource investment. At low levels of α the leader is constrained, and $di/d\alpha$ may be negative. At some point α becomes large enough for the leader to be able to implement the interior solution, and from then on $di/d\alpha > 0$.

Empirically, there seems to be a robust positive association between resource income and dictatorship (Ross, 2001), perhaps supporting a link between windfall and spending on repression.

3.4 The strategic leader

Next we consider the case in which the probability of regime survival increases with investment. This can be seen as a dictator winning support from a population through paying for economic development. The objective function is now:

$$u = \alpha - i + \pi(i)[\alpha + \tau f(i)],$$

with first-order conditions:

$$-1 + \pi'(i)[\alpha + \tau f(i)] + \pi(i)\tau f'(i) = 0,$$

and total differential,

$$d\alpha[\pi'(i)] + di[\delta^2 u/\delta i^2] = 0$$

By the second order condition, the second term in brackets is non-positive, so $di/d\alpha$ must be non-negative, so there cannot be a curse. The effect is very similar to that in the previous model: higher α raises the returns to investment through π, which in turns raises the returns to investment through f.

These same equations have another opposite interpretation. The probability of survival could be decreasing, instead of increasing, in investment ($\pi' < 0$). If economic development benefits not just the state, but other groups also (such as rebel guerillas, landholders, the middle class, or foreign firms) then the state may decrease investment in order to maintain its power. In this interpretation, the equations are identical to those above, except that now $\pi'(i) < 0$, so $di/d\alpha$ must now be non-positive, i.e. investment is decreasing with windfalls, and there could

be a curse. In short, this story says that dictators only ever invest reluctantly, because they fear the power that development gives to their rivals; with resource income they shut down other investment, starving off their challengers, and live comfortably off their resource wealth.

This theory of the curse may find some support in evidence that resource-rich countries tend to have less open economies (Mahon, 1992; Auty, 1994; Auty, 2001; Papyrakis and Gerlagh, 2004). Sachs and Warner (1995) confirm this association, but claim that it explains little of the curse effect. Acemoglu *et al.* (2004) explicitly argue that states intentionally prevent development because of fear of losing power. Dunning (2005) gives some conditions under which the elite fail to invest in diversification, for fear that it will raise the probability of a revolt, and applies this model to the facts of Zaire's development, saying '[t]he high degree of societal opposition to Mobutu in Zaire led him to believe that investments in infrastructure and other public goods would pose a threat to his grip on political power' (p.453). If Zaire had not had resource income, perhaps Mobutu would have risked his power more by investing in public goods.

3.5 The fatalistic leader

A final single-variable version of the survival function is $\pi(\alpha)$, with $\pi'(\alpha) < 0$, meaning that increasing resource income lowers the probability of regime survival. This can be easily justified with a model of the decision-making of potential political challengers (rebels, opposition parties, or coup leaders) whose incentive to challenge power increases with α. The dictator's problem is now:

$$u = \alpha - i + \pi(\alpha)(\alpha + \tau f(i))$$

Here investment unambiguously decreases with α, because high resources raise the effective discount rate, and so lower the return to investment. The net effect on non-resource value added is given by

$$dv/d\alpha = -\left(f' - 1\right)\frac{\pi' f'}{\pi f''},$$

which says a curse is more likely if the returns to investment are fairly steep and straight. If $\pi(\alpha) = 1 - \alpha$, and $f(i) = A\ln(i)$, then $dv/d\alpha = -A(\frac{1}{1-\alpha} - T)$, which is always negative, and for some parameter values can be below negative one. In this case the curse is increasing in the rate of return on investment.

The central assumption of this theory, that π is decreasing in α, has mixed evidence. Smith (2004) finds that oil exporters tend to have longer-lived governments. On the other hand Nigeria has had eight successful coups since independence in 1960, and it seems likely that Nigeria's oil revenues have contributed something towards the incentives of potential coup leaders.

