The role of markets and preferences on resource conflicts

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Abstract

This article investigates a generalized resource curse. The existing empirical and theoretical literature on the resources-conflict nexus argues that higher resource rents (or a lower opportunity cost of appropriation) exacerbates conflict. We demonstrate that these widely accepted results rely on two fundamental elements relating to market conditions and agents' preferences. When resource prices are treated as exogenous, we obtain the conventional result, where an increase in the profitability of either the appropriative or productive activity incentivizes agents to reorient efforts accordingly. However, when the price of the contestable resource is endogeneously set (i.e., locally determined), we find the opposite result may hold depending on the nature of agents' preferences: conflict can increase when the contestable resource becomes scarcer. Intuitively, if the contestable resource is abundant, players' relative marginal utility of the resource will be low, thereby resulting in low relative prices. Increases in the size of the contestable resource will lead to a reduction in appropriation effort, whereas scarcities will be conducive to conflict. We show an identical result is obtained if markets are absent for the contestable resource, such as when considering civil liberties and political rights.

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JEL Classification: C72; D72

1 Introduction Proposal

The well-known 'resource curse' explains that in places governed by weak institutions, resources may hamper the development process (Mehlum, Moene and Torvik, 2006; Robinson, Torvik and Verdier, 2006). In particular, it is often observed that rent-seeking activities—such as lobbying, legal expenditures, or even armed conflict—are used to capture contestable rents to the detriment of economic growth. For example, such adverse consequences include dictators hampering the democratization of their polities via the strategic use of natural resources, or violent clashes erupting in the vicinity of newly discovered diamond fields.

The conventional mechanism to connect valuable resources to inefficient rent-seeking activities suggests that higher rents—or indeed a lower opportunity cost of appropriation—are conducive to increased inefficient rent-seeking activities. The *prima facie* empirical evidence appears to corroborate this story: when 'resources' are defined as natural wealth such as oil, diamonds, or other precious minerals, the empirical evidence demonstrating a causal effect on violence is compelling. Yet, if one explores a little deeper into the literature, there are also circumstances in which *reductions* in the value of resources, or *higher* opportunity costs of appropriation, give rise to increased conflict (Koren, 2018; Castillo, Mejía and Restrepo, forthcoming). This is inconsistent with leading theoretical explanations of conflict and it remains uncertain whether resources are either a curse or a blessing. The aim of this article is to develop a general model of conflict—where we consider the connectedness of the conflict environment to international markets, and the role of preferences—to understand the conditions under which the classic resource curse holds, and when it does not.

The conventional explanation of the resource curse focuses on two effects: a *rapacity effect* and *opportunity cost effect*. First, a more valuable rent generates a *rapacity effect* whereby agents are incentivized to invest effort in appropriating the wealth. Second, a less profitable alternative use of productive resources, i.e., a lower *opportunity cost* of an income-generating activity, also increases wealth-appropriation incentives. The predictions of the theoretical literature are that higher rents and/or lower opportunity cost of appropriation are conducive to increased inefficient rent-seeking activities (e.g., Dal Bó and Dal Bó, 2011). There is a collection of empirical evidence on the rapacity and opportunity cost effects that corroborates this prediction. Using state-of-the-art econometric techniques, researchers have demonstrated that increases in the value of 'grabbable' resources such as oil, diamonds, or minerals incentivize agents to invest more effort in appropriative activities (e.g., Angrist and Kugler, 2008; Dube and Vargas, 2013; Ross, 2015; Berman, Rohner and Thoenig, 2017). Similarly, the opportunity cost effect has also received widespread empirical support since negative shocks to income-generating

activities have consistently been shown to spur violence (e.g., Miguel, Satyanath and Sergenti, 2004; Hsiang, Burke and Miguel, 2013; Gawande, Kapur and Satyanath, 2017).

Many scholars, however, stand in stark opposition. For instance, Homer-Dixon (1999) and Kahl (2006) argue that, in fact, scarcities of appropriable resources constitute a central driver of violent conflict. A main driver identified by these authors is the relative deprivation that often affects poorer populations: with resources becoming scarcer and thus more valuable, the deprived will harbor higher incentives to violently appropriate, a result that is echoed within the literature on food riots (e.g., Bellemare, 2015). Likewise—and in direct contrast with the opportunity cost literature—Koren (2018) demonstrates empirically that negative land-productivity shocks reduce conflict. Evidence against conventional conflict models can also be found within the civil rights movement in the United States, which was initiated by a rising black middle class whose civil liberties failed to grow in par with incomes (Bloom, 1987). Likewise, the nineteenth century women's right movements in the United States were pioneered by middle-class women rather than by the lower strata of the society (Buechler, 1990). More broadly, and in line with Moore (1966) and Huntington (1991), economic development appears to generate new social forces standing for more democratic rights (Lipset, 1959). This empirical evidence suggests that improved livelihoods—and consequently a higher opportunity cost of conflict—seem to sharpen the incentives to devote effort to appropriating resources in these contexts and contradicting the opportunity cost effect.[1]

In this article we reconcile all these seemingly contradictory observations into one general framework that can investigate whether a contestable resource generates either a resource curse or blessing. The model is simple: players have a time endowment and the opportunity to consume both a contestable and non-contestable good; they invest their time endowment into either appropriating the contestable resource or producing the non-contestable good. We model rent appropriation as a contest where the share of the contestable resource is based on an individual's appropriation effort relative to total outlays. Our innovation lays in the generalization of the players' preferences, which provides a fundamental transition mechanism for explaining the existence of a resource curse or blessing. We are interested in the equilibrium

