Commons as Insurance and the Welfare Impact of Privatization

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Abstract

It is shown here that despite the efficiency gains from privatization, when markets are incomplete, all individuals may be made worse off by privatization, even when the resource is equitably privatized. Such market incompleteness is common in the developing world and can explain the often encountered resistance to efficiency enhancing privatizing reforms, especially in the case of village level landholdings and forests. The advantage of commonly held property arises because of its superior insurance properties (which tend to provide income maintenance in low states). Sufficient conditions are established under which any feasible insurance scheme under private property cannot ex ante Pareto dominate allocations under the commons.

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1. Introduction

This paper provides the first formal comparison between the insurance properties of common property resources (CPR), and the insurance that could arise when these resources are privatized. The undeniable efficiency gains accompanying privatization suggest that privatization will yield outcomes dominating the commons when markets are complete. But, in a second best world, the commons may also have important insurance providing properties which have not yet received full attention and which are the focus here. It is shown that when these insurance properties are explicitly analyzed, conditions exist under which privatization of commons makes all individuals no better, and perhaps worse off, than they were under common property.

In many circumstances, resources that are openly accessible to all community members provide an asset of last resort drawn on to stave off situations of extreme hardship and need. In the developing world, the form of commons most usually providing such a service is land, and the next section briefly surveys empirical work documenting this role for land. The insurance providing role of a commonly held, as opposed to a privately owned, asset is its unique form of resource rent allocation. When a resource, such as land, is privately owned, the competitive allocation ensures that labour receives recompense for its marginal contribution, but the land owner also obtains income purely from ownership. There is no necessary link between labour allocations to the resource and the allocation of resource rents. This contrasts with a commons, where no one owns the resource, and individuals are free to utilize it for personal gain. Those working it receive not only a return on their labour, but also an imputed form of resource rent, and importantly, the amount of rent they obtain is directly proportional to their labour contribution. Individuals who do not allocate labour to the resource receive no resource rent. The insurance providing advantage of the commons follows directly from this linking of resource rents to labour allocations. Those in most need, i.e., those with relatively poor outside earnings chances who allocate relatively high effort to gathering resources from the commons, obtain a relatively high share of the resource rent. In contrast, those with good outside earnings opportunities obtain none of the resource rent, since their labour time is more valuably applied off the resource.

An additionally important feature of the commons, which is essential for it to provide insurance in this way, is that, across individuals, the productivity of labour allocated to the commons, is relatively homogeneous in comparison with productivity outside. The most usual form of

livelihood provided by commonly held land is foraging for fruit and vegetables, trapping, firewood, timber products and building materials such as vines and rope, it also sometimes provides pasture. Access to wild food sources, in particular, plays a critical role in times of need. Individual returns to such activities vary little in comparison with their variations in outside earnings - be that working on own land, or in a formal labour market. This is because access to gainful employment outside the commons, and its terms, depends on private land holdings, education, experience and sometimes informal connections, all of which are unlikely to be correlated with returns to labour on the common. This allows the commons to provide a fall-back form of employment in cases where labour cannot find profitable employ elsewhere. Once again, the evidence we present in the next section corroborates this "employer of last resort" type feature of commonly held land in LDCs, and its low correlation with productivity elsewhere.

The problems that arise from common ownership of a resource, and the efficiency advantages of privatization are, by now, well known to all economists. But the insurance rationale for commons that we highlight here helps to make sense of the often-encountered resistance to land reform programs in third world countries that seek to institute private property regimes. Although privatization is a solution to Hardin's (1968) "Tragedy of the Commons" problem, even where the difficulty of assigning such private rights is overcome, the distributional consequences of privatization may be undesirable. Weitzmann (1974) has shown that returns to homogeneous labour supplied to a commonly owned resource always exceed returns on a privatized resource, so that labour is made worse off after privatization, if it does not also receive an ownership share.

However De Meza and Gould (1985, 1987) show that even without a share of rents, returns to labour may possibly rise if complementary inputs to labour are also variably supplied to the resource. The same authors also suggest that, in general equilibrium, as the output produced on the common will fall after privatization, its price will rise and hence the marginal product of labour and the real wage may also rise with privatization. More recently, Brito, Intriligator and Sheshinski (1997) show that, where labour supplied to the resource is not uniformly productive, and there exists a sufficiently rich set of tax instruments for the owner, labour returns will again rise. One may be tempted to conclude then that Pareto improving privatization may be possible even when the resource is not equally allocated.

