

Resource Curse? A Theory of Contestable Political Markets with Endogenous Entry Barriers

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Abstract

This paper provides a unified framework to study both the economic and political aspects of the so-called “resource curse.” A model of political competition in a two-sector economy is developed to analyze the effects of natural resource wealth on economic policy, political development, and civil insurrection. Contrary to popular belief, but consistent with recent empirical findings, my model shows that natural resource abundance is an economic blessing even in a rent-seeking society, although resource dependence can be negatively associated with economic performance. The appropriation of natural resource wealth entails lower deadweight cost because of its relatively inelastic supply. When the political market is contestable, even dictators care about popular support and hence resource wealth can help reduce the cost of financing the provision of efficient economic policy. However, resource wealth can be a political curse. When the size of political entry barriers is endogenous, natural resource wealth induces incumbent dictators to run more repressive regimes, but the anti-democratic effect is smaller for countries with a strong private sector, as well as high costs of rent appropriation and political entry deterrence. Moreover, because the number of challengers is also endogenous, resource abundance has no effect on the incidence of civil war, unless the costs of maintaining or overcoming entry barriers are affected. This clarifies the two seemingly contradictory hypotheses that “resource wealth enhances regime durability ” and “resource wealth fuels conflict.”

Keywords: resource curse, barriers to entry, contestable markets

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1. Introduction

Richness in natural resources is now widely thought to contribute to negative economic and political outcomes, at least for currently developing countries during the last few decades. The economic curse thesis contends that natural resource wealth is an impediment to economic development, and in particular it is one major explanation for Africa's growth tragedy. However, the curse is an economic anomaly because it refutes the fundamental economic principle of "more is preferred to less," and it contradicts many cases of successful resource-based economic development, such as the United States, Australia, Chile, Peru, Brazil, and Botswana, as discussed by economic historians (Wright and Czelusta, 2007; Wrigley, 1988).¹ Being a political curse, natural resource abundance is said to hinder democracy and enhance regime durability because it enables authoritarian regimes to become stronger by funding patronage and repressive apparatuses, and hence it is responsible for the "freedom deficit" in the oil-rich Middle East. But this seems to be inconsistent with another popular argument that resource wealth undermines regime stability because it gives a financial incentive to initiate conflict. For instance, how do we reconcile the coexistence of some unusually durable regimes, such as those of Iraq's Saddam Hussein, Indonesia's Suharto, or Saudi Arabia's royal family, and the high incidence of conflict and war in some other oil-rich countries like Angola and Nigeria, where distribution of the oil rent is believed to contribute to violence and separatist tendencies? Understanding the impact of natural resource wealth on society is important, especially in a time of concern about energy security and sustainable economic development. There are also important implications for policy design: If natural resources themselves are not to blame for various disappointing economics or political outcomes, there will be no resource curse to be escaped from and some of the policy solutions designed to help the resource-rich countries may need

¹See also the staple theory, which contends that the development of many countries, such as Canada, has been led by the export of natural resources (Watkins, 1963).

to be reevaluated (Humphreys, Sachs, and Stiglitz, 2007). To better understand the resource curse, one needs to study how economic factors shape political institutions and how political institutions affect the economy. However, surprisingly, few theoretical studies examine both the economic and political aspects of the resource curse simultaneously.

This paper provides a unified theoretical framework to understand the economic and political resource curse. A model of sequential political competition in a two-sector economy is developed to analyze the effects of natural resource wealth on economic policy, political development, and civil insurrection. Having a natural monopoly, an incumbent political leader can enjoy temporary monopoly rent until he is replaced by a new challenger, either through a relatively lower-cost fair election under democracy, or a higher cost insurrection under nondemocracy.² The model therefore resembles a sequential patent race (Reinganum, 1985). In a contestable political market, political leaders are concerned about not only their leadership income, but also their longevity. Public policies, including both economic and political ones, are chosen to maximize the expected political rent subject to the constraint of entry threat. A major departure from the patent race models is that entry barriers, which are more important in the political sector, are endogenous. Leaders choose the size of the political entry barriers, which are presumably lower the more democratic a society is. However, because entry barriers are costly to maintain and enforce, even leaders of the most repressive regimes show some sensitivity to popular support.

Because popular support matters when political market is contestable, contrary to many existing arguments, my model shows that natural resource wealth is an economic blessing, even in repressive political regimes where the dictators' goal is solely to seek rent. In other words, rent-seeking

²According to James Fitzjames Stephen (1873, pp. 27), the key difference between democracies and nondemocracies is the following: "Parliamentary government is simply a mild and disguised form of compulsion. We agree to try strength by counting heads instead of breaking heads, but the principle is exactly the same." Similarly, North et al. (2006) interpret the process of political development, and democratization in particular, as a transition from limited to open access and entry into political organizations.

activities in the political market alone, even when they are pervasive, do not necessarily lead to an inefficient public sector. The appropriation of natural resource wealth entails a lower deadweight cost because of its relatively inelastic supply. Resource wealth therefore can reduce the cost of taxation. To maximize popular support, political leaders follow the Ramsey's inverse elasticity rule and collect tax revenue from the resource sector to finance the provision of more efficient economic policies. Therefore, the general public also can benefit from the resource wealth, even under authoritarian regimes.

Resource wealth, however, is not necessarily an unmixed blessing. Wealth from natural resources is potentially a political curse because it serves as bait for political rent-seekers competition. When entry barriers are endogenous in a contestable political market, to improve their chances to stay in power, incumbent dictators will expend more resources to block entry. Governments in resource-rich nondemocracies therefore are predicted to be more repressive and militarily strong. However, my model does not imply that resource wealth leads to more civil conflicts. Higher entry barriers discourage challengers and hence the incidence of civil insurgency is independent of resource wealth abundance, unless resource wealth has a direct impact on the costs of maintaining or overcoming entry barriers. Finally, in countries with a strong private sector or high costs of rent appropriation and political entry deterrence, my model predicts that the extent of the political resource curse is smaller. The political resource curse is therefore a conditional one, and my theory helps clarify the two seemingly contradictory hypotheses that "resource wealth enhances regime durability" and "resource wealth fuels conflict."