[1]The concept of a contestable 'resource' is far broader than simply focusing on natural wealth: for example, contestable societal resources can include political rights, or public (club) good provision, to name but a few. In settings that involve an income-generating activity and a grabbable resource akin to a common-pool resource, one would naturally expect the results of the conflict literature to hold when replacing valuable minerals by such things as political rights. While when focusing on well-traded natural resources the evidence consistently points to the classic resource curse, this is brought into question when a broader conception of contestable resources is considered which at the same time is not precluded by the theory. It is this observation that inspires our theoretical approach in which we attempt to reconcile this conflicting empirical evidence.

distribution of players' time endowment between the contestable and non-contestable goods. In particular, our main focus is on analyzing how a change in the resource size—and the opportunity cost of appropriation—may alter the distribution of productive and rent-seeking (unproductive) activities. That is, how does resource abundance/scarcity, and the value of the alternative use of appropriative effort, affect the degree of conflict?

We show the existence (and extent) of a resource curse (blessing) depends on two pivotal factors: (i) the nature of the market for the contestable resource as well as (ii) the preferences of agents. If the resource price is exogenously determined, say due to the presence of an accessible international market, then conflict is always increasing with the size and value of the resource, similar to the conventional resource curse. If, however, the contestable resource price is endogenously determined, i.e., when markets clear locally, then resource abundance can generate either a resource curse or blessing. The determining factor is the nature of players' preferences. We find that if players have a more elastic marginal rate of substitution between contestable resource and non-contestable good—a very reasonable assumption on preferences—then conflict is decreasing in the size of the contestable resource—a resource blessing. This appears to be anecdotally true, as scarcity-driven conflicts appear to occur when markets clear locally such as with food conflicts (Bellemare, 2015) or where local prices differ from international ones as with drugs conflicts (Castillo, Mejía and Restrepo, forthcoming). Furthermore, this result extends to contestable rents that have no marketplace. If there exists no market for the resource, such as in cases of contestable public good provision or the determination of civil rights, then we can observe a resource curse or, instead, a resources blessing, which is directly linked the nature of players' preferences.

One of the conventional models to study the relationship between resources and conflict can be traced back to Gordon Tullock's (1980) contribution on rent seeking and his use of what is commonly known as Tullock's Contest Success Function. Applying this setting to conflict over resources, players optimally choose the contest effort to appropriate resources at some endogenous cost (e.g., Hirshleifer, 2001), which has equally been modeled as the opportunity cost of an alternative payoff-enhancing activity (e.g., Grossman, 1991). This literature unambiguously identifies a positive relationship between appropriable resources and conflict. Similar results are obtained for a plethora of contest models on appropriable resources (e.g., Hillman and Samet, 1987; Epstein and Nitzan, 2006; Wick, 2006). These contest models provide us with a good understanding of the time allocation between productive and appropriative activities. Recently, Dickson, MacKenzie and Sekeris (2018) modeled a contest for the share of a rent and found that it was possible for equilibrium effort to be decreasing in the size of the rent. While this work provides insights into agents' underlying incentives—and extends the application

of contest theory—it is based on the appropriation of a single rent in isolation. Yet to begin to understand the underlying incentives within the resource curse, it is imperative to focus on the interaction between contestable and non-contestable goods, as is clear from the discussion on the aforementioned *opportunity cost effect*. Our contribution, then, is to develop a general model of conflict where we relax—what we perceive to be overly-restrictive—assumptions imposed on contestants' preference. For example, our approach can now capture salient aspects of the resource curse, such as diminishing marginal utility of the contested resource (which is very natural) and interactions between the contested resource and appropriation effort (again very natural). Using this framework, if there is an international market for the contested good (prices are exogenous) this has no effect whatsoever, and the same results as the traditional conflict literature emerge giving the classic resource curse. However, when prices are endogenous, or there is no market, the story may be starkly different.

As our focus is on a multiple-goods/sectors setting, a key methodology is presented by Dal Bó and Dal Bó (2011). In this approach, a Heckscher-Ohlin model of trade is created with two productive sectors: a capital intensive one, and a labor intensive one. Dal Bó and Dal Bó (2011) develop the standard Heckscher-Ohlin trade model with an appropriative sector, which competes with the other sectors for the scarce labor and generates revenue by predating the productive sectors. In line with Heckscher-Ohlin predictions, increases in the price of the capital-intensive (labor-intensive) good lead to an increase of the relative remuneration of capital (labor), thus reducing (increasing) the opportunity cost of joining the appropriative sector, and by extension reducing (increasing) conflict intensity. Hence, Dal Bó and Dal Bó (2011)'s theory draws predictions tying prices of resources and wages to conflict which are in line with most of the empirical literature on natural resources and conflict.