But the historical record features many instances of privatization which have not been beneficial to all members of the population. This is especially true when they involve an unequal

allocation of property rights, as discussed in Cohen and Weitzman (1975), Humphries (1990) and Karanth (1992). The argument that will be made here, however, goes further than highlighting the dangers of inequitable privatization. It is argued here that even when privatization is done equitably, the loss of insurance providing features of the commons can also serve to make community members worse off. After the main results are established we will discuss an instance of such equitable privatization which seems to correspond to such welfare losses (at least for the poor) because of this loss of insurance provision.

We are not the first to point out that commons serve important insurance providing functions which are lost with privatization. As Bromley and Chavas (1989, p. 730) suggest, non-exclusive property rights can "be seen as an integral part of risk sharing strategies....the absence of a right to exclude someone desperately in need of the means of life means that risks are more effectively pooled." In a similar vein, Dasgupta and Maler (1991, p.19) argue that local commons " ....provide the rural poor with partial protection in times of unusual economic stress. For landless people, they may be the only non-human asset at their disposal."

However, such insurance arguments implicitly discount the possibility that, with privatization, other institutions may emerge to provide similar consumption insurance. In fact, if markets are complete, outcomes under privatization dominate those under the commons. But in an LDC context, where the question of privatizing common property resources most often arises, markets, especially for insurance, are typically not complete. The aim of this paper is to evaluate these informal arguments based on insurance in a rigorous framework where the reason for market incompleteness is explicitly modeled. Explicitly modeling the source of incompleteness allows us to examine the insurance outcomes that arise in lieu of common property, when the privatization occurs, and compare the outcomes in the two cases.[1]

We consider two contrasting sources of incompleteness, one of which arises out of informational asymmetries and the other out of limited enforcement. In the first situation, we suppose that individuals only have private productivity information, but that contracts conditioned on commonly known events can be fully enforced. The second type of economy we consider has less advanced institutions of enforcement (e.g. the absence of courts) but no information asymmetries

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[1]The framework we use to explore the insurance providing properties of commons is similar to that used by Brito, Intrilligator and Sheshinski (1997). However, they assume that productivity on the resource is correlated with labour allocated off it, thereby shutting down the commons' potential insurance role. They also do not consider the role of market incompleteness which is central here. We discuss the distinction further when setting up the model.

amongst the contracting parties. This second type corresponds to a traditional community with widely shared information about individuals but where there is unlikely to exist a formal enforcement mechanism, such as courts, to compel compliance with the terms of contracts ex post. Both types of contracting incompleteness capture important elements of the real world environment in LDCs.

In the presence of such contracting limitations, and a full tragedy of the commons, we show that if individuals face independently distributed risks and are sufficiently risk averse, privatization of the common property resource, even when perfect, costless and equitable, can reduce welfare. We explicitly derive the conditions for this. In the first case, when enforcement is good but there is private information, this is more likely to occur the higher the income derived from the use of the common property, and the lower the labour earning potential of the adversely affected agents. In the second case, where communities have good information but poor enforcement, this is more likely to occur the lower the efficiency gains from privatization and the lower the relatively productive agents' opportunity costs from working the resource. Thus, under these conditions, we demonstrate that common property has desirable consumption insurance features, that these features are not present under private property, and that they cannot be replicated by the establishment of a private insurance market under equivalent informational assumptions.

The paper proceeds as follows: Section 2 briefly surveys studies examining the insurance role played by commons, land in particular, in LDCs. Section 3 develops the model which compares income under private property versus the commons whilst temporarily abstracting from the problem of income uncertainty. Section 4 compares the income allocations: in 4.1, where there is no insurance under private property; in 4.2, where there is perfect ex post enforcement but ex ante insurance contracts can only be conditioned on observable labour allocations; and in 4.3, where there is full communal information, but transfer schemes are limited to being self-enforcing. Section 5 discusses the results in light of further empirical studies of commons and the final section concludes.