These implications are consistent with many previous empirical findings on the resource curse, democratic transitions, defense economics, and civil conflicts. The literature on the economic resource curse began with Sachs and Warner's (1995) study, which documented a negative statistical

relationship between natural resource dependence, measured by exports of natural resources as a fraction of GDP, and economic growth.³ Gylfason (2001) argues that natural capital crowds out human capital. Papyrakis and Gerlagh (2007) provide similar evidence using U.S.-state-level data. Mehlum et al. (2006) add a qualification that the curse applies only to countries with bad institutions. However, resource dependence or comparative advantage in resource products is not the same as resource abundance (Wright and Czelusta, 2004). When resource abundance is measured more appropriately, recent studies find that natural resource wealth tends to positively affect economic growth (Alexeev and Conrad, 2008; Brunnschweiler and Bulte, 2008; Lederman and Maloney, 2006; Stijns, 2005). My model predicts that resource wealth has a positive causal effect on efficient economic policy adoption and hence economic performance. However, holding resource abundance constant, countries with higher economic policy implementation costs will have a smaller nonresource sector, and hence appear to be more resource-dependent.

There is more consensus for the negative effect of resource wealth on democracy (Aslaksen, 2007; Barro, 1999; Jensen and Wantchekon, 2004; Ramsay, 2006; Ross, 2001; Tsui, 2007; Wantchekon, 2002).⁴ More interestingly, as predicted by my model, Tsui (2007) finds that the anti-democratic effect of oil appears only among nondemocracies that discovered oil. In terms of the amount of resources used to deter entry, it is well-documented that military expenditure shares in the oil-rich countries of the Middle East are among the highest in the world (Ross, 2001; Sköns et al., 2000). Existing evidence on the natural resource-civil war relationship is mixed. Collier and Hoeffler (1998, 2004) find that natural resource dependence has a positive effect on the onset and duration of civil war at low levels of natural resource dependence and a negative effect at high levels of

³Sala-i-Martin (1997) even concludes that natural resource dependence is one of the ten most robust variables in empirical studies on economic growth, although Sala-i-Martin et al. (2004) find that the fraction of GDP in mining has a robust and positive relationship with growth.

⁴A few exceptions are Herb (2005) and Haber and Menaldo (2007).

natural resource dependence. However, these findings are challenged by Fearon and Laitin (2003) and Fearon (2005), who argue that these findings reflect omitted variables (including weakness of the economy) rather than a causal relationship. More recently, Smith (2004) finds that oil has a negative effect on the incidence of civil conflict, Ross (2006) finds a positive effect based on a small number of cases, and Hegre and Sambanis (2006) and Sambanis (2004) find no effect on civil war and positive effects on lower-level civil conflict. Finally, drawing from experience in post-independence Botswana, Mobutu's Zaire, and Suharto's Indonesia, Dunning (2005) suggests the need for conditional theories of the resource curse. With these conflicting pieces of evidence, what we can conclude for now is perhaps that resource wealth is not very likely to have a robust and significant effect on civil war, which is again predicted by my model.

The structure of the paper is as follows: Section 2 reviews the existing theoretical literature on the resource curse. Section 3 describes the model and defines the equilibrium. Section 4 shows that natural resource wealth is an economic blessing rather a curse. The conditions of the existence of the political resource curse are identified in section 5. The nature of the political resource curse, when it exists, also is discussed. Section 6 concludes.

2. Previous Theoretical Studies of the Resource Curse

The negative correlation between natural resource dependence and economic growth has inspired many economists to consider its origins. Auty (2001) and van der Ploeg (2006) provide some useful overviews of the resource curse literature. One earlier explanation is based on the Dutch-disease type of arguments, in which the constant return of the resource sector crowds out the nonresource sector, which is responsible for long-term economic growth because of increasing returns (Sachs and Warner, 1995, 1999; Torvik, 2001; van Wijnbergen, 1985). More recent theories focus on rent-seeking. One reason that rent-seeking is harmful to growth is the so-called “voracity effect” — a

terms of trade windfall generates a more-than-proportionate increase in fiscal redistribution and reduces growth in an economy with weak institutions and multiple powerful groups (Lane, and Tornell, 1996; Tornell and Lane, 1999). Another possibility is that rent-seeking behavior reduces the number of entrepreneurs running productive firms, and this interacts with demand externality in the nonresource sector, especially when institutions are grabber friendly (Mehlum et al. 2006; Torvik, 2002). My model is related to Robinson et al. (2006), which provides a political-economy analysis of the impact of natural resources on economic development. Like Robinson et al.'s model, politicians compete for rent in my model. However, to analyze their incentive to enhance economic growth, politicians are assumed to choose an economic policy explicitly. More recently, another political-economy model is developed by Caselli and Cunningham (2007). My model is closely related to their centralized mechanisms which focus on the incentives and constraints faced by political leaders. A major difference between their (as well as Robinson et al.'s) framework and mine is that I endogenize both the size of entry barriers and the number of political challengers. This enables me to study democratic development and civil conflict along with economic development within the same framework and to understand how the technology of entry prevention affects these economic and political outcomes.

The argument that rentierism harms democracy, because there is no representation without taxation, is popular among political scientists (see Ross (2001) for a review). Relatively few formal economic studies analyze the political resource curse. However, the recent literature on democratic development has implications for how the structure of an economy can affect political transition. Acemoglu and Robinson (2006) argue that democratization is less likely in a more agricultural (or less industrialized) society because land is easier to tax and hence elites, who own land, have more to fear from democracy. Moreover, when political turbulence is less damaging to land than other

forms of capital, elites favor repression rather than concession. The same logic perhaps could be generalized to other natural resources. Following Acemoglu and Robinson, Huang (2007) emphasizes the distributive conflict among different factor owners in a political-economy framework to analyze the democratization process. She concludes that the fundamental force underlying democratization is not the income level per se, but the changing factor composition. My model adapts and extends the framework developed in Mulligan and Tsui (2006), which focuses on political competition between incumbent leaders and their challengers.⁵ None of these models, however, systematically studies both the economic and political resource curses together. Dunning (2005) extends Acemoglu and Robinson's framework to study how the world market structure of the resource, the degree of societal opposition to elites, and the prior development of the nonresource private sector affect incentives for diversification and thereby political stability and economic performance. His results suggest the need for conditional theories of the resource curse. By introducing various deadweight costs of rent appropriation and taxation in a two-sector economy, my model offers implications for how resource wealth may interact with the quality of institutions as well as the productivity of the nonresource sector to produce various economic and political outcomes.

