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On the redistributive impact of privatizing a resource under imperfect enforcement

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ABSTRACT. We consider the redistributive effects of privatizing a resource previously exploited under free access. We assume that illegal extraction is punished but that the sanction is bounded by individuals' wealth. First, we show that a segment of intermediate-wealth individuals is the most adversely affected from the regime change, while the poorest segment is not only less severely affected, but may actually gain from it. Next, we show how the authorities may prefer to choose an intermediate enforcement level in order to maximize the political acceptability of the regime switch among the local community.

1. Introduction

> Rural theft by itself is unremarkable; it is a nearly permanent feature of agrarian life whenever and wherever the state and its agents are insufficient to control it. When such theft takes on the dimensions of a struggle in which property rights are contested, however, it becomes essential to any careful analysis of class relations. (Scott, 1985: 265)

The establishment of clearer property rights over resources is often proposed as a solution to the problem of the 'tragedy of the commons'. (Gordon, 1954; Hardin, 1968; World Bank, 1992; Baland and Platteau, 1996). This solution is generally based on the premise that property rights can be perfectly and costlessly defined and enforced. Costless enforcement is a strong requirement in most settings, and especially so in the case of diffuse resources such as forests, fisheries, or game. In the present study, we introduce costly enforcement of property rights in order to analyze the redistributive effects of privatizing a natural resource when exclusion is

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imperfect.[1] We are also concerned about the political feasibility of the newly created private ownership regime. We thus consider its impact among heterogeneous individuals living in the vicinity of the resource.

The setting in our model is that of a village located next to a natural resource, such as a forest or fishery. A villager can earn a living by either exploiting the resource, or by some other occupation not related to the resource. The best alternative occupation shall be referred to as the 'outside' opportunity of a villager. Villagers are heterogeneous with respect to the income that each one can derive from his or her outside opportunity.

Initially, the resource is subject to a regime of free access. Given villagers' heterogeneous outside income opportunities, the free-access equilibrium is one in which the marginal exploiter of the resource equates the average productivity of the resource to the income he would get in his best alternative. The resource is thus inefficiently exploited, since the indifferent exploiter has a marginal productivity that lies strictly below that of his outside opportunity.

The local, or national, authorities privatize the resource by allowing an outside firm to access the resource, while declaring illegal its access to villagers. This implies that the authorities must enforce that limited access. The physical nature of such resources as forests and fisheries, however, makes exclusion difficult to enforce and often results in imperfect enforcement. Hence, members of the local community may decide to extract the resource illegally.

The main feature of our analysis resides in the combination of imperfect enforcement and heterogeneous villagers. Since villagers have different outside income opportunities, the severity of punishment for those who get caught encroaching on the resource will differ across individuals. More precisely, we adopt the argument that those who have low outside opportunities receive a lower absolute penalty when caught than those who have high outside opportunities. As a result, we show that individuals with low outside opportunities may gain from the privatization of the resource, even though they now exploit the resource illegally. This is because once some villagers are excluded from exploiting the resource, its average productivity may increase in such a way as to make the poorest villagers better off. This can be true even though none of the rents from the resource is returned to the village, and none of the workers hired by the outside firm comes from the village.

Not all of the villagers gain from the privatization however. Following privatization, those who decide to leave the resource will receive a lower income than the one they were getting from the resource in the free-access regime. Moreover, a segment of those who continue to exploit the resource illegally will lose in the new regime. This category is characterized by having outside opportunities poor enough such that they prefer to continue

[1] By privatization, we imply the switch from a regime of free access to one of exclusive ownership.

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exploiting the resource, but high enough such that they receive a significant punishment when caught.[2]

In our analysis, we find that the authorities can affect the degree of political feasibility of the regime change through the enforcement level, which we express as the expected severity of punishment of an encroacher. A high enforcement level has the advantage of leading to a more conservative use of the resource as well as to higher rents for its owner (which often partly accrue to the local or national authorities in the form of royalties or bribes), but carries the political cost of being too severe in its exclusion of the poorest villagers. Our contention is that the authorities might prefer to choose an intermediate level of enforcement in order to secure the political survival of the new exploitation regime.[3,4]

The establishment of property rights on a resource initially open to all is commonly explained by changes in the benefits and costs of exploiting the resource and protecting those rights. Demsetz (1967), for instance, proposed that an increase in the price of a resource can induce its exploiters to begin to enforce a restricted access. His analysis focused mainly on changes in the benefits of enforcing property rights. But the change could also come from a reduction in the costs of doing so. Anderson and Hill (1975) present such a case when they argue that the introduction of barbed wire in the American west allowed prairie farmers to enclose their land at a cost much lower than before. Hence, property rights came about by a reduction in the costs of enforcing those rights. Both studies assume exogenous enforcement costs. These costs may however be endogenous and set by those who try to gain control over the resource. Hotte (2005) makes that point by arguing that the owner of a resource can resort to over-exploitation in order to make poaching a less attractive option to others, thus lowering the costs of excluding them. McCarthy *et al.* (2001) draw an analogous conclusion in the case of a managed common property resource. Common to those studies is the fact that the decision to enforce property rights is taken at the individual level. This means that the state is either completely absent from the analysis, or it has a passive role in that it does not attempt to influence the decision to enforce property rights. At the very least, the enforcement of property rights is most frequently done with the complicity of the authorities, if not

[2] Note that the redistributive effects of a regime change from free access to private ownership has been extensively studied for the case of property owners versus workers (see, for instance, Weitzman, 1974 and Cohen and Weitzman, 1975). Our approach differs from those in that it concentrates on the redistributive effects among heterogeneous workers when enforcement is imperfect.