2. The Insurance Providing Role of Commons

There are numerous case studies which have examined, usually informally, the insurance providing role of common property resources. The type of resource generally emphasized is commonly held lands and forests, though some authors have argued that fisheries play a similar role. Agarwal

4

(1991), in her study of tribal groups in rural Bihar, contended that communally held forests provided the only means of survival for poorer members in lean seasons. Humphries (1990) in her study of eighteenth century British enclosures, found that access to the commons had a significant impact on a poor family's budget. She computed that fuel wood collection on the commons, when idle, amounted to savings in the order of between 5 and 15% of the household's annual budget. Their contribution as informal security mechanisms in times of economic distress has been documented by Hayami and Kikuchi (1981), Hayami (1981), Jodha (1986), McKean (1986), Das Gupta (1987), Agarwal (1991), Dasgupta and Maler (1991), Beck (1994) and Baland and Platteau (1996) amongst others.[2] Moreover, even though the extent of the market in LDCs is at unprecedented levels, commons are not restricted to isolated environments. For example, Chopra, Kadekodi and Murty (1990) estimate that in the less developed dry tropical regions of India, CPR lands may range from 10-20% of the geographical area. In these areas CPRs are a vital source of food items for the poorest households and the almost exclusive source of fuel, fodder and fibre for the very poor.

More formal studies have used survey data to estimate the significance of resources derived from commons and to investigate their insurance properties. The first such formal study seems to have been Jodha's (1986) study of ICRISAT data in rural India. He found that the inclusion of CPR income in total household income reduced the extent of rural income inequality, as indicated by lower values of the Gini coefficient. Across regions, Das Gupta (1987) showed how collection of products from local CPRs, again in India, was substantially higher in low labour productivity regions.

Newer data sets have also allowed detailed investigation of commons' roles in other parts of the world. A recent study by Pattanayak and Sills (2001) in the Tapajos region of Brazil systematically measured forest collection trips and the impact on these of both the riskiness of the principal plot cultivated and shocks to production. They found that non-timber forest products played a large role in providing this insurance. In the forest which covers 600,000 hectares in the middle of the Amazon, villagers obtained vines, honey, sap, brazil nuts, fruit, bark and rubber from unrestricted access. Risk to production outside the forest seemed weakly or totally

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[2]Among pastoralists a distinct form of insurance through common property has been suggested, that is, the ability to graze stock over wide ranges allows smoothing of time varying heterogeneity in rainfall or land quality that would not be possible with fixed plots, see Gilles and Jamtgaard (1981), van den Breemer, Drijver and Venema (1995), Wilson and Thomson (1993), Nugent and Sanchez (1998). This type of insurance will not be considered here.

uncorrelated with productivity in the forest, suggesting a possible insurance role, these were: seasonal flooding, unpredictable and variable soil quality, pests, crop diseases, illnesses, changing game and fish populations, prices and uncertainty over public policies and land tenure p.595. This role was confirmed in two ways. Firstly, the poor did access the forests more intensively. Secondly the formal analysis showed that any given individual was more likely to visit the forest if they either had a more risky crop, or if they experienced a negative shock (i.e., positive and significant coefficients were found on variables measuring risk and shocks in explaining the number of forest visits).

Godoy et. al. (2000) directly measured the consumption patterns of rain forest products by an indigenous population and its value in local markets in Eastern Honduras. They found that although the rainforest provided a low annual flow value, in consumption or cash income, it was important as a form of insurance, especially when there were unexpected losses. "At those times the forest may gain prominence as a safety cushion, allowing people to smooth consumption."p.63.

In what seems to have been the first panel study of forest use, Cavendish (2000) investigated use of environmental resources in Zimbabwe in the mid 90's. He again found that the poor obtained a significantly higher proportion of their income from environmental sources. A similar finding was reported in Wunder (2001) for Indonesia. Natural forests there were found to serve as safety nets for the rural poor with access rights that were often fully open, and completely informal.

All of these studies, which cover numerous regions in the developing world, suggest the intensive use of common property, in particular land, made by those that are relatively poor. Additionally, many of them suggest an important insurance role is played. We now turn to a formal analysis of this role, and an investigation of how it is affected by privatization of the commons. After the main results are established, we return to case studies which have examined the impact of a form of privatization in particular instances.