Besides Dal Bó and Dal Bó (2011) who consider the question in a general equilibrium setting, other articles have equally considered the role of prices on the resources-conflict nexus. Berman, Couttenier and Soubeyran (2017), for instance, consider the price of fertilizers and they show in a dynamic setting with heterogenous land plots that higher prices will intensify conflict in the presence of higher fertility-heterogeneity, as low fertility farmers will attempt grabbing more productive land. McGuirk and Burke (2017) distinguish institutional settings with net suppliers of the contested good, from ones with net demanders. High prices could then produce conflict—food riots—in net demand locations, while low prices reduce the opportunity cost of fighting in net supply locations, thereby also fueling conflict. Both these studies adopt a partial equilibrium analysis and derive conditions for scarcities (i.e., high prices) to generate conflict. Yet, these models cannot explain the reverse phenomenon being observed, i.e., conflict being driven by these same agents in the presence of resource abun-

dance (i.e., low prices).[2]

Our contribution is the development of a more general model in which to understand the impact of conflict over resources. This ties together the existing literature that focuses on the rapacity and opportunity cost effects as well as the literature that focuses on scarcity and conflict, to identify the conditions for conflict. The remainder of the article is organized as follows. In Section 2 the model is introduced. Section 3 ties our theoretical contribution to the existing empirical literature. Section 4 provides some concluding remarks.

2 The model

2.1 Economic environment

Consider an economy in which there is a set of agents $N = \{1, 2, \ldots, n\}$ and two goods—a contestable good r and a non-contestable good y. The total amount of the contestable good that is locally available is R. The aim of this article is to capture a situation in which individuals make a decision about how much time to dedicate to appropriation of the contestable good, with the remainder of their time going to production; and they may also have access to a market to trade their allocation of the contestable and non-contestable goods determined by their time-allocation choice.

Each agent has a resource of $e^i > 0$ units of time available and has to decide on the number of units $x^i \in [0, e^i]$ of this time to allocate to appropriating the contestable good. The remainder of their time, $l^i = e^i - x^i$ is allocated to producing the non-contestable good according to the constant returns to scale production function $y^i = \alpha^i l^i$. If agent $i \in N$ consumes the bundle $(r^i, y^i) \in \mathbb{R}^2_+$ they receive utility $u^i(r^i, y^i)$ that we assume to be increasing in both arguments, differentiable as many times as required, and strictly quasi-concave. We denote by $MRS^i(r^i, y^i) \equiv \frac{u^i_y}{u^i_r}$ the absolute value of the marginal rate of substitution between the consumption of r^i and y^i. For simplicity of exposition we assume all agents are symmetric with $e^i = e$, $u^i(\cdot, \cdot) = u(\cdot, \cdot)$ and $\alpha^i = \alpha$ for all $i \in N$.

We suppose that appropriation of the contestable good is governed by a Tullock (1980) share contest, so agent i's appropriated share of the contested good is given by

$$\pi^i(x^i, X^{-i}) = \begin{cases} \frac{x^i}{x^i + X^{-i}} & \text{if } x^i + X^{-i} > 0 \text{ or} \\ \frac{1}{n} & \text{otherwise,} \end{cases} \tag{1}$$

[2] Acemoglu et al. (2012) also propose a model where scarcities generate conflict, albeit in a radically different context since they design a dynamic game with a resource-exporting country trading with a resource-importing one. The latter being able to appropriate with certainty (at some cost) the renewable resources of the former at any point in time.

where $X^{-i} = \sum_{j \in N \setminus \{i\}} x^j$. Accordingly, given a vector of appropriation effort choices $\mathbf{x}$, the quantities of the contestable and non-contestable goods allocated to agent i are given by

$$\hat{r}^i = \pi^i(x^i, X^{-i})R, \text{ and}$$
$$\hat{y}^i = \alpha(e - x^i).$$

Following the outcome of the contest, we want to consider that individuals may then be able to trade their allocation of the contested and non-contested good in a market. Accordingly, we consider three alternative economic frameworks:

1. where a local market exists between the contestable and non-contestable goods, in which prices are determined endogenously with agents' choices to locally clear the market (i.e., a general equilibrium setting);

2. where a market exists but market clearing is at a higher geographical level so prices are (locally) exogenous (i.e., a partial equilibrium setting); and

3. where no market exists between the contestable and non-contestable goods so the allocation from the contest is the final allocation.

In each case, we seek a Nash equilibrium of the simultaneous-move game of complete information that is played.

Consider this problem in (y^i, r^i)-space, as observed within Figure 1. The contest technology combined with the production function imply a production possibilities frontier (PPF) of allocations of the contested and non-contested good that an individual can achieve by engaging in the contest (for given actions of the other contestants). If there is no market between the contested and non-contested goods this gives the final combinations of goods the individual can achieve and so they will seek to choose their contest effort to get them to the point on their PPF that maximizes their utility. This case is represented in Figure 1 (a). Conversely, if there is a market between the contested and non-contested goods then the outcome of the contest essentially determines the budget an individual has to transact in this market. If prices are exogenous it is intuitively clear that the individual will seek an outcome from the contest that maximizes their budget, then they will choose the allocation that maximizes their utility subject to a linear budget constraint, as observed in Figure 1 (b). If prices are endogenous, however, the situation is somewhat more nuanced since the rate of exchange between the contested and non-contested good is not fixed, but the basic story is the same: the initial contest outcome determines the goods available for trade in the market, but where the price is influenced by individuals' actions.