In a sequence of papers, Herschel Grossman pioneers a framework to study insurrections (Grossman, 1991) revolutions (Grossman, 1999) and civil wars (Gershenson and Grossman, 2000; Grossman, 2003). Although these papers do not directly address the resource curse problem, one of the predictions is that disputes are more likely to result in civil conflict when the appropriable rents are large. These papers take the political regime as given, however, and hence ignore the possi-

⁵Mulligan and Tsui's (2006) model is closely related to a framework developed independently in North et al.'s (2006), which emphasizes the role of political violence and how political institution is evolved to control political violence, provide social order, and facilitate economic exchange. Nondemocracy, according to them, is a natural state because limited access orders manipulate the economy to produce rents and then systematically use those rents to create political stability. The concept of political entry barriers developed in Mulligan and Tsui (2006) serves to limit political entry and to create rent.

ble interaction between institution and conflict. Aslaksen and Torvik (2006) study how resource abundance affects the choice between conflict and democracy. They also conclude that resource wealth makes conflicts more likely. Motivated by the observation that poor countries are much more likely to have civil wars than rich ones, Fearon (2007) shows that higher income means that there is not only more stuff to appropriate but also more stuff worth defending. His model therefore predicts government and rebel force levels are independent of the size of the appropriable rent. Morrison (2007), in contrast, argues that non-tax revenue, such as resource rent, enhances regime stability for both democracies and nondemocracies, although non-tax revenue is neither anti- nor pro-democratic. These models are, however, static and with a fixed number of players (two, in particular). Moreover, because the choice is between conflict and democracy in Aslaksen and Torvik's model, their framework basically assumes that civil conflict goes hand in hand with nondemocracy. In my sequential model, in which the incumbent can choose the size of entry barriers anticipating the reaction of his potential challengers, I can distinguish the impact of resource wealth on the level of force (measured by the expenditure on blocking entry) from the incidence of civil war (measured by the number of challengers), and hence my model allows for durable as well as unstable authoritarian regimes.

3. An Endogenous Political Entry Barriers Model in a Two-Sector Economy

Following Mulligan and Tsui (2006 and 2008), my model has two basic components, which reflect the two concerns of a political leader; leadership income and longevity. Political leaders choose various policies, which affect both income and longevity, to maximize the expected discounted political rent. Because challengers cannot credibly commit to policies until they are in power, these policies are chosen only after taking power. To study the problem of resource curse under different political institutions, I extend the model to a two-sector economy and introduce various deadweight

costs associated with different public policies.

3.1. Economic and Political Policies, Deadweight Costs, and Government Budget Constraint

The resource sector generates a constant flow of income α , and the rest of the economy produces an income flow denoted by y . Incumbent leaders choose three types of public policies: (1) an economic policy x , (2) a political entry barrier policy b , and (3) tax policies τ_y and τ_α . The economic policy x is assumed to enhance national income from the nonresource sector (i.e. $y \equiv y(x)$ where $y'(x) > 0$, $y''(x) < 0$, and $y'(0) = \infty$), but is functionally unrelated to the blocking of political challengers. The political entry barrier policy has the primary effect of blocking political competition. Every challenger has to spend b to challenge the existing regime. It is important to note that the policy b , which is assumed to be non-negative, is not a money transfer from the challengers to the incumbent; it is a pure deadweight loss due to rent-seeking behavior. Presumably, the more democratic a country is, the smaller is the size of the political entry barriers, and an “ideal” democracy can be thought of as one with b equals zero. Therefore, b can be interpreted as an indicator of the degree of (non)democracy. Finally, because there are two sectors, τ_α represents the tax rate of the natural resource sector, and τ_y is the tax rate for the rest of the economy. Each tax rate lies between zero and one.

In general, there are deadweight costs associated with tax collection, and the deadweight costs are presumably lower in the natural resource sector because the supply of natural resource, such as oil, is relatively more inelastic and its ownership can be highly concentrated. For simplicity, assume that there is no deadweight loss in taxing the natural resource sector and the rate of deadweight cost of taxing the rest of the economy is $1 - \delta$, where $\delta \in [0, 1)$. Total tax revenue therefore becomes $\delta\tau_y y + \tau_\alpha \alpha$. On the expenditure side, tax revenue can be spent on implementing the economic

policy, at a per unit cost p , or potentially be captured by the incumbent leader as political rent r . Therefore, the government budget constraint can be written as

$$\delta\tau_y y(x) + \tau_\alpha \alpha = r + px. \quad (1)$$

Market power permits leaders to influence public policies for their satisfaction or personal profit, which is legal if the leader is sufficiently convincing as to the public's interest in the policy. However, in general, there is transaction cost associated with rent appropriation, so that only a fraction γ can be captured. A country with a higher γ can be interpreted as “grabber friendly” (Mehlum et al. 2006). This parameter γ depends on the transparency of the budget or the administrative procedures (Persson and Tabellini, 2000, pp. 70), although γ may also depend on the structure of the economy. For instance, an oil dependent producer state in which her oil sector is nationalized may have a higher γ .⁶ In many cases, however, part of the political rent is spent on entry barrier maintenance. The flow of the net political rent is $\gamma r - \beta b$, where β is the per unit cost of maintaining political entry barriers. The parameter β is the marginal enforcement cost of deterring entry (e.g. military spending), which may depend on the imbalance of military power between the incumbent and the challengers and other technologies available for communication, monitoring and pursuing criminals, etc.

3.2. Zero Profit Condition and Popular Support

The flow of political rent $\gamma r - \beta b$ serves as bait for challengers to compete for. When the first challenger succeeds, the incumbent stops receiving this flow. If the first challenger succeeds at date R in the incumbent's regime, the incumbent's value of governing (from the perspective of the time

⁶Gehlbach (2006) considers the allocation of collective goods across sectors depending on the taxability of those sectors.

he began) is $v_t(R)$:

$$v_t(R) = (\gamma r_t - \beta b_t) \int_0^R e^{-is} ds = (\gamma r_t - \beta b_t) \frac{1 - e^{-iR}}{i}, \quad (2)$$

where i is the interest rate. The above expression captures the two basic components of my model: leadership income $\gamma r_t - \beta b_t$ and longevity R . Expression (2) also suggests a fundamental complementarity between leadership income and longevity: the higher the leadership income per period, the longer a leader prefers to remain in power, and vice versa.

A large pool of identical citizens are potential challengers to the incumbent's political leadership. Each challenger proposes a set of ex post incentive compatible policies, which both determines the profits he would earn if successful and the amount of popular support he enjoys. By implementing a set of popular policies, a leader in power lengthens the expected lifetime of his regime.