On investment, Gylfason and Zoega (2006) have argued that productive investment is low in resource dependent countries, though investment may be nominally high. It appears that many resource-rich countries have undertaken large long-term

investment projects, and apparently with little success. Gelb (1988) has a detailed study of how six oil producers spent their windfall income in the 1970s, compared to carefully constructed counterfactuals, and finds 'the six countries used the windfalls largely for domestic investment in the public sector, rather than to increase consumption or to acquire foreign assets'. Possibly the public sector investments were poor choices, nevertheless this behaviour is not immediately consistent with a model predicting a high discount factor.

3.6 Sketch of a $\pi(\alpha, b, i)$ model

Caselli (2006) presents a simple model that combines several of the main effects discussed above. The model studies the strategic interaction between a leader in power and a potential coup leader. The potential coup leader compares the expected return from a coup with the return from becoming an entrepreneur in the private sector. The expected return from a coup takes the form $(1 - P)V^p(\alpha)$, where $V^p(\alpha)$ is the value of being in power, and is increasing in the resource flow to the elite.[13] This is discounted by P, which is the probability that the coup will fail. The expected return from becoming an entrepreneur, V^e, is increasing in the productivity of the private sector, $V^e(i)$. Hence, there exists a threshold level of investment, $\bar{i}(\alpha, P)$, such that a coup occurs if and only if $i < \bar{i}(\alpha, P)$. This implies that as α increases the productive investment needed of the leader to forestall a coup increases, i.e. more revenue makes self-preservation through development more expensive.

As in the models above, the leader decides how to allocate first-period resource revenues between first-period consumption, investment, and repressive activities. Repressive activities increase the probability of coup failure (conditional on a coup taking place), or $P = P(b)$. Technologies are linear. In particular, $f(i) = \rho i$, with $\tau\rho > 1$. The latter parametric assumption implies that if the leader expects no coup (or expects all coups to be crushed with probability 1), it invests all of the first period resource revenue in the pro-growth activity. However, if it expects a coup, and the probability of coup success is large enough, it invests nothing in the activity.[14] The repressive technology is of the form $P = \min(\gamma b, 1)$, which implies that if the leader can throw enough resources into repression it can successfully face down any challenge.

[13] To be more precise the value of being in power also increases in the leader's first period investment, i, or $V^p(\alpha, i)$. This is because an increase in i increases tax revenues from the non-resource sector. Under mild assumptions, however, the effect of i on the opportunity cost of a coup is stronger than its effect on the attractiveness of a coup, so for simplicity we abstract from this complication in this discussion. See Caselli (2006) for details.

[14] The investment function is

$$i = \begin{cases} 0 & \text{if} \quad \text{no coup or } P\tau\rho < 1 \\ \alpha & \text{if} \quad \text{coup and } P\tau\rho \geqslant 1 \end{cases}$$

Under certain additional parametric assumptions the equilibrium of this model is described by Fig. 1. There are three regions for α. For $\alpha < \underline{\alpha}$ the leader ploughs all of his resource income into the private economy. Increases in α increase the incentives of coup leaders to stage a coup, but not by enough to push i below $\bar{\imath}(\alpha, 0)$. Since there is no coup, there is no need for wasting resources on counter-insurgency, and $b = P = 0$.

When α is just above $\underline{\alpha}$, in the absence of counter-insurgency spending a coup will take place and succeed. Hence $i = \alpha$, $b = 0$ can no longer be the optimal policy for the leader. The figure is drawn for the case where $P(\underline{\alpha})\tau\rho < 1$, i.e. when the leader faces a return to investment which is less than the opportunity cost even if it invests all of $\underline{\alpha}$ into counter-insurgency. Hence, in this region the leader invests all of his resource revenue in counterinsurgency.