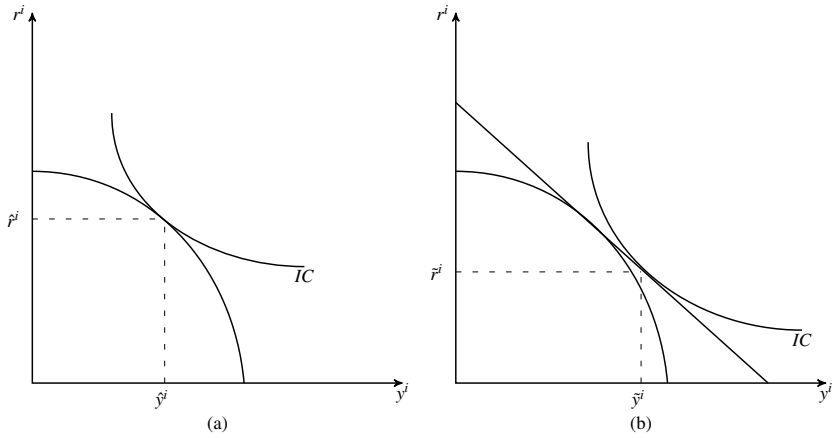

Figure 1: The consumption choice of contestable and non-contestable goods under (a) no market and (b) exogenous market prices, where $\tilde{r}^i$ and $\tilde{y}^i$ denote the allocation of the contested and non-contested goods following transacting in the market.

First, let us note some relationships that will allow us to derive the PPF that is common to all settings. The resource constraint requires that $l^i + x^i = e$, and the production function implies $\hat{y}^i = \alpha l^i$. Combining these equations gives $x^i = e - \hat{y}^i/\alpha$, and therefore we can write the PPF, which depends on the actions of other contestants, as

$$\hat{r}^i = \frac{e - \hat{y}^i/\alpha}{e - \hat{y}^i/\alpha + X^{-i}} R, \tag{2}$$

the absolute value of the slope of which is the marginal rate of transformation:

$$MRT = \frac{X^{-i}}{[e - \hat{y}^i/\alpha + X^{-i}]^2} \frac{R}{\alpha}. \tag{3}$$

We next turn to consider each market setting in turn.

2.2 Equilibrium with endogenous price formation

When individuals engage in the contest the allocation of the contestable good they receive is given by $\hat{r}^i = \frac{x^i}{x^i + X^{-i}} R$ and the amount of non-contestable good produced is $\hat{y}^i = \alpha[e - x^i]$. As such, if ϕ is the price of the contested good (with the price of the non-contested good normalized to 1) the budget available to the individual is $\alpha[e - x^i] + \phi \frac{x^i}{x^i + X^{-i}} R$. Denoting by $\tilde{r}^i$ and $\tilde{y}^i$ the allocation of the contested and non-contested good following transacting in the market, the value of an individual's chosen bundle $\tilde{y}^i + \phi \tilde{r}^i$ must not exceed this budget. Moreover, since here we assume markets clear locally the price must adjust so that the market for the contestable good clears (of course, by Walras' law, the market for the non-contested good will also clear). We envisage market clearing, as in Cournot markets, being administered by an auctioneer who sets the price and individuals understand their influence on the price by

anticipating how the auctioneer would respond to changes in their behavior. Market clearing thus requires $\sum_{j \in N} \tilde{r}^j(\phi) = R$.

As such, individuals may be seen as solving the problem

$$\max_{x^i, \tilde{r}^i, \tilde{y}^i} u(\tilde{r}^i, \tilde{y}^i) \text{ s.t. } \begin{cases} \tilde{y}^i + \phi \tilde{r}^i \leq \alpha[e - x^i] + \phi \frac{x^i}{x^i + X^{-i}} R \\ \sum_{j \in N} \tilde{r}^j(\phi) = R. \end{cases}$$

The outcome of the contest determines the point on the PPF the individual reaches, that they can then trade away from in the market subject to their budget constraint. When markets clear locally and prices are determined endogenously, the budget constraint an individual will face is a complicated non-linear function. In the case where we have symmetric agents, however, we can use a feature of the environment to provide a simple solution to the problem: in any symmetric equilibrium it has to be the case that all individuals are on the production possibilities frontier otherwise the market would not clear (since all individuals would want to either supply the contested good, or demand more of it).

The solution to the above optimization problem will coincide with where utility is maximized subject to being on the PPF, at which point the marginal rate of substitution will be equal to the marginal rate of transformation:

$$MRS^i(\tilde{r}^i, \tilde{y}^i) = \frac{X^{-i}}{[e - \tilde{y}^i/\alpha + X^{-i}]^2} \frac{R}{\alpha}.$$

Now, in a symmetric equilibrium $\tilde{r}^i = R/n$, $\tilde{y}^i = \alpha[e - x^*]$ and $X^{-i} = [n-1]x^*$. As such, the above optimality condition can be written

$$MRS^i(R/n, \alpha[e - x^*]) = \frac{n-1}{n^2} \frac{R}{\alpha x^*}. \tag{4}$$

We can use this expression to determine how the optimal allocation of the non-contested good, and consequently effort in the contest (since $x^* = e - \tilde{y}/\alpha$), changes as the total amount of the contested good changes. Consider, in particular, the effect on the optimality condition when R increases keeping the contest effort fixed at the old x^*. The MRS changes by $\frac{1}{n} MRS^i_r = \frac{1}{R} r^i MRS^i_r$; and the MRT changes by $\frac{n-1}{n^2} \frac{1}{x^* \alpha} = \frac{1}{R} MRS^i$ (using the optimality condition). Now, if the MRT changes by more than the MRS then the equilibrium will involve a smaller $\tilde{y}^i$ and consequently larger x^*. This is represented in Figure 2 (a). In this case, an increase in R expands the PPF and consequently increases the MRT more than the increase in the MRS. Thus the agent's optimal consumption of $(\tilde{y}^i, \tilde{r}^i)$ moves from point a to point a', so there is an increase in appropriation time x^*. Conversely, if the MRT changes by less than the MRS then the new equilibrium will involve a larger $\tilde{y}^i$ and therefore smaller x^*. This is observed in Figure 2 (b) with an optimal consumption bundle moving from point a to point a' with an