[3] Although Demsetz (1967) focused on the relative costs and benefits of exchanging property rights, he did recognize that a community's tastes for property rights is an important explanatory element (p. 350). In the present study, we argue that these tastes are (at least partly) endogenous, as they depend on individual comparison between the new and the old property rights regimes.

[4] The fact that imperfect enforcement can be used as a means of redistributing wealth is a point that has similarly been made by Lasserre and Soubeyran (1999). Their study focuses on optimal enforcement when individuals have decreasing marginal utilities.

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by them.[5] In the present study, we will assume that enforcement is not under the owner's control but is undertaken by the authorities.

Finally, the reader should bear in mind that this work constitutes a positive analysis that simply compares two exploitation regimes: free access versus private property. Such regimes are frequently observed. Privatization has moreover often been recommended by international institutions as the solution to over-exploitation under free access. Obviously, common property constitutes a third option that might Pareto-dominate the others. It is well-known, however, that common property has its own sources of inefficiencies, such as cooperative allocation of extraction quotas, peer-monitoring and exclusion, and lack of investment in superior technologies (Ostrom, 1990; Baland and Platteau, 1996). Its consideration goes beyond our original intent for this study.

The paper is organized as follows: the empirical underpinnings of the model are discussed in section 2. Section 3 presents the local 'physical' setting that we wish to analyze. We then solve for the free-access and private property equilibria in the subsequent two sections. The analysis of the distributive impact of privatization (without rent distribution) is performed in section 6, while the political-economic implications of varying the enforcement level are considered in section 7. Section 8 reviews some political-economic implications of privatization with rent distribution. A conclusion reviews the results and discusses possible extensions.

2. The empirical underpinnings

Situations in which the right of access to a resource is given to outsiders are not uncommon. Klooster (2000a, 2000b) provides a case study of the province of Oaxaca, Mexico, where the legal access to a forest is given by the village authorities to an outside firm which hires labor from outside the community. Villagers are thus not legally entitled to access the forest. Enforcement is performed through a combination of efforts by the village authorities, the national forest service, and the firm. Tree theft nonetheless occurs and is said to have 'the potential to drastically affect the forest' (Klooster 2000a: 287).[6] In Kalimantan, Indonesia, timber concessions have been assigned to large-scale timber companies with close connections to the Suharto family and the army. This effectively pushed local timber operations 'underground', giving rise to the formation of an informal timber economy (Casson and Obidzinski, 2002). In Senegal, Ribot (1998) reports that access to forests is given to woodcutters originating from outside the village, even though access is controlled by the village chiefs. Toufique (1997) describes the case of inland fisheries in Bangladesh where property rights go to large owners also originating from outside the community, although it is not clear in this case where the fishermen originate. It reports on encroachment and serious enforcement problems. And, finally, Colchester writes that, 'Despite apparently secure land rights, New Guinean communities have frequently

[5] After all, one of the main *raison d'être* of any state organization resides in its coercive power against what it considers deviant behavior.

[6] Klooster (2000a) provides an interesting and detailed account of how tree theft and enforcement actually takes place on pages 286–291.

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negotiated away rights over their lands, by leasing them to logging and mining companies in exchange for royalties' (Colchester, 1994: 86–87, cited in Baland and Platteau, 1996: 258.)

We further make the important assumption that wealthier individuals receive a higher punishment, in its monetary equivalent value, than poorer ones for the same crime. In the literature on crime and punishment, we can find various reasons justifying this. We highlight four: (i) During imprisonment, the foregone income is larger for wealthier individuals. (ii) There is an adverse effect on the reputation of the person receiving a sentence which reduces their future income opportunities. Lott (1990) finds that this effect is likely to be quite significant and progressive. (iii) A poor person may simply not have the means to pay the fine (Polinsky and Shavell, 2000). (iv) An enforcement officer may be more lenient with a poor person than a rich one.[7]

The first two reasons being rather uncontroversial, we provide empirical support only for the last two. Although we could not find a comprehensive study that addressed those issues directly, there is substantial indirect evidence that corroborates our hypothesis. Baland and Platteau (1996: 250) argue, for instance, that when the official fine for an offense is very large in comparison to the rule-breaker's income, an (illegal) compromise will often be reached with the monitoring agent. The authors provide the example of the Indian Forest Bill of 1981 whereby 'if a person is found using dried wood as fuel, or grazing cattle or collecting minor forest produce in these areas, he is liable to a fine amounting to as much as Rs 1,000 (a family earns a maximum income of Rs 20 per day!) and to a one-year imprisonment sentence' (p. 241).

The justification for a reduction in the severity of the penalty can also rest on the argument of necessity. Indeed, Hay reports, in a study of criminal law practices in eighteenth-century England, that, 'In passing a sentence of death on a prosperous sheep-stealer in 1787, Sir Beaumont Hotham argued that the law understood the trials of the poor and properly held the rich rogue to stricter account' (Hay, 1975a: 44). In the opinion of this Judge, therefore, mercy can be accorded to a poor man who commits a crime from real want, but one must be less lenient to wealthier individuals.

In a study concerning poaching in eighteenth-century England, Hay (1975b) provides another argument for why the poor may face lower expected fines in a variety of practices punishable by law. It rests on the idea that the rural poor may *consider* certain practices to be legitimate. For instance, taking wood from an ancient commons would be seen as a practice defined by the customs and thus considered as legitimate by villagers. As a result, communal solidarity makes it quite difficult for the authorities to enforce exclusion as, 'The keepers met a wall of silence when they tried to make inquiries, but found that word spread like lightning when they

[7] It may be argued that the rich can often 'buy' justice by affording better defense (Lott, 1987), bribing a guard, or influencing a judge (with promise of future favor or some loss of reputation). But this only implies that richer individuals have the means to avoid conviction and are willing to pay more for it; it does not necessarily mean that the monetary equivalent cost of having been caught is lower for them.