Finally, the last region is defined by $\alpha > \alpha^*$, where α^* is defined by $P(\alpha^*) = 1$. With the possibility of a coup, completely eliminated, the leader returns to pro-growth investments. Details aside, this model confirms that when several of the mechanisms discussed above are put together, the relationship between GDP and resource revenue can become very non-monotonic. In this particular case, more resources are unquestionably a blessing at low levels of α, they are a curse

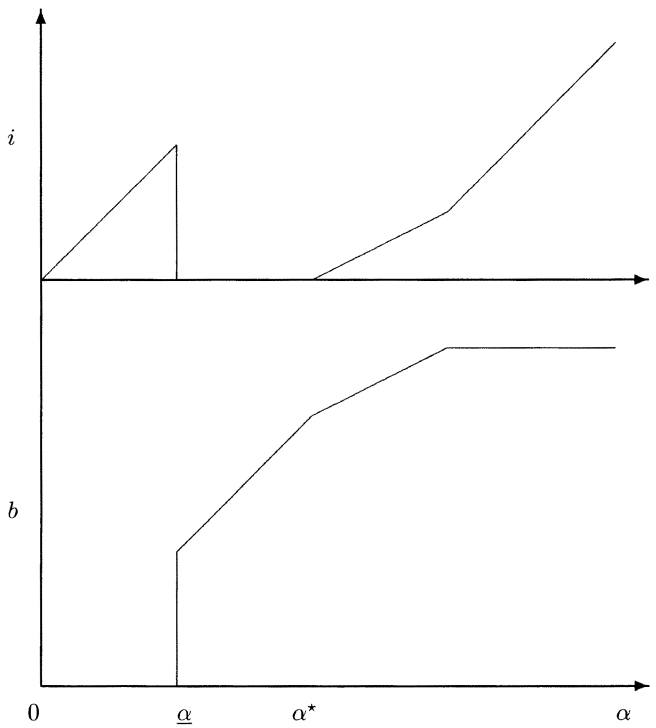

Fig. 1 Investment and funding as a function of windfall

(both political and economic) at intermediate levels, and a qualified blessing (modulo high levels of political repression) at very high levels.

3.7 Patronage

Patronage, particularly interpreted as buying votes or buying political support, is often mentioned in connection with resource-rich economies.

At first sight patronage serves the same role in the dictator's choice situation as does spending on repression: money that increases the probability of keeping power. As discussed under that heading, such spending can only crowd out investment if the leader faces a binding budget constraint.

Another way of representing the relationship between patronage and investment decisions is as alternative ways of getting support: either through funding public services, or through directly buying votes.

To represent this in the general model we allow π to be a function of both i and p. For simplicity we drop the budget constraint and set $\tau = 0$. In this model, if $\pi(i, p)$ is continuous and weakly concave, patronage cannot crowd out investment. In order to generate a curse the model must incorporate some discontinuity or non-complementarity between the two inputs.

A simple way this may be true is if there are increasing returns to patronage. For example if a dictator has to bribe the entire judiciary to steal an election, this may not be feasible for low levels of income (in which case the dictator uses investment to win support), but it is feasible for high levels (in which case the dictator neglects public services). Collier (2007, p.45) argues that poor democracies, when given income from resource exports, tend to substitute from investment to patronage.[15] Humphreys and Bates (2005) argue that resource-rich countries will tend to use more patronage than investment, just because the provision of public goods is relatively more expensive, due to the inelasticity with respect to taxation that they exhibit.

Patronage models are interesting and clearly have a ring of truth to them. From a theoretical point of view the main unanswered question is why the promises exchanged by the patron and the recipients of patronage are mutually credible. Why do the recipient reward patronage with his or her vote after having received it? Or, if the vote is given in exchange for promised future patronage, why can't other politicians promise the same? Robinson *et al.* (2006) make some progress on these questions, but the puzzle remains.

[15] Another interesting argument offered by Collier is that increased resource income attracts lower-quality politicians to office, who in turn are less inclined to provide public services. It may be possible to embed this argument in Caselli and Morelli's (2004) model of self-selection by quality in political life.