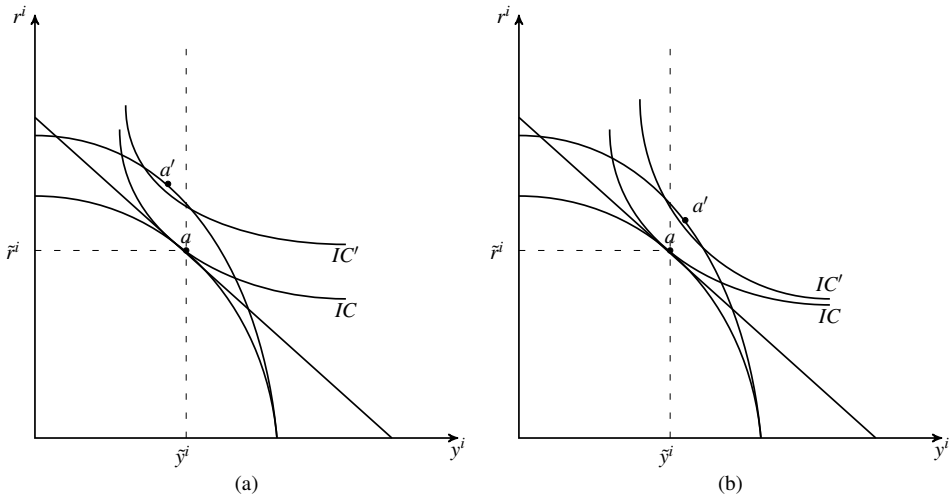

Figure 2: The effects of an increase in the contestable good. In case (a) the marginal rate of transformation increases faster than the increase in the marginal rate of substitution and there is an increase in appropriation time (decrease in $\tilde{y}^i$). In case (b), the marginal rate of transformation increases at a slower rate than the marginal rate of substitution and an increase in R results in a decrease in appropriation time.

associated decrease in appropriation time. As such, when the amount of the contested good, R, increases, the effort dedicated to contesting this good will increase (decrease) if and only if $MRS^i > (<) r^i MRS^i_r$.

Proposition 1. *When relative prices are endogenously determined, an increase in the stock of the contested good distorts effort toward (away from) appropriation activities iff*

$$\eta^i \equiv \frac{r^i MRS^i_r}{MRS^i} < (>) 1.$$

Proposition 1 implies that if the marginal rate of substitution between the contested and non-contested good is inelastic, then increases in the stock of the contested good will call for contestants to substitute production time for appropriation time, as per the usual conclusion in production-appropriation settings: the effort dedicated to contesting contestable goods is monotonically increasing in the quantity in which they are available. But note also that if the marginal rate of substitution between the contested and non-contested good is elastic, the reverse is true. This implies that when the contested good becomes scarcer time will be shifted from production to appropriation even though the quantity of the contested good has declined.

Now we turn to study the effect of the productivity parameter, α. Keeping x^* fixed, if α increases the change in the marginal rate of substitution is given by $[e - x^*]MRS^i_y = \frac{1}{\alpha} y^i MRS^i_y$, which is negative. The change in the marginal rate of transformation is $-\frac{n-1}{n^2}\frac{R}{\alpha^2 x^*} = -\frac{1}{\alpha} MRS^i$.

As such, the equilibrium allocation of the non-contested good will increase (decrease) if the reduction in the marginal rate of transformation is more (less) than the reduction in the marginal rate of substitution, i.e., if $MRS^i > (<)|y^i MRS^i_y|$. Since x^* and the equilibrium allocation of the non-contested good are inversely related, this allows us to draw the following conclusion.

Proposition 2. *When relative prices are endogenously determined, an increase in productivity α distorts effort away from (toward) appropriation activities iff*

$$\xi \equiv -\frac{y^i MRS^i_y}{MRS^i} < (>) 1.$$

Proposition 2 echoes Proposition 1 since it establishes that when the marginal rate of substitution of r to y is inelastic to changes in the quantity of the produced good y^i, increases in the productivity α will incentivize players to substitute appropriation time for production time, while if it is elastic increases in productivity will lead to less production and consequently more appropriation activity. The intuition of this result is similar to the one of the previous proposition: when players produce large amounts of y, and if the marginal utility of y^i is not very sensitive to changes in y^i, contestants place a relatively low valuation on incremental amounts of y. This in turn drives upwards the relative price, ϕ, hence incentivizing players to compete more fiercely for the control of the contestable good. In such instances, the effect on production will be indeterminate since while less time is dedicated to production that time is more productive. If, however, the marginal rate of substitution of r to y is inelastic to changes in the quantity of the produced good y^i, then the relative price of good r will be low and positive productivity shocks will drive away effort from appropriative activities towards production. This in turn will unambiguously result in an increase in production of the y good.

2.3 Equilibrium with exogenous prices

If there is a market between the contestable and non-contestable goods, but that market clears at a higher geographical level, then we may consider that both goods can flow in and out of the local economy in which the contest takes place and that actions in the local economy have no influence on the relative price of the contested good. In this case, an individual's allocation from the contest determines their goods available for trade in the market, which does not affect the market price. As such, individuals can be seen as choosing their market allocation to maximize their utility subject to a linear budget constraint where the budget is given by the value of the allocation from the contest.