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obtained a search warrant, and that the suspects had escaped with "the apparatus" just before they arrived. Witnesses lost their memories . . .' (Hay, 1975b: 198). In a study of smuggling on the Belize–Mexico border, Wiegand draws similar conclusions. According to his observations, 'an unstated policy of leniency prevails in which the officers charge the shoppers a variable tax rate, depending on a whole host of social and demographic factors'. Moreover, 'No stigma or loss of reputation is associated with petty smuggling. The villagers see it as their right' (Wiegand, 1993: 179). As with poaching in eighteenth-century England, Wiegand noticed that villagers tend to protect each other in the face of the authorities' enforcement activities, although they would be more cooperative when it came to reporting and stigmatizing larger-scale commercial smugglers.

As the above examples show, the fact that the activity is declared illegal by the authorities while it is perceived as a legitimate right to local users seems to matter a lot when it comes to enforcement. Hay (1975a) notes that penalties for poaching on what used to be a local common tended to be smaller than for other property theft of similar value, and that, 'The petty thief could never enjoy the unqualified support of the community, even if he preyed only on gentry and wealthy farmers, because he was never above suspicion among his neighbours.' Clearly, the type of privatization considered in the present study would fit the case of poaching described by Hay.

The fact that people with lower opportunity cost of time tend to perform illegal extraction finds much support, as testified by the cases reported above. We consider two additional cases. Illegal clam fishing in the Venice lagoon, as documented by *The Independent* of 28 May 2001, represents one case. This activity is banned in almost all of the immense lagoon because clams have been contaminated by local industrial plants. However, illegal fishing is a major activity involving approximately 800 small fishing crafts managed by part-time workers, pensioners, and civil servants. Precisely those whose time opportunity cost is the lowest. Another case refers to timber extraction in Indonesia. According to Casson and Obidzinski, illegal logging is hard labor and extremely dangerous but always available and comparatively well paid. This pool of jobs involves around 12,000 people out of an approximate population of 100,000 people on a part-time base. The authors add that it 'constitutes an important source of part-time employment for rural poor'.

The concept of a 'politically acceptable' enforcement level also finds empirical support. For instance, in Casson and Obidzinski's Indonesian case of illegal logging, enforcement is performed by local authorities. Their interests do not coincide perfectly with the central authority that distributed timber concessions. The authors mention that, during economic crises, 'local government has been forced to be sympathetic to local community needs and are turning a blind eye when it comes to illegal logging activities' (p. 2147). As evidence of the political pressure that local governments can face, the author reported that during their stay in the region a police car had been burned by loggers because the police had attempted to confiscate some of the 'illegal' timber they were transporting. Abbot and Mace (1999) provide an additional example for the case of illegal fuelwood collection in the protected woodlands of Lake Malawi National Park. They report

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that the low penalties imposed on illegal wood collectors 'may reflect a recent policy toward more lenient penalties for illegal wood collectors to improve the relations between park management and local communities' (p. 420). Similarly, Baland and Platteau (1996: 260) argue that, 'Under the pressure of strong political bases, the governments may indeed refrain from applying unpopular conservationist measures.' They refer to a study in Costa Rica where the lack of enforcement of forest regulation was part of 'an explicit strategy of the state to avoid or reduce tensions' (Utting, 1994: 239, cited in Balland and Platteau, 1996: 260). And, finally, Wiegand makes the argument that partial enforcement against smuggling activities reflects 'a tenuous compromise between competing social and economic interests' (Wiegand, 1993: 189).

3. The community and its resource

A community is composed of individuals who differ solely by the opportunity cost of their time. We wish to interpret this opportunity cost as a proxy for their wealth, or income opportunities, outside of the natural resource under consideration here. Those individuals are distributed on a continuum of opportunity costs c, within range $[0, \bar{c}]$, according to some distribution function $G(c)$. The total population of the community is of mass N.

The community is located next to a natural-resource site which is characterized by a certain difficulty, limiting its access to the general population. Typical examples include fisheries, forests for wood or fuelwood, hunting grounds, and pastures. Exclusion is thus a costly activity. The total harvest of the resource is given by $h(x)$, where x represents the total extraction effort of the community. For ease of exposition, the average product of the resource, $h(x)/x$, will be denoted as $\phi(x)$. Each unit of the resource sells for a price p. The average return from each unit of extraction effort is thus $p\phi(x)$.[8]

Each individual is endowed with one unit of inelastically supplied labor time, which can be devoted either to the exploitation of the resource or to some alternative activity. The returns from resource exploitation are endogenous to the present model and will depend, among other things, on the effective property regime, as described below. The returns to alternative activities are exogenous and given by c as described above.

4. The free-access regime

If the resource is subject to a free-access regime, individuals will enter the resource so long as the gains from doing so exceed their opportunity cost c. Let c^{fa} denote the opportunity cost of the individual who is indifferent between exploiting the resource or not. In order to have an interior equilibrium with $c^{fa} \in [0, \bar{c}]$, we assume that $p\phi(N) < \bar{c}$. The return from each unit of labor time being equal to the mean return from each unit of extraction effort, c^{fa} is defined by the following condition

$$p\phi(NG(c^{fa})) = c^{fa} \tag{1}$$

[8] To keep the analysis simple, we do not consider the resource's stock effects, as if it were constant throughout.