3.8 The lazy leader

We now move to a model in which the π function does not play a role, this involves a static trade-off between the dictator's leisure and time spent overseeing development. This serves as an alternative formalization of the idea, mentioned above, that dictators reliant on abundant natural resources do not need to worry about developing the economy. The non-resource production function is now more sophisticated:

$$v = v(l, i),$$

where l is the time and energy the dictator devotes to governing the country and i is the amount of resource-revenue invested by the dictator in non-resource activities. For example, besides money being invested in public infrastructure, the non-resource sector may also require careful management of the that money so as to avoid waste and theft and identify the most profitable projects. We assume that v is neoclassical.

The dictator cares about his own consumption (c) and leisure ($1 - l$) only, i.e. he maximizes

$$u(c, 1 - l),$$

which has the usual properties.

So the objective function is now:

$$u(\alpha + \tau v(l, i), 1 - l)$$

In this model, both l and i (and hence v) are decreasing in α. Put differently, an increase in resource income leads to a decline in non-resource income. The intuition is of course that resource revenue has a wealth effect that induces the dictator to wish to consume more leisure. If investment and effort are complementary, investment will also fall, possibly leading to a curse. This is because any increase in resource revenue is associated with a one-for-one increase in the dictator's income, while a decline in non-resource revenue only leads to a $\tau < 1$ fall in the dictator's income. Hence, it is possible for aggregate income to fall while the dictator's income increases, thus preserving the negative wealth effect on effort.

At first sight the lazy dictator model seems a bit silly, with these dictators trading off leisure with consumption, as if they were assembly-line workers. Taken slightly less literally, however, the lazy dictator theory is one where the ruling elite (and the top brass of the army) have virtually costless access to immense wealth. They can therefore finance a lavish lifestyle without having to pay particularly close attention to how the rest of society is faring. That immense personal riches may sap a ruling elite's interest and willingness to promote wealth in the rest of the economy is not entirely implausible. Certainly anecdotal examples in which the inner circle of the dictator ends up almost completely out of touch with the rest of society abound. Still, it is not as if absolute rulers of resource-poor countries are

exactly indigent. The model does assume that the wealth effect is still operational at levels of wealth that are fantastic for most people: $1bn makes you lazy, but not $100m. The earlier points about the costs of delegation also apply here.

Whether realistic or not, that the elite values leisure and that the elite's effort is an important input in non-resource GDP are critical to tell stories for the resource curse which are based on the idea that the elite does not need growth in non-resource GDP to get rich. If we replace $v(l, i)$ with $v(i)$, or $u(c, l)$ with $u(c)$, or both, then both the equilibrium value of i and the equilibrium value of v are independent of α.[16] The intuition of course is that if the leader's effort is constant (or does not matter) the optimal amount of natural resource revenue invested for non-resource development depends exclusively on the rate of return of this investment. In this case, non-resource GDP cannot be declining with natural resource revenue, and GDP must increase.

3.9 Centralized mechanisms: summing up

A very simple reduced-form model of leadership in a resource abundant country generates a wealth of possible mechanisms, some of which imply that resources are a blessing, others that they are a curse. In order to get a curse it is necessary that government provided inputs to the non-resource sector fall, and that the magnitude of the fall or the elasticity of non-resource GDP to government-provided inputs be very large.

Whether government-provided inputs will fall in response to a resource windfall, and by how much, depends crucially on the shape of the leader's survival function, the object we call π. Different combinations of elasticities of π to its arguments can lead to utterly different predictions. Furthermore, if these elasticities change for different values of the arguments, it is relatively easy to get significant non-monotonicities in the response of government-provided inputs to changes in the resource base. We can summarize the findings as follows, organized according to how a windfall changes incentives:

(i) *Increasing the incentive to maintain power* This can cause substitution away from investment and towards activities which raise the probability of survival. This channel can only work if the leader operates under a constraint, either on time (busy leader) or on money (repressive leader).

(ii) *Decreasing the probability of survival* A windfall can induce more competition for power, causing a lower probability of survival, and so lowering the expected returns to investment (fatalistic leader).