Each individual's optimization problem is thus simply to

$$\max_{\tilde{r}^i, \tilde{y}^i, x^i} u(\tilde{r}^i, \tilde{y}^i) \text{ s.t. } \bar{\phi}\tilde{r}^i + \tilde{y}^i \leq \bar{\phi}\frac{x^i}{x^i + X^{-i}}R + \alpha(e - x^i)$$

where $\bar{\phi}$ is the market price.

To maximize utility through trade in the market, each individual will seek to maximize their budget available as a result of the outcome of the contest. As such, in choosing their effort each individual will seek to

$$\max_{x^i \in [0,e]} \bar{\phi}\frac{x^i}{x^i + X^{-i}}R + \alpha(e - x^i).$$

The necessary and sufficient (since the objective function is readily confirmed to be concave) first-order condition is given by

$$\frac{X^{-i}}{[x^i + X^{-i}]^2}\bar{\phi}R - \alpha = 0.$$

Imposing symmetry thus gives

$$x^* = \frac{n-1}{n^2}\frac{\bar{\phi}R}{\alpha}.$$

It then readily follows that the maximized budget available for trade in the market is given by $\alpha e + \bar{\phi}\frac{R}{n^2}$.

From the explicit solution we find in this case of exogenous markets, it follows that

$$\begin{aligned}
\frac{\mathrm{d}x^*}{\mathrm{d}R} &= \frac{n-1}{n^2}\frac{\bar{\phi}}{\alpha} > 0, \\
\frac{\mathrm{d}x^*}{\mathrm{d}\alpha} &= -\frac{n-1}{n^2}\frac{\bar{\phi}}{R}\alpha^2 < 0, \text{ and} \\
\frac{\mathrm{d}x^*}{\mathrm{d}\bar{\phi}} &= \frac{n-1}{n^2}\frac{R}{\alpha} > 0.
\end{aligned}$$

As such, a greater abundance of goods, or a reduction in productivity, will give rise to an increase in effort dedicated to appropriation.

Proposition 3. *When relative prices are exogenously determined, an increase in the stock of the contested good (R) or an increase in the relative price of the contested good ($\bar{\phi}$) unambiguously distort effort toward appropriative activity, while an increase in productivity of the non-contested good (α) unambiguously distorts effort towards productive activity.*

The intuition of this result is that with exogenous prices, the players strategically interact only in the allocation of the contested good. Hence, the time-allocation problem and the utility maximization problem for a given budget can be seen as two independent problems, and thus solved sequentially. It follows that any individual will seek an outcome from the contest that maximizes their budget. Upon inspection of any individual's budget constraint,

we observe that the time-allocation problem then simply consists of maximizing an additive objective function of two terms: $\bar{\phi}\frac{x^i}{x^i+X^{-i}}R - \alpha x^i$. Increasing the amount of contestable good then implies an increase in the marginal return from the appropriation activity, for a given marginal return from the production activity, hence incentivizing any individual to increase their appropriation effort. Likewise, an increase in the productivity parameter α will incentivize individuals to increase the time devoted to production.

2.4 Equilibrium with no market

In the case where no market exists between the contested and non-contested good, each individual's allocation from the contest will be their final allocation of goods. The PPF determines the combination of allocations that can be achieved by engaging in the contest, and therefore we may see each individual as choosing their allocation of the contested and non-contested goods to maximize their utility subject to the constraint of being on the PPF. As such, the equilibrium with no markets will be characterized by the tangency condition of each individual's marginal rate of substitution being equal to their marginal rate of transformation, just as we argued was the case when markets with endogenously determined prices exist. Consequently, with no markets the equilibrium will be exactly the same as in the case with endogenous markets, allowing us to apply Propositions 1 and 2 to this case as well.

3 Revisiting the empirical evidence

The results derived in the previous section suggest that the two crucial factors determining the allocation of resources between production and appropriation activities are the market structure and the shape of the utility functions. First, provided markets exist, the way prices are determined proves central to the activities the players invest their time in. When prices are exogenously given, the relative profitability of either activity will not be reflected in the goods' relative prices, and will thus only affect the income-generating capabilities of players. Accordingly, any increase in the relative return to productive effort will unambiguously imply a substitution from appropriative to productive effort. Second, when either prices are endogenously determined, or when there are no markets, the sensitivity of the marginal rate of substitution between the two goods to the quantities of either good will prove essential for determining the changes in effort allocation. If the MRS is sensitive to changes in quantity of the first argument, this will imply that even if that good was to become more abundant, players would nevertheless *reduce* the time allocated to producing/appropriating that good.

We can now revisit the existing empirical literature in light of our theoretical predictions to better understand the mechanisms driving the results.

3.1 Markets and prices

Most of the existing literature on resources and conflict has concentrated on resources that are marketable and for which markets exist. The two most robust findings in the empirical literature on conflicts are the empirical confirmation of the *rapacity effect* and the *opportunity cost* effect.

Regarding the rapacity effect, numerous articles uncover the positive causal impact of valuable lootable resources' price increases on conflict incidence and/or intensity. Micro-econometric studies provide overwhelming support of this theoretical channel since increases in the price of coca (Angrist and Kugler, 2008), oil (Dube and Vargas, 2013) or minerals (Maystadt et al., 2014; Berman, Rohner and Thoenig, 2017) all lead to more violence at subnational geographical units. These findings uncover that in localized geographical areas, when the looting activity becomes more profitable following an exogenous price shock, efforts to appropriate the valuable resource increase. It is noteworthy to mention that the focus of the above studies has exclusively been on resources that are not consumed locally, and whose price is determined on international markets. These two features combined imply that relative prices can be seen as exogenous, and as such the above observations are in line with the predictions of Proposition 3.