More specifically, regimes are indexed $t = 0, 1, \dots$ with 0 denoting the incumbent regime. For simplicity, policies are assumed to be constant within a regime. For example, b_t denotes the entry barrier protecting regime t . Let c_t denote the number of potential leaders challenging regime t . Each challenger j ($j = 1, 2, \dots, c_t$) has success hazards h_{jt} , where h_{jt} is a function of his policies $\{x_{jt+1}, b_{jt+1}, \tau_{y,jt+1}, \tau_{\alpha,jt+1}\}$ and the incumbent's policies $\{x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}\}$. In particular, I assume that challenger j 's hazard h_{jt} depends on his support relative to the incumbent's:

$$h_{jt} = \frac{\lambda u((1 - \tau_{y,jt+1})y(x_{t+1}) + (1 - \tau_{\alpha,jt+1})\alpha)}{u((1 - \tau_{y,t})y(x_t) + (1 - \tau_{\alpha,t})\alpha)}. \quad (3)$$

$\lambda > 0$ is a parameter representing the baseline success hazard rate of a challenger who is expected to replicate the incumbent's policies. Popular support is indexed by a utility function u , representing citizens' aggregated preferences. The utility function is an increasing and concave function of the

after-taxed income.⁷

Given these policies, the probability that regime t lasts exactly R units of time is $c_t h_t e^{-c_t h_t R}$, where h_t is the average success hazard among the challengers and $c_t h_t$ is the aggregate success hazard. The expected value of governing regime t can be written as:

$$V_t \equiv \int_0^\infty c_t h_t e^{-c_t h_t R} v_t(R) dR = \frac{\gamma r_t - \beta b_t}{i + c_t h_t}. \quad (4)$$

Equation (4) says that the leadership has a discount rate that combines the interest rate with a hazard rate $c_t h_t$ for ending the regime.

Once in power, the expected value of governing in regime $t + 1$, V_{t+1} , can be obtained in the same fashion. Before the takeover takes places, however, challenger j has to pay an entry cost. The entry cost has two components: b_t , an endogenous entry barrier set by the incumbent, and w , an exogenous entry cost which represents the opportunity cost (i.e. reservation wage) of challenging. To separate w from b , w is assumed to be a fixed parameter. Generally speaking, the more productive the citizens are in the private sector, the higher will be this reservation wage. After overcoming the entry barrier $b_t + w$, the probability of replacing the existing regime depends on the hazards of succeeding for each challengers and the total number of challengers. In particular, Mulligan and Tsui (2006) show that the expected profit for each challenger j challenging the regime t can be written as

$$\pi_{jt} = \frac{h_{jt} V_{t+1}}{i + c_t h_t} - b_t - w, \quad (5)$$

which is decreasing in c_t . Entry will occur as long as equation (5) is positive. The actual number of challengers will be determined by the zero-profit condition $\pi_{jt} = 0$ for all $j = 1, 2, \dots, c_t$. In other

⁷Mulligan and Tsui (2006) consider a more general case when u also depends on policies b and x directly.

words, as long as the zero-profit condition binds, the political market is contestable. Throughout the analysis, I rule out the trivial case when entry is never profitable because the opportunity cost of challenger is too high.⁸ Furthermore, I will focus on the case in which the number of challengers in equilibrium is always positive so that even the most repressive regime will not last forever.⁹ In a symmetric equilibrium where $h_{jt} = h_t$, I can invert the zero-profit condition to obtain

$$c_t = \frac{V_{t+1}}{b_t + w} - \frac{i}{h_t}. \quad (6)$$

Equation (6) implies that holding V_{t+1} and h_t constant, the size of entry barriers is negatively related to the number of challengers. However, V_{t+1} and h_t are endogenously determined. I interpret a regime with both high levels of b_t and c_t as one experiencing intense civil insurrection.

3.3. Political Entry Equilibrium

Because of the assumption that regimes choose public policies only after taking power, when an incumbent chooses his policies, he anticipates what his challengers will choose once they takeover. Similarly, citizens may also anticipate the new regime's decisions, but those decision from regime t will be treated as sunk. This means that r_t and x_t have no effect on V_{t+1} because those variable are no longer relevant once the $t + 1$ regime takes power. Formally,

Definition. (*Equilibrium*) An equilibrium is an infinite sequence $\{x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}\}_{t=0}^{\infty}$ of policies such that:

$$V_t = \max_{x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}} \frac{\gamma r_t - \beta b_t}{i + c_t h_t} \quad (4')$$

⁸In particular, this requires $w \leq \frac{\lambda \gamma (y^\delta + \alpha)}{i}$, where $y^\delta \equiv y(x^\delta)$ and $x^\delta \equiv \arg \max \delta y(x) - px$.

⁹The precise condition for the existence of positive number of challengers will be derived below.

subject to

$$\delta\tau_{y,t}y + \tau_{\alpha,t}\alpha = r_t + px_t \quad (1)$$

$$\frac{h_t V_{t+1}}{i + c_t h_t} - b_t - w = 0 \quad (5')$$

and

$$h_t = \frac{\lambda u((1 - \tau_{y,t+1})y + (1 - \tau_{\alpha,t+1})\alpha)}{u((1 - \tau_{y,t})y + (1 - \tau_{\alpha,t})\alpha)} \quad (3')$$

where $x_t, b_t \geq 0$ and $0 \leq \tau_{y,t}, \tau_{\alpha,t} \leq 1$ for all $t \geq 0$, with regime t taking as given the sequence $\{x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}\}$ from regimes $s \geq t + 1$.

4. Is There an Economic Resource Curse?

I consider in this section the economic impact of natural resource wealth.

4.1. Natural Resource is an Economic Blessing

Incumbent leaders in contestable political markets pay attention to their citizens' preferences, because popular support can help to extend their longevity of ruling. Indeed, because the economic policy x is functionally unrelated to the blocking of political challengers, the economic policy will be chosen efficiently to maximize national income. Formally, my model implies:

Proposition 1. (*Economic Resource Blessing*) In any regime t , (a) when α is small,

$$\tau_{\alpha,t} = 1, \tau_{y,t} > 0, \text{ and } x_t = x^\delta \equiv \arg \max y(x) - \frac{p}{\delta}x. \quad (7)$$

(b) However, when α is large,

$$\tau_{\alpha,t} < 1, \tau_{y,t} = 0, \text{ and } x_t = x^* \equiv \arg \max y(x) - px. \quad (8)$$

The above proposition predicts that natural resource sector, such as oil sector, tends to be monopolized by the state in the sense that all the natural resource revenue goes to the government. In general, the tax rate is always higher in the natural resource sector than the nonresource sector. Indeed, to maximize support, even in the most repressive dictator in my model will act as if he is benevolent because he will implement the Ramsey's optimal taxation rule in order to minimize the deadweight cost of taxation. Moreover, not only the economic policy will be chosen efficiently, an increase in income from the resource sector tends to reduce the cost of the economic policy and increase the income generated from the rest of the economy. Interestingly, because leaders are constrained by competition, the most efficient economic policy can be chosen even when $\delta = 0$ so that political leaders can never tax the nonresource sector.