(iii) *Lowering dependence on non-resource sectors* If the main motivation for investment by leaders is to keep their citizens satisfied then a windfall could make available alternative means to keep power, such as repression

[16] More precisely, the interior equilibrium level of i, which is determined by the condition $v'(i) = 1$. If this level of investment exceeds α then $i = \alpha$.

or patronage. If the alternative instrument is a substitute, instead of a complement, then a windfall can cause a drop in investment (strategic leader, and section 3.7 on patronage).

(iv) *Lowering the value of money* Finally, a windfall could, through a wealth effect, cause substitution away from time spent overseeing investment (lazy leader).

In order to make progress it is essential to learn more about the function π. A first step is obviously to unpack π into its two components: the probability that the leader will face a challenge, and the probability, conditional on a challenge being launched, of surviving it. The former requires explicit modelling of other actors in society, particularly those who have the personal qualities that make them potential political leaders. This is likely to be a small minority in the population (though the current leader may have difficulties in identifying them). Hence, it seems appropriate to focus on games with a finite number of players. The latter is mostly a technological relation between investments in repression and the effectiveness of such investments. It is mostly an empirical issue, though it is possible to think of theoretical mechanisms that determine this effectiveness and its variation across countries. In countries with a lot of forest cover, for example, counter-insurgency spending is probably much less effective.

Another elaboration of this structure would model in more detail the competition for power between groups within the elite. The competition can produce an incentive for the incumbent to keep political institutions weak, which may as a side-effect keep market institutions weak. We think that the mechanics of such models will fit within our structure, interpreting investment as institutions, but more detailed discussions are contained in, for example, Acemoglu *et al.* (2004), Besley and Kudumatsu (2007), and Padró i Miquel (2007).

4. Decentralized mechanisms

Decentralized approaches to the resource curse focus on the actions of agents outside the ruling circle. Broadly speaking, they emphasize the dependence of non-resource GDP on productive investment, x, and labour supply, s by the citizens, rather than by the ruler. Hence,

$$v = v(x, s),$$

and a resource curse emerges if x and s decline in response to an increase in α so that v falls more than proportionally. In the political-economy literature, the main reason offered for this decline in private investments is rent seeking.

4.1 Basic rent seeking model

The basic structure of rent seeking models is that individuals make a choice between working in the productive private sector or engaging in competition to appropriate part of the resource revenue. Suppose, then, that there is a continuum of individuals of mass 1. Abstracting for the time being from physical

inputs, assume that if engaged in the productive activity individuals earn ν, while those who rent seek divide equally among themselves the resource α. At an interior equilibrium we have

$$\nu = \frac{\alpha}{1-s}, \tag{3}$$

The condition then says that the marginal non-rent-seeker is just indifferent between the two occupations.

With constant returns to scale (i.e. if ν a constant), this model clearly has no trouble generating a fall in s in response to an increase in α. Non-resource GDP will thus fall. But aggregate GDP will not. In fact, aggregate GDP is always ν, independent of α.[17] Hence, the model features full resource dissipation through rent seeking but no resource curse. This is of course an immediate consequence that the-private sector production function featuring constant returns to scale.[18]

To get a resource curse we need to assume that ν' is increasing in s. If $\nu''(s) > 0$ then an increase in α will bring about a decline in aggregate GDP. This is essentially the model of Torvik (2002). One way to motivate the assumption is that there are increasing returns to scale in the non-resource sector. In this sense the rent-seeking model is reminiscent of classic Dutch disease arguments, where it was assumed that the non-resource sectors enjoyed externalities (or learning by doing) unavailable to the resource sector. Such externalities are currently de-emphasized in the macroeconomics literature, largely because they have proved very hard to document empirically. In addition, admitting that there are important externalities in private-sector activity seems to open the door to significant size effects in GDP. Since larger countries don't seem to be richer, this may be a problem.