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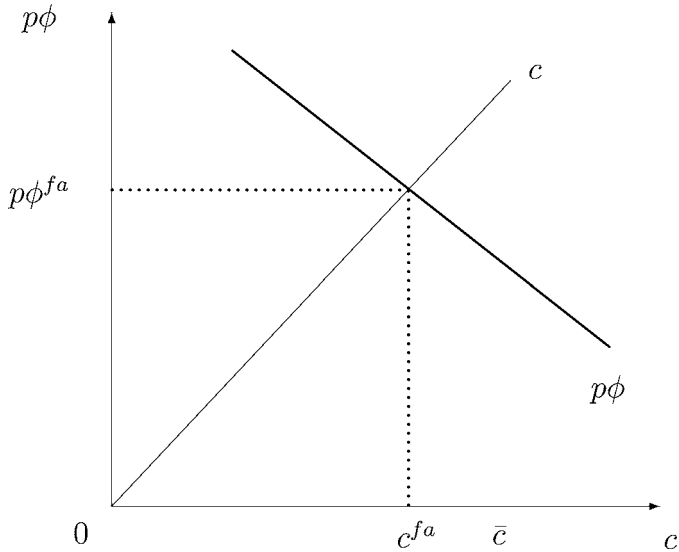


Figure 1. *The free-access equilibrium*

In a free-access regime, all individuals whose opportunity cost of labor time is below c^{fa} will enter the resource. Each receives a surplus of

$$s^{fa}(c) = p\phi(NG(c^{fa})) - c \tag{2}$$

from doing so. Individuals whose opportunity cost lies above c^{fa} will not exploit the resource. Their surplus from a free-access regime is zero. The free-access regime is illustrated in figure 1.

5. The private property regime

In order to analyze the political-economic problem in its simplest form, we assume that following privatization of the resource site, both the rents and the hired input payments accrue to individuals located outside the community. At first sight, this may give the impression that nobody from the community stands to gain from a privatization of the resource. We will see that it is not necessarily so in the context of *imperfect* enforcement of property rights. In order to distinguish between outside workers hired by the owner and individuals living in the community next to the natural-resource site, we shall refer to the latter as *villagers.*

Once the authorities have opted for private ownership, they must enforce that arrangement by excluding 'potential' encroachers.[9] This will take the form of a probability (λ) of catching an encroacher and punishing him. Enforcement activities are the prerogative of the authorities only. The enforcement level λ is thus taken as exogenous for the owner.

[9] Depending on the context, the terms 'thief', 'poacher', or 'smuggler' are also often used. We adopt the term 'encroacher' for convenience.

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The problem of the resource owner is to maximize his profits by hiring l workers at constant unit cost w, while taking into account the induced effect on the level of encroachment, given enforcement level λ. Moreover, compared with an individual in a free-access situation, the owner may have better equipment available to the workers, because, say, of easier access to credit, more secure investment, or the possibility of benefitting from increasing returns. We thus introduce a superior extraction technology by assuming that each hired worker has an *effective* labor input b times larger than that of a villager, with $b \geq 1$. Hence, the total effective labor input chosen by the owner equals bl.[10]

We assume that the decision to encroach by a villager is taken after having observed the level of exploitation bl by the owner and knowing the probability λ of being caught and punished.[11] In order to solve the problem of the owner, it is thus necessary to derive first the equilibrium level of encroachment for any given bl and λ.

5.1 Punishment and the decision to encroach

As in the case of free access, we assume that all villagers face a choice between using their unit of labor time on the resource, or getting c from their best alternative activity. Their (gross) return from exploiting the resource is still the value of average product $p\phi(x)$, where the total effort devoted to the exploitation of the resource, x, now combines the owner's input level bl and the total number of encroachers. From a villager's point of view, the institution of private ownership differs from that of free access in that if he chooses to exploit the resource, he becomes an encroacher and faces a probability λ of being caught and punished.

In the present analysis, we wish to bring out the importance of the role played by the instrument of punishment. More precisely, we will account for the fact that the severity of punishment of an individual is proportional to the level of his wealth. Note that we do not make a clear difference between wealth and income opportunities since they are normally highly correlated, especially when it comes to the punishment of individuals.[12] Moreover, this assumes that the wealth level is perfectly observed by the enforcer once he catches an illegal extractor. This can be achieved by noting

[10] Note that the assumption of zero minimal opportunity cost rules out a strategy of full exclusion of encroachers by the owner. Indeed, with a strictly positive minimal opportunity cost, the owner can deter encroachment completely by increasing extraction further so that the average product of the resource becomes lower than the expected opportunity cost of the poorest persons (as in Hotte, 2005). However, this strategy does not pay when the minimal opportunity cost is low enough and/or poorest people are not so numerous.

[11] Whether the exploitation level is observed or not by encroachers is always an issue in this type of model. Reality probably lies somewhere in between; that is, there is partial observation and it depends on the context. We assume that it is perfectly observed here for analytical convenience.

[12] An 'unoccupied' wealthy person could always acquire capital such as land or a business on which to work and receive a higher return to labor than a poor individual without access to such capital.

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his status in society, the type of house and neighborhood he lives in, his legitimate occupation, etc.

We therefore assume that once caught, an encroacher receives a fine equal to γc, with $\gamma \geq 0$.[13] For any exploitation level x, the expected surplus from encroachment, for a villager of opportunity cost c, is thus given by

$$s^p(c) = p\phi(x) - c - \lambda\gamma c \tag{3}$$

where superscript p refers to the private property regime. For any given bl and λ, a villager of opportunity cost c will decide to encroach as long as he gains from doing so, $p\phi(x)$, does not fall below its expected opportunity cost, $c + \lambda\gamma c$.[14] Now $NG(c)$ increases with c, and $\phi(x)$ is strictly decreasing. This implies that for any given l, the total number of encroachers will be determined by the following equality

$$p\phi(bl + NG(c^p)) = (1 + \lambda\gamma)c^p \tag{4}$$

where c^p denotes the *marginal* encroacher; that is, the one who is indifferent between encroaching on the resource or receiving his best alternative income c^p. The implicit relation between c^p and l, as defined by equation (4), will henceforth be referred to as $c^p(l)$.