The details of the proof can be found in the appendix. The intuition can be understood as follows. Because the deadweight loss from taxing the nonresource sector is uniformly higher than the deadweight loss from taxing the resource sector, given any size of the government budget, political leaders will first tax the sector with the lowest deadweight cost in order to maximize popular support. Note that this result is in sharp contrast to the implication from a simple uncontested monopoly model. In such a case, entry barriers are no longer necessary (i.e. $b_t = 0$) and the objective function becomes

$$V_t = \max_{x_t, \tau_{y,t}, \tau_{\alpha,t}} \frac{\delta \tau_{y,t} y + \tau_{\alpha,t} \alpha - p x_t}{i}. \quad (9)$$

An unthreatened dictator will tax as much as possible (i.e. $\tau_{y,t} = \tau_{\alpha,t} = 1$), and will implement the economic policy only to the extent that he is able to capture the gain (i.e. $x_t = \arg \max \delta y(x_t) - p x_t$).

Because of the specific deadweight cost structure that I assume to simplify the exposition, my model may require a discrete jump in resource wealth to induce a switch to a more efficient tax

regime. However, the general idea is that natural resource wealth, which entails a relatively lower deadweight cost when being taxed, is an economic blessing because it reduces the cost of running the public sector, and hence more efficient economic policy can be implemented.

Moreover, citizens are always better off from the increase in resource wealth. To see this, note that when the nonresource sector is taxed, the citizens' income is simply $(1 - \tau_{y,t})y$. I show in the appendix that

$$\frac{d\tau_{y,t}}{d\alpha} = \frac{1}{\delta y} \frac{\delta \gamma u'}{2u''(\gamma r_t - \beta b_t) - 3\gamma u' \delta} \quad (10)$$

which is negative, and hence $\tau_{y,t}$ is decreasing in α . Citizens, therefore, can capture part of the gain from the increase in resource wealth, even in repressive regimes. Similarly, when the nonresource sector is not taxed, the citizens' income can be written as $y + \alpha - px_t - r_t$. Differentiating the citizens' income with respect to α gives

$$1 - \frac{dr_t}{d\alpha} = \frac{\gamma u'}{3\gamma u' - 2u''(\gamma r_t - \beta b_t)} \quad (11)$$

which is positive. In both cases, citizens can benefit from the increase in resource wealth in a rent-seeking political environment because leaders care about popular support.

The above result therefore suggests that natural resource wealth is an economic blessing. Numerous earlier studies showed a negative correlation between resource dependence and economic growth (Sachs and Warner, 1995; Sala-i-Martin, 1997). However, more recent empirical studies found that resource abundance has a positive impact on growth and development (Alexeev and Conrad, 2008; Brunnschweiler and Bulte, 2006; Lederman and Maloney, 2006; Stijns, 2005). My theory is consistent with these seemingly contradictory pieces of evidence. Other things being equal, my model predicts that an increase in α tends to improve x and hence y . Other things, however,

may not be all the same. For instance, holding α constant, a country is more resource dependent if it has a higher p and hence lower net income from the nonresource sector, $y - px$. Therefore, resource dependence can be a signal of higher cost of economic policy implementation, even though resource wealth has a positive casual effect on the economy.

4.2. What Countries are More Likely to Benefit from the Economic Resource Blessing?

Although the parameters γ , β , and w do not have a direct impact on the choice of economic policy when resource wealth is either very low or very high, they do affect the transition to the adoption of the efficient economic policy. Consider the following power utility function example, where $u(z) = z^\varepsilon$. Suppose the nonresource sector is taxed. It is straightforward to show that

$$r_t = \frac{2\alpha}{2+\varepsilon} + \frac{2(\delta y^\delta - px^\delta)}{2+\varepsilon} - \frac{\varepsilon w\beta}{\gamma(2+\varepsilon)} \text{ and } b_t = \frac{\gamma\alpha}{\beta(2+\varepsilon)} + \frac{\gamma(\delta y^\delta - px^\delta)}{\beta(2+\varepsilon)} - \frac{w(1+\varepsilon)}{(2+\varepsilon)}, \quad (12)$$

where $y^\delta \equiv y(x^\delta)$. Using the government budget constraint we can solve for

$$\tau_{y,t} = \frac{2}{2+\varepsilon} + \frac{\varepsilon px^\delta}{\delta y^\delta (2+\varepsilon)} - \frac{\varepsilon w\beta}{\delta y^\delta \gamma (2+\varepsilon)} - \frac{\varepsilon \alpha}{\delta y^\delta (2+\varepsilon)}, \quad (13)$$

which is decreasing in α , as we have seen above in general. Since $\tau_{y,t} \geq 0$, we need

$$\alpha \leq px^\delta + \frac{2\delta y^\delta}{\varepsilon} - \frac{w\beta}{\gamma} \equiv \alpha_1. \quad (14)$$

Similarly, when only the resource sector is taxed, I can show

$$r_t = \frac{2\alpha}{2+\varepsilon} + \frac{2(y^* - px^*)}{2+\varepsilon} - \frac{\varepsilon w\beta}{\gamma(2+\varepsilon)} \text{ and } b_t = \frac{\gamma\alpha}{\beta(2+\varepsilon)} + \frac{\gamma(y^* - px^*)}{\beta(2+\varepsilon)} - \frac{w(1+\varepsilon)}{(2+\varepsilon)}, \quad (12')$$

and hence

$$\tau_{\alpha,t} = \frac{2}{2+\varepsilon} + \frac{2y^*}{\alpha(2+\varepsilon)} + \frac{\varepsilon px}{\alpha(2+\varepsilon)} - \frac{\varepsilon w\beta}{\alpha\gamma(2+\varepsilon)}, \quad (13')$$

where $y^* = y(x^*)$. Since $\tau_{\alpha,t} \leq 1$, we must have

$$\alpha \geq px^* + \frac{2y^*}{\varepsilon} - \frac{w\beta}{\gamma} \equiv \alpha_2. \quad (14')$$

Note that $\alpha_1 < \alpha_2$, so that for $\alpha \in [\alpha_1, \alpha_2]$ the optimal tax rates are $\tau_{\alpha,t} = 1$ and $\tau_{y,t} = 0$. However, α_1 approaches α_2 as δ is getting close to one.