To complement these findings, the literature has consistently established the empirical validation of the opportunity cost channel as well. Following the pioneering study of Miguel, Satyanath and Sergenti (2004) on negative shocks on agricultural income and civil wars in Sub-Saharan Africa, a series of studies provided further econometric support of this channel (Bruckner and Ciccone, 2010; Hidalgo et al., 2010; Hsiang, Burke and Miguel, 2013; Couttenier and Soubeyran, 2014; Harari and La Ferrara, 2018; Vanden Eynde, 2018). Similar causal conclusions are indeed reached when considering the effect of negative commodity price shocks (Bruckner and Ciccone, 2010), negative international demand shocks (Berman and Couttenier, 2015), the introduction of more drought-resistant crops (Jia, 2013), or simply accounting for poverty and local income levels (Humphreys and Weinstein, 2008; Do and Iyer, 2010; Bohlken and Sergenti, 2010).

The empirical literature studying the link between resources and conflict has mostly remained silent on the underlying market structure. Yet, while the above micro-empirical findings are all consistent with our theoretical findings in settings with exogenously given prices,

it is not implausible in the case of agricultural goods to conceive of prices that—in some cases—are endogenous to local conditions. Such would be the case when the agricultural production is consumed locally, a reality in remotely located areas. The above results would still be consistent with our theoretical predictions in settings with endogenous prices, under some conditions, but the above-cited empirical literature nevertheless does not account for market conditions. The two exceptions we are aware of that account for market isolation are Maystadt and Ecker (2014) and Berman and Couttenier (2015), neither of which goes against our theoretical predictions. Maystadt and Ecker (2014) show that severe periods of drought in Somalia have pushed cattle owners to over-supply the market, thereby provoking prices to fall and thus increasing the likelihood of conflict because of the reduction in the opportunity cost of fighting. Berman and Couttenier (2015) claim that international price shocks do not affect prices in remotely located areas, thus shielding such localities from conflict-inducing price downturns.

Our theory predicts that when prices are endogenously determined, resource scarcities (rather than abundance) may be a driver of increased conflict. Given the absence of micro-econometric studies accounting for market conditions, we revert to cross-country studies and descriptive papers analyzing the role of resource scarcities in fueling conflict. By emphasizing the role of markets and of preferences, our contribution helps clarifying the unsettled debate on the role of environmental depletion and resource scarcity on conflict. Kahl (2006) succinctly summarizes this debate. The literature has identified both abundance (e.g., Collier and Hoeffler, 2004) and scarcities (e.g., Homer-Dixon, 1999; Kahl, 2006) as drivers of violence and conflict. The above-cited literature brings support to the scarcity-driven conflict by demonstrating the validity of the *opportunity cost* channel in explaining conflict. Yet, this argument fails to explain rising concerns of conflict surrounding scarcities of resources with ill-defined property rights like fish, forests, or water. Our theoretical framework sheds light on a fundamental mechanism incentivizing agents to increase appropriation efforts in such instances: as the stock of resources becomes scarce, the marginal utility of the resource use increases, and the marginal rate of substitution between the scarce resource and other consumables becomes highly sensitive to changes in the size of the stock of resources. Consequently, further depletion of the resource stock will incentivize agents to devote more effort to appropriate the scarcer resource. The historical example of Easter Island, as documented by Diamond (2005), illustrates this phenomenon well. As the island population rose to unsustainable levels in the absence of strong institutions, the various clans inhabiting the island competed for scarce resources with the competition becoming so intense that a civil war erupted, *de facto* plunging the population into chronic poverty. Generally speaking, one should expect different degrees

of market integration depending on the remoteness of the unit of observation in the datasets employed in the above-mentioned studies. As such, carefully accounting for market penetration could produce opposing results across geographical units, such as in Maystadt and Ecker (2014) and Berman and Couttenier (2015).

Turning next to the cross-country literature on the topic, it appears less conclusive than the micro-empirical literature. Cross-country data confirming the rapacity channel for the case of oil include Ross (2006) and Lei and Michaels (2014), although these results have been contested by some researchers (Cotet and Tsui, 2013; Bazzi and Blattman, 2014). Nunn and Qian (2014) uncover a positive effect of (lootable) US food aid on the intensity of ongoing civil conflicts, while de Ree and Nillesen (2009) identify a peace-promoting effect of foreign aid. The same contrasting image is obtained when considering resource-dependence within countries. As another example, Collier and Hoeffler (2004)'s highly publicized results on the positive correlation of resource dependence and civil conflict were later refuted by Brunnschweiler and Bulte (2009).

The above articles feature different datasets and identification strategies, but even after accounting for the limitations of some studies, the evidence does not unambiguously point in one direction. One needs to consider cross-country evidence with precaution since such studies may, by construction, attenuate the impact of local resources on surrounding regions at a fine level of geographical disaggregation. In natural resource-rich countries, for instance, increases in resource prices are likely to have a differential effect on the propensity to take up arms across geographical entities depending on the local specificities (i.e., on the local production and appropriation technologies). The dilution of such localized effects on national aggregates can eventually explain the lack of statistical significance; what is commonly known as an *ecological fallacy*. Couttenier and Soubeyran (2014) and Berman and Couttenier (2015) provide evidence in support of this phenomenon. Another reading of the cross-country results, however, is that on global markets prices can be considered endogenous. In such instances, (relative) abundance of resources will have a pacifying effect, while (relative) scarcities will boost conflict. The country-heterogeneity may therefore mask opposing mechanisms taking place across countries, eventually yielding ambiguous econometric results.