3. The Model

In this section we show that, without insurance, even completely equitable privatization may make some individuals strictly worse off. We construct the common property resource (CPR) and privatization outcomes as two polar cases. In the first case of commons production, there is assumed to be unlimited access to the CPR so that the tragedy of the commons drives down

labour returns to their average product.[3] This is contrasted with an equitable allocation of ownership rights over the CPR, the most favorable case of privatization, in which efficiency in allocation of labour is achieved by equating labour's marginal product with its opportunity cost. By considering the most favorable case of privatization and the least efficient production process on the commons we bias the model's results in favour of privatization. We return to this point subsequently.[4]

3.1. Commons

Consider an economy with measure 1 of agents, each of whom is endowed with one unit of labour. Each agent i can allocate labour to a private project, with returns θ_i, or work on the commons. Returns to labour on the private project, θ_i, are continuously distributed over $[0, \infty)$, by the density $f(\theta)$. Let R denote the fixed amount of CPR and L aggregate labour used on the commons. We assume that all labour allocated to the commons is equivalently productive and receives the average product, $\frac{Y(R,L)}{L}$, where the commons' production function, $Y(R,L)$, is homogeneous of degree 1, strictly increasing and concave in L, ($Y_L(R,L) > 0$, and $Y_{LL}(R,L) < 0$) and continuously differentiable. The assumption that all labour is equally productive on the CPR is the main point of contrast between our approach and that of Brito, Intriligator and Sheshinski (1997), and arises because of our focus, motivated by the empirical evidence on the insurance potential of the commons. In our framework, insurance from access to the commons arises precisely because individuals with low outside options work on it instead of working outside. In their framework, individuals with low outside options are also relatively unproductive on the common, so that free access to the common allows no possibility for insurance. Our situation is most likely to arise in the case of commonly owned lands. Individuals within a village may vary greatly in the marketable skills at their disposal, but their capacity to ensure a living in times of hardship by foraging from village level common lands is unlikely to vary as much. Thus, the common's insurance properties arise because the externally unproductive agents desire, and are able to, work the resource more intensively.

A commons equilibrium is an allocation of labour to the CPR, $L^c : \frac{Y(R,L^c)}{L^c} = \theta^c$ with

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[3] As will be discussed, the case of regulated access to the CPR strengthens the relative advantages of CPR by limiting the "Tragedy of the Commons" and can also be used as a form of informal insurance for collective members.

[4] It may be suggested that a more equitable form of privatization would be, where possible, for the privatizing agency to allocate resource shares based on ex post labour allocations. It will be seen that this is a special case of the type of redistribution considered in Section 4.2.

$\int_0^{\theta^c} f(\theta) \, d\theta = L^c$. With such an allocation, all agents i, for whom $\theta_i \leq \theta^c$, work on the commons and receive $\frac{Y(R,L^c)}{L^c}$, all agents with $\theta_i > \frac{Y(R,L^c)}{L^c}$ work on private projects receiving payment θ_i. For simplicity, we restrict the analysis to ensure interior solutions; i.e., the distribution of θ is such that $L^c > 0$.[5] Concavity of $Y(\cdot)$ in L ensures that the equilibrium allocation, L^c, is unique.

Equilibrium allocations on the commons therefore imply that those individuals with poorest external opportunities obtain a larger proportion of rents generated by the resource. This form of income targeting to the poor corresponds precisely with the observations in the field that we surveyed in Section 2.

3.2. Private Property

In the case of private property we assume that property rights on the former CPR are equally distributed among all members of the population, so that each agent receives parcel R of the commons.[6] Privatization thus creates a competitive labour market in which, as a worker, each agent, i, chooses between allocating labour to one's own external project with return θ_i, or working at the equilibrium wage, w, on the newly privatized resource. As a property owner, each agent hires labour up to the point where its marginal product equals w. As a result, labour is allocated to each parcel such that the marginal product of labour is equalized across all parcels; $w = Y_L(R,L)$ (since $Y(\cdot)$ is homogeneous of degree one).

An equilibrium is an allocation of workers $L^P : Y_L(R,L^P) = \theta^P$ with $\int_0^{\theta^p} f(\theta) \, d\theta = L^p$. All agents i, with $\theta_i \leq \theta^P$, are allocated to privatized parcels and earn the equilibrium wage $w = Y_L(R,L^P)$. Those with $\theta_j > Y_L(R,L^P)$ allocate labour to their individual projects and receive θ_j. Since each individual is also a property owner, each receives rent:

$$\left[Y\left(R,L^P\right) - Y_L\left(R,L^P\right) L^P \right]. \tag{3.1}$$

Note that rents are distributed evenly across all agents in the economy, a process which we refer to as 'equitable' privatization. As is the case above, we restrict attention to interior equilibria which, from strict concavity, will again be unique in L^P.

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[5] For example, a sufficient condition for this is: $\exists \theta' : \frac{F(R,L')}{L'} > \theta'$ with $\int_0^{\theta'} f(\theta) \, d\theta = L'$.