The first-best economic policy x^* will be chosen when $\alpha \geq \alpha_2$, which is increasing in γ and decreasing in w and β from equation (14'). In other words, holding the size of resource wealth constant, a country is more likely to adopt the first-best economic policy when the labor productivity in the private sector is high, the transaction cost of rent appropriation is high, and the enforcement cost of deterring entry is high. While a theory of the determinants of the parameter γ is beyond the scope of this paper, my model predicts that countries with grabber friendly institutions are less likely to benefit from the resource wealth. Since a country with low γ , high w , and high β tends to be democratic (i.e. b low), a country that is observed to be democratic empirically is more likely to benefit from the economic resource blessing. However, if resource wealth also reduces the transaction cost of rent appropriation, some of the economic benefits from natural resource wealth may dissipate away (Mehlum et al., 2006).

5. Is There a Political Resource Curse?

While natural resource wealth is an economic blessing, it can also be a political curse. Moreover, the political resource curse can be multi-dimensional. In this section, I consider the impact of resource wealth on the degree of democracy, military spending, and civil conflict. For simplicity, I

will focus on stationary equilibrium when discussing the impact on civil conflict.¹⁰

5.1. Natural Resource is a Political Curse

Natural resource wealth serves as bait for potential competitors. Moreover, although resource wealth can increase the nonresource income y through the implementation of a more efficient economic policy x , it does not necessarily increase the labor productivity w in general. Holding the size of entry barriers fixed, resource rent increases the number of challengers. In other words, when entry barriers are exogenously high, resource wealth will increase the incidence of civil conflicts. However, when entry barriers are endogenous, incumbent leaders will commit more resource to deter entry. Formally, my model predicts the following:

Proposition 2. (*Political Resource Curse*) In any regime t , (a) when $b_t = 0$ in equilibrium,

$$\frac{db_t}{d\alpha} = 0 \text{ and } \frac{dc_t}{d\alpha} > 0. \quad (15)$$

(b) However, when $b_t > 0$ in equilibrium,

$$\frac{db_t}{d\alpha} > 0 \text{ and } \frac{dc_t}{d\alpha} = 0. \quad (16)$$

There are two margins of adjustment: the size of entry barriers and the number of challengers. Even when the size of entry barriers b is endogenously determined, the optimal level can be zero in my model, because of the existence of exogenous entry barriers w . Since b cannot be negative, in an “ideal” democratic regime where $b = 0$, an increase in resource wealth will affect only the entry margin. However, for any other nondemocracies (i.e. $b > 0$), more resource wealth will induce incumbent leaders to run more repressive regimes to prevent entry, leaving the number of

¹⁰The possibility of non-stationary equilibria is discussed in Mulligan and Tsui (2008).

challengers unchanged in equilibrium.

I will only show the proof when the nonresource sector is taxed, because the same argument applies for the other case. When w is positive, the optimal entry barriers can be zero. In particular, to prove part (a), the first-order conditions are

$$u - \frac{r_t}{\delta}u' = 0 \text{ and } \frac{w\beta}{\gamma} > r_t. \quad (17)$$

Therefore, either when the reservation wage is high, or when the cost of entry barriers enforcement or the transaction cost of rent appropriation is high, the equilibrium will be an “ideal” democracy in the sense that $b = 0$. As long as the above conditions hold, b will remain zero. On the other hand, differentiating the optimal condition for r with respect to α , we obtain

$$\frac{dr_t}{d\alpha} = \frac{r_t u'' - u' \delta}{r_t u'' - 2u' \delta} \quad (18)$$

which is positive but less than one. In other words, more rent will be extracted when there is an increase in resource rent, although a fraction of the rent will also go to the citizens.

In a stationary equilibrium, $V_t = V_{t+1} = V$ and $h_t = \lambda$. Substituting into the objective function implies the value of governing

$$V = \sqrt{\frac{w\gamma r}{\lambda}} \quad (19)$$

is increasing in α because r is so. Using the stationary conditions and equations (6) and (19), the number of challengers can be written as

$$c = \frac{V}{w} - \frac{i}{\lambda} = \sqrt{\frac{\gamma r}{\lambda w}} - \frac{i}{\lambda}, \quad (20)$$

which is also increasing in α , and hence we have proved (15). Therefore, in an “ideal” democracy, resource wealth is neither an economic curse nor a political curse. Natural resource wealth in these regimes will only increase the competitiveness of the political sector measured by the number of challengers and hence regime turnover. Finally, also note that because the number of challengers has to be positive, the above equation also implies that w has to be less than $\lambda\gamma r/i^2$, where r is determined by equation (17).

For part (b), when w or β is sufficiently low and γ is large, the optimal b will be positive. The first-order conditions now become

$$\gamma u - \frac{(\gamma r_t - \beta b_t)}{\delta} u' = 0 \text{ and } (\gamma r_t - \beta b_t) - \beta(b_t + w) = 0 \quad (17')$$

Differentiating equations (17') with respect to α we can solve for

$$\frac{db_t}{d\alpha} = \frac{\gamma[(\gamma r_t - \beta b_t)u'' - \gamma\delta u']}{\beta[2(\gamma r_t - \beta b_t)u'' - 3\gamma\delta u']} \quad (18')$$

which is positive.

Using the optimal condition for b , in the stationary equilibrium, the value of governing becomes

$$V = \sqrt{\frac{\beta}{\lambda}}(b + w) \quad (19')$$

which is increasing in α because b is so. However, when $b > 0$, using equations (6) and (19'), the number of challengers becomes

$$c = \frac{V}{b + w} - \frac{i}{h} = \sqrt{\frac{\beta}{\lambda}} - \frac{i}{\lambda} \quad (20')$$

which is independent of α . Note also that to ensure $c > 0$, we need $\beta > i^2/\lambda$.