Note that the possibility of all villagers encroaching, that is $p\phi(bl + N) \geq (I + \lambda\gamma)\bar{c}$, is ruled out by the assumption that $c^{fa} \in [0, \bar{c}]$.

5.2 *The resource owner's problem*

The resource site owner will choose input level l while taking into account its effect on decisions to encroach. His problem can thus be expressed as follows

$$\max_l \pi = p\phi(bl + NG(c^p(l)))bl - wl \tag{5}$$

The first-order condition is

$$p\phi(bl + NG(c^p(l)))b + p\phi'(bl + NG(c^p(l)))\left(b + \frac{\partial}{\partial l}NG(c^p(l))\right)bl = w \tag{6}$$

where, using equation (4) to derive the implicit relation between c^p and l, we get

$$\frac{\partial}{\partial l}NG(c^p(l)) = Ng(c^p)\frac{\partial c^p}{\partial l} = \frac{Ng(c^p)p\phi'(bl + NG(c^p))}{1 + \gamma\lambda - Ng(c^p)p\phi'(bl + NG(c^p))}b \tag{7}$$

where $g(c)$ is the *density* function corresponding to wealth distribution $G(c)$.

The first term on the left-hand side of (6) says that the marginal benefit of a unit increase in l is to raise profits by labor's value of average product $p\phi(x)b$. This corresponds to the usual result, aside from the fact that the

[13] Note that γ could be larger than 1. For instance, assume that c denotes the monthly salary, while wealth is the lifetime present value of income. Punishment could then be equal to three months' salary.

[14] Note that in order to simplify the analysis and concentrate on the issue of choice of property regime, we assume all individuals to be neutral towards risk.

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average product depends not only on l, but also on the total number of encroachers $NG(c^p(l))$.

The second term on the left-hand side of (6) accounts for the fact that an increase in the number of inputs affects negatively the value of average product, an effect that has repercussions on all inputs l already in place. This effect differs from the usual case without encroachment in that a one unit increase in l will not be matched one-to-one by a unit increase in total inputs exploiting the resource. This is so because as l increases the reduction in the average product will drive out some encroachers, as implied by equation (4). Indeed, equation (7) gives the magnitude of the change in encroachment following a one unit increase in l, an amount that lies between $-b$ and 0.

Finally, a unit increase in l increases the wage bill by w, as given by the right-hand side of (6).

Notice that the free-access regime is just a special case of the private property regime. Indeed, if we let $\lambda\gamma$ tend to 0 in the private property regime described above, then all individuals are allowed to enter the resource without punishment. In this case, since nobody really owns the resource anymore, the previous owner simply becomes a large exploiter in the sense that he can hire any amount of workers to exploit the resource. It is thus equivalent to adding a large exploiter to the free-access regime described in section 4. The free-access regime with a large outside exploiter is thus described by conditions (4), (6), and (7), at the limit where $\lambda\gamma = 0$.

Obviously, the addition of a large, outside exploiter to the pre-existing free-access regime will increase the intensity of exploitation of the resource. The equilibrium average product of the resource will thus be lowered, with the result that all the small village exploiters will be made worse-off with the introduction of a large exploiter. We will see below, however, that if the resource is privatized but imperfectly enforced, then some exploiters may be made better off.

6. The distributive effect of privatization

The heterogeneity of individuals introduces an asymmetry in the relative gains or losses from privatization. We argue that the presence of encroachment on the privatized resource is not only compatible with the profit maximizing behavior of its owner, but may actually make the privatization beneficial for a certain segment of the population, the poorest one for that matter. And this can be true even though neither the rents, nor the labor payments, are returned to the community.

The following discussion assumes that before privatization, the large exploiter was not allowed to exploit the resource. The benchmark free-access regime we refer to is thus the one depicted in section 4.

As will become obvious below, a necessary and sufficient condition for some of the poorest individuals to gain from privatization is for the value of average product of the resource to increase following privatization. Consider a situation in which $p\phi^p > p\phi^{fa}$, where $p\phi^p$ and $p\phi^{fa}$ are the average product values with private ownership and free access respectively.[15] For

[15] Remember that the average product in private ownership is endogenous and must satisfy the first-order conditions of the owner.

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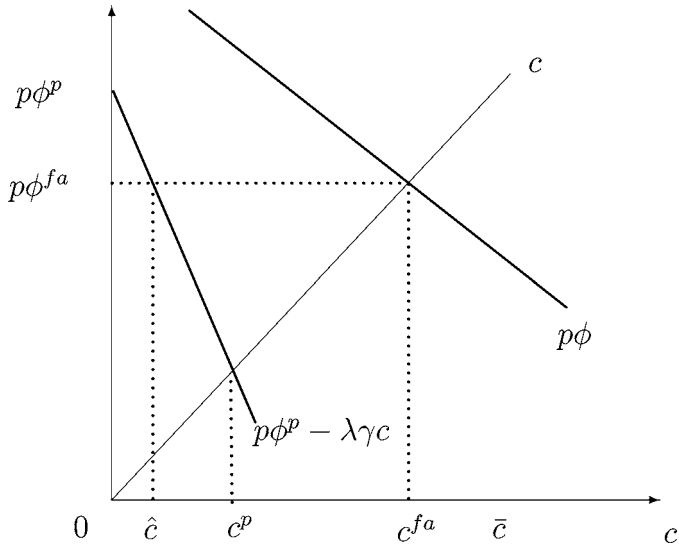


Figure 2. *The private-ownership and free-access equilibria*

those who continue to exploit the resource after its privatization, that is the encroachers, the expected income is now $p\phi^p - \lambda\gamma c$. Before privatization, they were getting $p\phi^{fa}$. For those who leave the resource, they now get their next best alternative, that is c. Following privatization, some villagers will necessarily leave the resource, since the introduction of punishment increases their opportunity cost, that is $c^p < c^{fa}$.