3.2 Absence of markets

Our theory is flexible enough to equally study settings where markets are absent. While commodities can always be traded, either on markets or in the context of a barter economy, there are no markets for other 'goods' such as political rights and civil liberties, or public goods. As

such, one reading of our theory is that positive (negative) shocks on the income-generating activity can induce individuals to devote more (less) time to expanding their political rights, to defending their civil liberties, or to obtain public goods.

One instance of particular interest where our paper contributes to the literature is by proposing micro-foundations for the *modernization hypothesis* proposed by Lipset (1959). The Lipset hypothesis posits that democratization emerges in tandem with economic development for reasons such as the development of a middle class, or the rise in citizens' education. Our theory brings forward an alternative explanation regarding the microfoundations of this hypothesis. To see that, taking for granted that agents obstructing democratization do so because of self-interest, it is reasonable to conceive of agents as having preferences on the optimal degree of democratization on a line segment in the Euclidean space. Accordingly, the implemented degree of democratization will reflect the relative effort invested by the various concerned parties with divergent objectives. As citizens see their income rise, the marginal utility of income becomes lower, and the sensitivity of the marginal rate of substitution of income to political rights becomes higher. This in turn implies that when wealthy individuals see their income rise further, they will substitute resources devoted to income generation by resources devoted to increasing their political rights.

The empirical support for Lipset's hypothesis has been mixed so far since Acemoglu (2008) showed the absence of a correlation between income per capita and democracy, while Cervelatti, Sunde and Valmori (2017) do demonstrate the existence of correlations, conditional on countries not being former colonies. The latter result is of particular interest since rising incomes may very well spark a desire for more democratic rights, alongside mobilisation attempts, but the particular context in which this happens will determine whether such desires and attempts translate to increased democratic rights. In former colonies governed by strong elites and—typically—strong security apparatuses, state repression will contain democratic demands more effectively, and rent-seeking elites will likely appropriate wealth. In regimes without a history of military repression, democratization demands are more likely to be accommodated. To observe this, consider popular demands for extending civil liberties in Western countries. The civil rights movement in the United States, for example, was initiated by a rising black middle class whose civil liberties failed to grow in par with incomes (Bloom, 1987). Likewise, the 19th century women's rights movement in the United States was pioneered by middle-class working women rather than by the lower strata of the society (Buechler, 1990). More generally speaking, and in line with Moore (1966) and Huntington (1991), economic development seems to give rise to new social forces standing for more democratic rights.

4 Conclusion

Resources have been shown to spark conflict in a wide range of contexts. The empirical literature has established that conflicts are more likely in the presence of valuable lootable resources, thus confirming the *rapacity channel* identified in the theoretical literature, but also when income-generating opportunities dwindle, confirming the *opportunity cost channel*, which has also been theorized. Yet, not all conflicts occur in the presence of abundant valuable resources, as exemplified by the neo-malthusian theses. Moreover, no consistent theoretical framework is able to capture these two contradictory results. Our theory bridges this theoretical gap by proposing a unified production-appropriation model that identifies two crucial ingredients as drivers of conflicts, namely the market structure and the agents' preferences.

We demonstrate that when players are unable to influence the relative prices of commodities, any change in the relative profitability of either activity will incentivize players to devote relatively more time to that activity so as to be able to expand their income, and thus to purchase a utility-enhancing consumption bundle. When markets clear locally, however the opposite result can obtain. With locally clearing markets, relative prices will reflect the relative desirability of agents to both appropriate/produce goods and to consume them. If the appropriable resource is scarce, this will drive upwards the relative price of the resource. This in turn will make players more sensitive to changes in the stock of scarce resources. Further reductions in the stock of the scarce (appropriable) resource will then induce players to reduce their production of the other (relatively abundant) commodity so as to devote more time to claim a share of the scarce resource. The specular result derived from this mechanism is that when the appropriable resource is scarce, conflict will be more likely when the opportunity cost of fighting *decreases*, a result in stark contrast with the established literature. Interestingly, we demonstrate that in the absence of markets we obtain the same exact conditions than with locally clearing markets.

Preferences—and in particular the degree of substitutability of the goods in the players' utility function—prove to be of central importance as well. With endogenous prices, an exogenous shock to the production or appropriation technologies will lead to a relative price change that produces two mechanisms. If the marginal rate of transformation between appropriation of valuable resources and production of the consumable increases because of an improvement in productivity or because of a degradation of the appropriation technology, agents will want to devote more time to production. Second, however, and by analogy to the income effect in consumer theory, for a given marginal rate of transformation, improvements in the production technology generate *ceteris paribus* a positive income shock enabling agents to obtain more of

both goods, with lower production effort. In essence, therefore, whether better production technologies will translate in more or less appropriation effort will depend on which effect dominates.

This new theory enables us to better comprehend a plethora of empirical results, and to clarify the debate on the resources-conflict nexus. By identifying the market structure and preferences as key elements driving players' decisions, our model opens up a new avenue for future research on the impact of environmental depletion or of Malthusian pressures on conflict.

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