Therefore, among nondemocracies (i.e. $b > 0$), the size of resource wealth in general has no effect on the number of challengers. When the intensity of civil war of a country is measured by the number of challengers in a repressive regime (i.e. with b high), according to my model, natural resource wealth has no effect on the incidence of civil war. It is true that rent from natural resource, such as oil, gives a financial incentive to initiate conflict (Collier and Hoeffler, 2004). However, when the size of entry barriers is endogenous, more resource wealth will increase the incumbent's expenditure on deterring entry, βb . Since military spending has a primary effect of blocking political competition, my model predicts that resource abundant countries tend to spend more on defense.

5.2. What Countries are More Likely to Suffer from the Political Resource Curse?

It is usually said that government in oil-rich countries are corrupted because of the lack of revenue transparency. If natural resources are easier to be stolen by political leaders, γ may be higher as α increases. For non-ideal democracies ($b > 0$), the comparative statics of γ shows that b is increasing in γ , although the effect on r is ambiguous.¹¹ In other words, if natural resource wealth reduces the transaction cost of rent appropriation, the negative effect on democracy will be further exacerbated. But again, γ has no effect on the number of challengers and hence the incidence of civil war when entry barriers are endogenous.

The number of challengers, however, does depend on the enforcement cost of deterring entry β and the interest rate i . If political leaders face a binding credit constraint to borrow money to finance their expenditure on either enforcing or overcoming entry barriers, natural resource wealth

¹¹In particular, it is straightforward to show

$$\frac{db_t}{d\gamma} = \frac{r_t u'' (\gamma r_t - \beta b_t) - \gamma u \delta^2 (1 + r_t)}{\beta [2u'' (\gamma r_t - \beta b_t) - \gamma \delta (2u\delta + u')]} \text{ and } \frac{dr_t}{d\gamma} = \frac{\delta (r_t u' - 2u\delta)}{2u'' (\gamma r_t - \beta b_t) - \gamma \delta (2u\delta + u')}.$$

may help relax this constraint. In my model, it can be interpreted as a reduction of the interest rate. While i has no effect on polices as long as both incumbent and challengers face the same interest rate, it affects the number of challengers. Because c is decreasing in i , when resource wealth reduces the cost of financing conflicts so that leaders discount less for the future, an increase in resource wealth can increase the number of challengers and hence the incidence of civil war.

Resource wealth may also affect incumbent and challengers in an asymmetric fashion. For example, suppose an oil-rich incumbent dictator is more able to receive foreign military assistance and hence faces a lower β . In this case the anti-democratic effect of resource wealth will be further exacerbated. Moreover, the regime will become more durable. Alternatively, natural resource wealth can be lootable — that is, it can be easily appropriated by individuals of unskilled workers (e.g. diamond), or non-lootable (e.g. oil), and a lootable natural resource is said to be more favorable to insurgent group (Ross, 2003). One way to model this asymmetry in my model is through a change in β . If the natural resource wealth is lootable (non-lootable), β will be higher (lower). My model therefore predicts that resource wealth may intensify civil war when it is lootable, because in this case a higher β induces the incumbent to reduce the size of entry barriers.¹² However, since b is increasing in α , the overall effect on b is ambiguous in general.

I conclude this section by reconsidering the power utility function example. Recall from equations (12) and (12') that b_t is increasing in α and γ , but decreasing in β and w . Since b is nonnegative, natural resource is not a political curse when either γ or w is sufficiently small, or when β is sufficiently large. More importantly, there is an interaction effect. In particular, $\frac{d^2 b_t}{d\gamma d\alpha} > 0$ and $\frac{d^2 b_t}{d\beta d\alpha} < 0$. Therefore, even when natural resource wealth has no impact on γ or β , the power

¹²It can be shown that

$$\frac{db_t}{d\beta} = \frac{(2b_t + w)(\gamma r_t - \beta b_t)u'' - \delta\gamma(2w + 3b_t)u'}{\beta[3\delta\gamma u' - 2(\gamma r_t - \beta b_t)u'']}$$

which is negative.

utility example suggests that the negative effect of the political resource curse is more significant in countries with lower transaction cost of rent appropriation and enforcement cost of deterring entry. This result is complementary to part (a) of Proposition 2: the negative effect of the political resource curse is expected to be smaller for “healthy” democracies which impose higher costs on incumbent leaders regarding rent appropriation and entry prevention. The political resource curse, even when it exists, is a conditional one. Finally, the power utility function example also predicts that the magnitude of resource spent on deterring political entry as a fraction of national income is increasing in the size of natural resource wealth, but decreasing in the marginal enforcement cost of deterring entry and the reservation wage and hence labor productivity of the private sector.

6. Concluding Remarks

This paper argues that natural resource wealth is an economic blessing, although resource dependence can be positively associated with bad economic performance. I also identify conditions under which natural resource wealth becomes a political curse. The extent of the political resource depends on the transaction cost of rent appropriation, the enforcement cost of political entry barriers, as well as the private sector’s productivity. By endogenizing the size of entry barriers and the number of challengers, my model distinguishes the two margins of the political resource curse: the level of repression and the incidence of civil war. This distinction is important because it helps clarify the two seemingly contradictory notions that natural resource wealth fuels conflict on the one hand, and natural resource wealth enhances regime durability on the other.

The successful story of Botswana is sometimes used to illustrate the argument that the resource curse is not inevitable because good governance and sound economic policies can mitigate its ill effects (Acemoglu et al., 2003; Sarraf and Jiwaji, 2001). An alternate interpretation of the Botswana’s growth experience is that the economic resource curse simply does not exist. Recent

empirical evidence seems to support the latter interpretation. Good governance and sound economic policies are of course desirable by definition. Whether they are something that an outsider can impose is another story. The resource curse doctrine argues that natural resource wealth is an obstacle to economic development and hence to overcome it, well-designed resource wealth management is the solution. This is the rationale behind the World Bank's Chad-Cameroon Petroleum Development and Pipeline Project (Pegg, 2006). My model, however, suggests that natural resource wealth is an economic blessing, although it can also be a political curse. Moreover, the model also implies that countries with good institutions are more likely to benefit from the economic blessing and less likely to suffer from the political curse. Nonetheless, without a deeper understanding of the formation and evolution of good institutions, it takes a big leap of faith to conclude that good institutions can be exogenously imposed on developing countries through foreign intervention.