It now becomes clear why the very poorest individuals may gain from the privatization. Take the poorest one for instance. Since $c = 0$, he will not be punished if caught. Hence, his opportunity cost from exploiting the resource does not change following privatization, while his returns increase by $p\phi^p - p\phi^{fa}$. All those who have very low cs are in a similar situation: the very limited punishment that they can receive when caught is not enough to outweigh the gain from the increased productivity of the resource.

Figure 2 illustrates a case where $p\phi^{fa}$ is the (equal) income received by each villager exploiting the resource in the free-access regime, and curve $p\phi^p - \lambda\gamma c$ denotes the expected income received by those villagers who continue to exploit the resource as illegals, which now depends on c. c^p represents the marginal encroacher as defined by $p\phi^p - \lambda\gamma c^p = c^p$. The regime switch has thus reduced the number of villagers exploiting the resource from $NG(c^{fa})$ to $NG(c^p)$, which has contributed to increase the value of average product from $p\phi^{fa}$ to $p\phi^p$. A villager of wealth level $\hat{c}$ is thus indifferent between both regimes.

For all those individuals with $c \in [0, \hat{c}]$, the net expected return with private ownership exceeds the one they were getting in free access. On the other hand, the villagers with wealth between $\hat{c}$ and c^p lose from the privatization. This is because their alternatives are poor enough to make them prefer to exploit the resource as encroachers, but they are good

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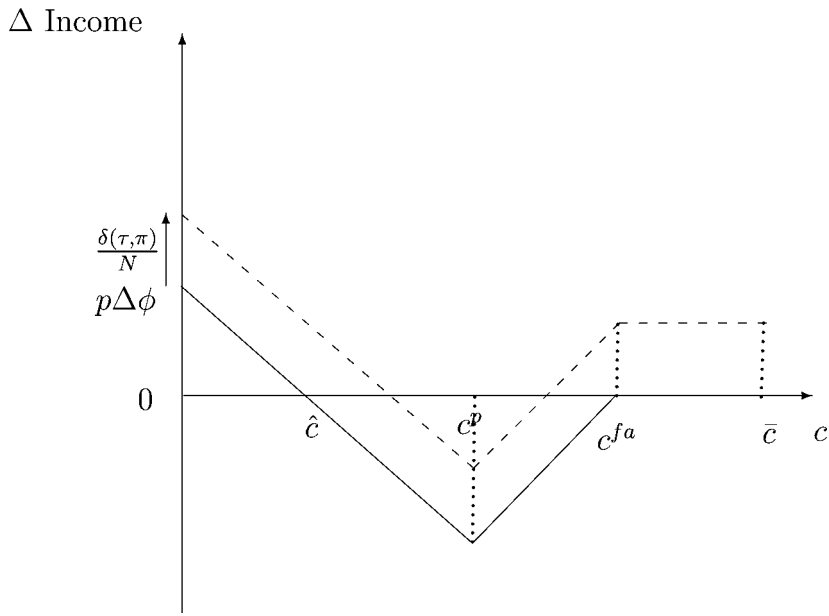


Figure 3. *Variation of income*

enough to give them a significant punishment when caught. As a result, their expected income is driven below the one they were getting as free-access exploiters.

Those whose wealth lies between c^p and c^{fa} also lose from the privatization, even though they do not encroach on the resource. This is because with their higher wealth, the threat of punishment becomes large enough to make them leave the resource and revert to their alternative income c, which, for those individuals, is lower than what they were getting in the free-access regime. The full line in figure 3 represents the variation in expected income, for all individuals, following privatization without rent redistribution.

Note that the argument presented here is not general. As mentioned above, if the rents are not redistributed among the community, a necessary and sufficient condition for the argument to hold is that the average product of the resource increases after privatization.

What if the large exploiter was present in the pre-existing free-access regime? It is shown in the appendix that $p\phi^p$ strictly increases with $\lambda\gamma$ and that the converse holds for c^p. A privatization of the resource will thus always increase the value of average product of the resource, resulting in a sure gain for some of the poorest individuals, while making some intermediate wealth individuals worse off.

From figure 2, we can also see that if privatization leads to a lower equilibrium average product, then even though all villagers are adversely affected, the poorest individuals lose relatively less than a certain range of intermediate wealth villagers.

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The following proposition summarizes our results:

Proposition 1. *(i) There always exists a certain range of intermediate wealth individuals that will be made worse off following a privatization of the resource. (ii) Compared to a free-access regime, the poorest segment of the population gain from the regime change if, and only if, the average product increases following privatization. (iii) If the average productivity does decrease after privatization, then all villagers are adversely affected, but the effect on the poorest individuals is less severe than some segment of intermediate wealth villagers. (iv) If the large exploiter is already present in the free-access regime, then the poorest segment of the population necessarily gains from the regime change.*

Since the equilibrium average product is privately determined, we would like to understand how it is affected by the different parameters of the model. More specifically, we would like to see if and how the authorities could affect the private equilibrium average product through its choice of detection probability λ or severity of punishment γ, thereby affecting the distributional impact of the regime change.

7. The enforcement level

We now turn to the effects of varying the enforcement level, subsumed here by the probability of detecting an encroacher (λ) multiplied by the severity of punishment (γ). The purpose of performing such an analysis is to see whether and how the authorities of the community could affect the redistributive effects of privatization solely through the instrument of enforcement. If it were the case, then the degree of success, that is its social and political acceptability, of the privatization process could depend on how it is enforced, as discussed in some of the case studies presented in section 2.[16] This issue is of particular relevance for a state which cannot effectively tax the resource and redistribute it within the community.