Alternatively one could interpret the assumption $\nu''(s) > 0$ to mean that there are negative externalities from rent seeking to private production. Whether or not this is a plausible assumption depends on the specific interpretation one gives to rent seeking.

4.2 Roadblocks

A simple model of rent seeking that naturally generates negative externalities on the non-resource sector is one where the rent seeking activity consists of setting up road blocks aimed at extorting money from passing vehicles. An increase in resource income can increase the attractiveness of setting up roadblocks relative to employment in the non-resource sector, if resource income can be extracted

[17] To check the result note that GDP is $\alpha + \nu s$. Plugging in ν from (3) the result is immediate.

[18] The complete-dissipation case is a special case in general rent-seeking models, and the more typical case is one of under-dissipation, which makes a resource curse even harder to generate. See Nitzan *et al.* (1993) for a discussion on how dissipation rates depend on modelling assumptions.

from passing vehicles. A negative externality on the non-resource sector can then result, if the extortion tax levied by the roadblocks induces those who remain in the non-resource sector to reduce their effort and/or their investments.

The story has logical and anecdotal appeal. However, it is somewhat incomplete. Resource revenue does not spread itself equally in the population: it tends to flow mostly to the elite. It seems likely that the elite will have means to protect itself against this sort of predation. If so, however, the incentives to start the road blocks diminish considerably. More generally, one would expect the state to be able to internalize the negative spillovers generated by rent seeking. Any model of rent seeking needs to explain why the central government cannot or chooses not to control the spillover-generating activity.[19] Hence, a fully compelling model of rent seeking needs to explicitly model the leader's behaviour. In other words, there is no such thing as a fully decentralized explanation.

4.3 Civil war

One type of rent-seeking activity that is sure to have negative externalities on the non-resource sector is civil war. In countries ravaged by civil war the return to investment and productive effort are clearly severely curtailed. However it is doubtful that a model featuring such an extreme degree of decentralization as the one on hand can be thought of as a good model of civil war. For one thing, the government is usually a major player in civil wars. Second, civil-war situations present enormous incentives to create coalitions, as witnessed by the fact that most civil wars are fought by just two main groupings. Given the likely involvement of the government, and given the coalition-formation questions raised by civil war, models of civil war are perhaps better thought of as semi-decentralized.

An important question in modelling civil war is the nature and robustness of the coalitions that form in order to fight the war. Caselli and Coleman (2006) point out that members of the losing coalition have overwhelming incentives to defect to the winner. This way they can regain access to the distribution of the resource revenue. But this defection is actually a problem for the winner. If unchecked, it implies that the resource income will have to be shared widely, thereby defeating the very purpose for which the coalition had gone to war initially. We should therefore expect civil war to be more likely to erupt if there exist relatively low cost means of policing coalition boundaries. Caselli and Coleman suggest that one such means is ethnicity. If coalitions can be formed along ethnic lines, and ethnicity comes with markers that allow fairly easy categorization of individuals into groups, then the winning ethnic group can be quite effective at preventing infiltration by the losers. We would therefore expect natural-resource abundance to be more likely to trigger civil war in ethnically heterogeneous societies.

[19] Failure to control these externalities could be considered as lack of investment, *i*, as modelled above.

5. Conclusions

We have tried to advance the view that explicit consideration of the political elite's incentives and constraints is essential in understanding the effects of resource windfalls. Resource windfalls affect the political elite's returns from staying in power, as well as their perception of the likelihood of becoming involved in a power struggle. These considerations are likely to have first order effects on their choices, including the amounts of resources and effort they devote to increasing the productivity of the non-resource sector. Unfortunately, however, it is hard at this stage to be confident about the direction, much less the magnitude, of these changes. They depends on a rich set of elasticities of the probability of staying in power to its various determinants. It is possible to describe equally plausible scenarios where resource windfalls are beneficial as well as detrimental. Furthermore, it is relatively easy to generate non-monoticities, whereby additions to resource income is beneficial at certain levels of resources, and detrimental at others.

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