7. Appendix

To prove the Proposition 1, it is useful to substitute the zero-profit condition (5') and the hazard function (3') into the objective function (4'):

$$V_t = \frac{\max_{x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}} (b_t + w)[\gamma(\delta\tau_{y,t}y + \tau_{\alpha,t}\alpha - px_t) - \beta b_t]u((1 - \tau_{y,t})y + (1 - \tau_{\alpha,t})\alpha)}{\lambda V_{t+1}u((1 - \tau_{y,t+1})y + (1 - \tau_{\alpha,t+1})\alpha)} \quad (21)$$

where $0 \leq \tau_{y,t}, \tau_{\alpha,t} \leq 1$ and $x_t, b_t \geq 0$. Note that all variables at $t + 1$ can be factored out from the maximization problem (9) because they are taken as given from the incumbent's point of view, given the assumption of lack of policy commitment. Hence, when all parameters are constant over time, the dynamic is trivial in the model because all regimes will choose the same set of policies.

Let $f(x_t, b_t, \tau_{y,t}, \tau_{\alpha,t}) \equiv (b_t + w)[\gamma(\delta\tau_{y,t}y + \tau_{\alpha,t}\alpha - px_t) - \beta b_t]u((1 - \tau_{y,t})y + (1 - \tau_{\alpha,t})\alpha)$.

Differentiating f with respect to $\tau_{y,t}$, and $\tau_{\alpha,t}$ we obtain

$$f_{\tau_{y,t}} = (b_t + w)y[\gamma\delta u - (\gamma r_t - \beta b_t)u'] \quad (22)$$

and

$$f_{\tau_{\alpha,t}} = (b_t + w)\alpha[\gamma u - (\gamma r_t - \beta b_t)u'] \quad (23)$$

respectively. Suppose there is an interior solution for $\tau_{y,t}$. Then we must have $\gamma\delta u - (\gamma r_t - \beta b_t)u' = 0$. But this implies (11) is positive because $\delta < 1$. Because $\tau_{\alpha,t}$ is bounded above by one, we must have $\tau_{\alpha,t} = 1$. Similarly, suppose there is an interior solution for $\tau_{\alpha,t}$. Then $\gamma u - (\gamma r_t - \beta b_t)u' = 0$, which implies (10) is negative and hence we must have $\tau_{y,t} = 0$. Finally, it is also possible that there is no interior solution at all, in which case we will have $f_{\tau_{\alpha,t}} > 0 > f_{\tau_{y,t}}$ with $\tau_{y,t} = 0$ and $\tau_{\alpha,t} = 1$.

Consider the first case where the nonresource is taxed (i.e. $\tau_{\alpha,t} = 1$ and $\tau_{y,t} > 0$). Substituting

$\tau_{\alpha,t} = 1$ into the government budget constraint, we have $\tau_{y,t} = \frac{r_t + px_t - \alpha}{\delta y}$. The maximization problem can then be written as

$$V_t = \frac{\max_{x_t, b_t, r_t} (b_t + w)(\gamma r_t - \beta b_t)u(y + \frac{\alpha}{\delta} - \frac{p}{\delta}x_t - \frac{r_t}{\delta})}{\lambda V_{t+1}u((1 - \tau_{y,t+1})y + (1 - \tau_{\alpha,t+1})\alpha)}. \quad (21')$$

The optimal x_t simply maximizes $y(x_t) - \frac{p}{\delta}x_t$, and hence we have proved (7).

Similarly, in the second case where the nonresource sector is not taxed (i.e. $\tau_{\alpha,t} < 1$ and $\tau_{y,t} = 0$), $\tau_{\alpha,t} = \frac{r_t + px_t}{\alpha}$ and hence the maximization problem becomes

$$V_t = \frac{\max_{x_t, b_t, r_t} (b_t + w)(\gamma r_t - \beta b_t)u(y + \alpha - px_t - r_t)}{\lambda V_{t+1}u((1 - \tau_{y,t+1})y + (1 - \tau_{\alpha,t+1})\alpha)}. \quad (21'')$$

The optimal x_t in this case maximizes $y(x_t) - px_t$, which gives the first-best solution as in equation (8). Since $\delta < 1$, the optimal level of x_t will be higher when the nonresource sector is not taxed, which implies that the nonresource sector income will also be higher. In this equilibrium, the efficient economic policy will be chosen regardless of the size of the deadweight cost associated with taxing the nonresource sector. Indeed the economic policy will be chosen efficiently even if the nonresource sector can generate no government revenue (i.e. $\delta = 0$).

Finally, when $\tau_{y,t} = 0$ and $\tau_{\alpha,t} = 1$, the problem becomes

$$V_t = \frac{\max_{x_t, b_t, r_t} (b_t + w)[\gamma(\alpha - px_t) - \beta b_t]u(y)}{\lambda V_{t+1}u((1 - \tau_{y,t+1})y + (1 - \tau_{\alpha,t+1})\alpha)}. \quad (21''')$$

Unlike the above two cases, the optimal x_t will depend on the utility function u and all other parameters as well. In general, this can happen when the size of α is neither too small nor too large. For simplicity, I will not consider this case in detail for the rest of the analysis. For point-

source natural resource, such as oil and gas, this is a reasonable assumption. Moreover, when δ is close to one, this region of corner solution is negligible.

It remains to determine when the nonresource sector will be taxed or not in equilibrium. Apparently, when $\alpha = 0$, $\tau_{y,t}$ has to be positive in order to finance r_t and px_t . Since $y'(0) = \infty$, $x_t = 0$ is never optimal. Therefore, by continuity, for α sufficiently small, we must have $\tau_{y,t} > 0$.

On the other hand, when α is sufficiently large, the government will be able to eliminate the tax on the nonresource sector as long as the government budget grows slower than the rate of increase in resource wealth, which will be the case because the political market is contestable. Formally, when $\tau_{\alpha,t} = 1$ and $\tau_{y,t} > 0$, and assuming interior solution for b_t , the first-order conditions for r_t and b_t are respectively

$$\gamma u - \frac{(\gamma r_t - \beta b_t)}{\delta} u' = 0 \text{ and } (\gamma r_t - \beta b_t) - (b_t + w)\beta = 0. \quad (24)$$

Differentiating (24) with respect to α and using the government budget constraint, we can solve for

$$\frac{d\tau_{y,t}}{d\alpha} = \frac{1}{\delta y} \left(\frac{dr_t}{d\alpha} - 1 \right) = \frac{1}{\delta y} \frac{\delta \gamma u'}{2u''(\gamma r_t - \beta b_t) - 3\gamma u' \delta} \quad (10)$$

which is negative for all α . Therefore, $\tau_{y,t}$ will become negative for α sufficiently large, and taxing the nonresource sector can no longer be an equilibrium.

The proof of the case when $b_t = 0$ is similar.

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