We note first that an increase in $\lambda\gamma$ necessarily leads to an increase in the average product of the resource. Indeed, an increase in the enforcement level makes encroachment less attractive, with the result that the owner does not need to resort to so much over-exploitation of the resource in order to deter encroachers. The overall intensity of exploitation of the resource is thus reduced, which leads to an increase in its average product (a formal proof of this is provided in the appendix).

An increase in $\lambda\gamma$ has two opposite effects on the total number of encroachers

$$\frac{dNG(c^p)}{d\lambda\gamma} = Ng(c^p)\left[\frac{dc^p}{d\lambda\gamma} + \frac{\partial c^p}{\partial l}\frac{dl^p}{d\lambda\gamma}\right] \tag{8}$$

The sign of the two derivatives within brackets is formally derived in the appendix. A more intuitive explanation is provided here with reference to figure 2. The first effect on the right-hand side of (8) is to make the slope

[16] Peluso (1992) goes further by arguing that we should interpret violent and non-violent forms of peasant resistance 'as responses to specific forms of control over access to resources' (p. 19). She interprets tree theft not only as a means of generating income, but also a form of nonviolent resistance.

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of curve $p\phi^p - \lambda\gamma c$ steeper in absolute value. This negative effect tends to reduce the number of encroachers, $NG(c^p)$, and also reduce the number of those who gain from the regime change, $NG(\hat{c})$. The second effect on the right-hand side of (8) is due to the increase in the equilibrium value of average product of the resource. This second effect shifts curve $p\phi^p - \lambda\gamma c$ upward, thus increasing the numbers of encroachers, $NG(c^p)$, and also the number of those who gain from the regime change, $NG(\hat{c})$.

The net effect is ambiguous. We can nevertheless argue that if for some $\lambda\gamma$, $p\phi^p > p\phi^{fa}$ (a necessary and sufficient condition for $NG(\hat{c}) > 0$), then there must exist a finite and positive enforcement level which maximizes the number of those who gain from the regime change. It is easy to see, indeed, that for arbitrarily large values of $\lambda\gamma$, the encroachment level is driven to zero without the need for the owner to over-exploit the resource. As far as the owner is concerned, this is akin to a situation of perfectly and costlessly enforced property rights. If, on the other hand, $\lambda\gamma = 0$, then $p\phi^p \leq p\phi^{fa}$, since this situation is equivalent to simply adding an exploiter to the pre-existing free-access situation. In both situations, no encroacher gains from the privatization of the resource, that is $NG(\hat{c}) = 0$ in both cases. The following proposition entails from a continuity argument:

Proposition 2. *If there exists an enforcement level $\lambda\gamma$ for which $p\phi^p > p\phi^{fa}$, then there must exist an enforcement level which maximizes the number of those who gain from the privatization, $NG(\hat{c})$.*

This result implies that if the enforcement level is set very low, then the arrival of an outside firm will make everyone worse off in the village. This is because the situation approaches that of a free-access situation and the outside firm will just make matters worse for the resource.[17] Alternatively, if the enforcement level is set very high, then the resource will be more efficiently exploited. However, except for extremely poor individuals who stand to lose nothing from being caught encroaching, barely any villager will gain from the privatization. Let us imagine, as is often the case, that the state or local members of the authorities collect a share of the rents from the privatized resource, either as part owners of the outside firm or in the form of bribes from the firm. They may decide to impose an intermediate enforcement level in order not to raise too much local opposition to an outside firm exploiting the resource, at the cost of lower rents.

8. The redistribution of rents from privatization

Assume that, following privatization, the community gets a share τ of resource rents π by selling the resource and/or taxing the owner. Due to transaction costs, tax distortions, bureaucratic inefficiencies, or corruption, this share τ is less than one. In an economy characterized by a high capacity to raise taxes and redistribute the proceeds, and a low level of corruption, the share τ can be large. Otherwise, τ is small, as the proceeds from privatization are retained by corrupt officials or because the state's administration is simply too weak to effectively collect taxes. Parameter τ

[17] This argument assumes no redistribution of rents among the villagers.

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can thus be interpreted as a proxy to a state's capacity to effectively raise taxes and redistribute its proceeds.[18]

A privatization of the resource will also drain additional resources from the community, since it must now enforce its agreement to privatize the resource. Suppose that the share of rents collected, $\tau\pi$, outweighs this additional enforcement cost so that a net gain, $\delta(\tau,\pi) > 0$, can be redistributed among the community. Take the simple case where $\delta(\tau,\pi)$ is distributed equally through a uniform lump-sum transfer or the provision of a public good. Each individual's net gain or loss is shifted upward by $\delta(\tau,\pi)/N$ in figure 3.

The figure suggests that those who stand to lose the most from the privatization of the resource are still the intermediate wealth individuals. Moreover, the poorest and wealthiest individuals in the local community will likely form a coalition in favor the privatization, while the intermediate wealth individuals might oppose it.

Suppose now that the authorities would like to increase the acceptability of the privatization process and are somehow able, through a redistribution scheme, to target individuals with certain wealth characteristics. Figure 3 reveals that intermediate wealth individuals would be targeted first. Indeed, wealthy individuals, namely those labelled by $c \in \left[c^{fa}, \bar{c}\right]$, are indifferent between free access and private property and can be convinced by receiving any small positive transfer. The poorest individuals already gain. By directing the higher share of the rent to intermediate wealth agents, that is those with $c \in [\hat{c}, c^{fa}]$, their losses can be mitigated or eventually turned into a gain from privatization. We could find parameter values for which unanimity on privatization would be achieved. It would be the case in a country characterized by a high enough τ. This suggests that natural resources should be easier to privatize in less corrupt economies, or at least in those with a higher state capacity to raise taxes and redistribute the proceeds by targeting intermediate wealth individuals.[19]

It is unfortunately too often unrealistic to suppose that a less-developed country can devise a direct redistribution scheme that can effectively target the intermediate wealth classes. However, it can be – and often is – done indirectly. Government programs for micro-credit provision provide an example. Its benefactors are more likely to be the intermediate wealth agents (see Aghion and Bolton, 1997).[20] This renders privatization more acceptable to the community. The public provision of

[18] Klooster (2000b) and Ribot (1998) both report on the fact that a significant part of the rents from the exploitation of the forest are not returned to villagers as they are captured by the village chiefs. In Casson and Obidzinski (2002), the rent is captured by central government elites and key military figures to the detriment of local communities.

[19] The above argument assumes, for simplicity, that the average product of the resource increases after privatization. If it were not the case, a similar argument could be made except for the fact that the poorest individuals would need to be compensated also, though at a lower rate than the intermediate wealth ones.

[20] Note that by borrowing money, those same individuals gain access to higher outside opportunity, which has the additional benefit of lowering their incentives

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secondary-level education constitutes certainly another way of targeting intermediate wealth households.

9. Discussion and conclusion

In this study, we have argued that with imperfect enforcement, the welfare impact of resource privatization may depend on individual wealth. More precisely, we have shown that in comparison to a free-access regime, private exploitation with partial enforcement may hit the 'moderately' poor harder than the poorest individuals. It can even be the case that the poorest favor privatization, even though it turns them into illegal exploiters of the resource who face a probability of being caught and punished. The reason is that if, by limiting access, privatization improves the productivity of the resource, this gain will be felt equally by all those who continue to access the resource. But the punishment effect will not be spread equally, as individuals with higher wealth may receive greater punishment than poorer ones.

An implication of the above result is that when there are no other means of redistributing income, the leaders of a community, if concerned about their political survival, may prefer softer enforcement, knowing that it may benefit the poorest individuals – or hurt them less. As a result, we argue that there must exist an intermediate enforcement level which maximizes the number of those who gain from privatization. Note that softer enforcement is done at the cost of lower rents for the private exploiter of the resource, which may translate into less kickbacks for the leaders of the community, be it in the form of royalties or bribes.

Another implication is that if some of the rents from a privatization of the resource do find their way back to the community, a 'politically sound' strategy would be to redirect more of it to the moderately poor, not the poorest.

The above results have various empirical implications. First, those who illegally extract the resource are the poorest, that is the people with the lowest outside opportunities. Illegal extraction should thus increase during economic crises, conflicts, and political instability, that is when revenues from legal economic activities shrink compared with the expected benefit of illegal extraction. Second, the authorities in charge of the enforcement of property rights tolerate some illegal extraction when they are concerned by the social acceptability of their decisions. Such tolerance would be more likely among weak governments in need of more support from the local communities. Some of the case studies presented in section 2 appear to corroborate those results. The role played by a community's perceptions as to who is the legitimate owner of the resource in determining both the enforcement level and the supply of illegal extraction constitutes another interesting avenue of investigations.

Probably the boldest proposition concerns the fact that the poorest individuals would favor privatization, even though it turns them into illegal extractors. Empirically, this is a difficult one to measure directly, because

to encroach on the resource. This should benefit both the owners of the resource and the rest of the encroachers.

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it requires people to admit to engaging in illegal behavior and benefiting from it. We would surmise, however, that such an occurrence would be more likely in the case of severely over-exploited resources with free access. We may think of an indirect way to measure such an effect through the voting behavior of individuals. This question is also linked to the issue of whether the resource is better managed following privatization. We have not found any strong evidence either way.

It goes without saying that the effects of privatization considered here are of interest only if the authorities cannot effectively redistribute income by properly targeting the most needy. They are thus mostly relevant in a setting where the state is too weak or rudimentary. Otherwise, such a redistribution scheme would not be desirable since it is made at the cost of a less-efficient resource usage. With a well-developed state apparatus, strong enforcement with taxation of the rents earmarked for redistribution would certainly be superior. We would therefore expect such an instrument of redistribution to be used more frequently in less-developed countries. Whether this is so constitutes an empirical question which may deserve more attention.

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Appendix: The effect of varying the enforcement level

A.1 The effect on the average product of the resource

Let x^p be the equilibrium total input on the resource, that is $x^p = bl^p + NG(c^p(l^p))$, where l^p is determined by condition (6). We have

$$\frac{\partial x^p}{\partial \lambda\gamma} = \frac{\partial x^p}{\partial l}\frac{\partial l^p}{\partial \lambda\gamma} \tag{A1}$$

where

$$\frac{\partial x^p}{\partial l} = b + \frac{\partial}{\partial l}NG(c^p(l)) \geq 0 \tag{A2}$$

The last inequality stems from (7).

The implicit relation between l^p and $\lambda\gamma$ is given by first-order condition (6). Assuming that the second-order condition for a maximum holds, we

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can verify that $\partial l^p/\partial\lambda\gamma \leq 0$. Hence, $\partial x^p/\partial\lambda\gamma < 0$. Since the average product is strictly decreasing with total input, a more severe enforcement level necessarily results in an increase in the resource's average product.

A.2 The effect on the number of encroachers

From the implicit relation in (4), it can be verified that $\partial c^p/\partial\lambda\gamma < 0$ and $\partial c^p/\partial l < 0$. Since, as mentioned above, $\partial l^p/\partial\lambda\gamma \leq 0$, the total derivative of c^p with respect to an increase in the enforcement level is ambiguous.

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