[6] If private property rights could be proportionately allocated in favour of the poor, the process of privatization could, itself, be an instrument of redistribution. Such a reallocation depends upon information about individual types which is not generally observable to the privatizing agency. Alternatively, the privatizing agency could attempt to allocate private property shares proportionately to labour allocations on the resource. It will be seen that this is identical to the case that we analyze in Section 3.3.

3.3. Income under the two regimes

We first note that returns to labour under CPR are necessarily higher than the wage under private property. This follows since, on the commons, as labour payments are made at the average product, there is an inefficient over-allocation of labour (tragedy of the commons). Private holders thus demand less labour and extract a rent from their parcel. Since demand is lower in the private case, and labour supply is (weakly) upward sloping, the wage rate falls. This has already been demonstrated by Weitzman (1974):

Lemma 3.1. *(Weitzman (1974)) In equilibrium, returns to labour under private property are lower than under the commons:* $\frac{Y(R,L^c)}{L^c} \geq Y_L(R, L^p)$ *.*

But, we are interested in the case of equitable privatization, where all agents receive an equal share of the resource. Thus, wage income of all agents is now supplemented by an equal share of rents on the resource. Let us denote the income of individuals under private property by $z^p(\theta)$:

$$z^p(\theta) = \begin{cases} Y_L(R, L^p) + [Y(R, L^p) - Y_L(R, L^p) L^p] \text{ for } \theta \leq \theta^p \\ \theta + [Y(R, L^p) - Y_L(R, L^p) L^p] \text{ for } \theta > \theta^p \end{cases}, \tag{3.2}$$

which comprises the wage rate and the rent. On the commons, denote income by $z^c(\theta)$:

$$z^c(\theta) = \begin{cases} \frac{Y(R,L^c)}{L^c} \text{ for } \theta \leq \theta^c \\ \theta \text{ for } \theta > \theta^c \end{cases}, \tag{3.3}$$

It does not follow immediately now that some individuals will be made worse off by privatization, but comparison of the two expressions implies the following:

Proposition 3.2. *There always exists a distribution of θ such that a positive measure of agents have lower income under equitable private property than CPR: $z^c(\theta) > z^p(\theta)$. For any θ' such that $z^c(\theta') > z^p(\theta')$, $z^c(\theta) > z^p(\theta) \ \forall \theta < \theta'$.*
Proof: see appendix.

For any production function, there always exists a distribution of outside earning opportunities such that some, but not all agents, work on the privatized resource. Earnings of those individuals working on the resource will fall under privatization if the amount of labour applied to the resource is relatively unchanged by privatization. Since the efficiency gain from privatization comes from solving the tragedy of the commons and reducing labour allocations, small reductions imply only small efficiency gains. If this occurs, privatization entails a redistribution of rents from those

9

working on the resource to the other agents, making the low θ individuals worse off. In fact, the income of low θ individuals under private property can be directly related to the amount of labour working on the resource:

Proposition 3.3. *For given $Y(\cdot)$ and L^c, the income of low θ individuals under private property is monotonically decreasing in L^p.*

Proof: The derivative of equation (3.2) with respect to L^p is:

$$\frac{dz^p(\theta)}{dL^p} = Y_{LL}(R, L^p)(1 - L^p) < 0. \blacksquare$$

Clearly, there are distributions for which equitable privatization involves income gains for all agents. As follows from Proposition 3.3, this occurs when labour allocated to the resource is much lower under private property, i.e., when efficiency gains from privatization are great. It should also be noted that the income gains from privatization are always monotonically non decreasing with θ. This is because rents are equally distributed but labour applied to the commons is decreasing in θ, so that losses in labour income with privatization are higher for lower θ.

The very stylized nature of the model allows a number of alternative interpretations. For instance, heterogeneity could have been defined over consumption needs instead of productivity. In this interpretation, θ denotes the inverse of individuals' marginal utility of consumption, and analogous equilibria obtain under the two regimes. Alternatively, one could interpret θ as reflecting productivity differences on private land, e.g., owing to quality differentials in land, with each agent deciding on the allocation of his own labour between the commons and his own fields. Agents with low productivity land will tend to work more on the commons. Whichever interpretation is favoured the results we present will persist provided returns on the CPR are uncorrelated with the $\theta_i s$.

4. Insurance properties of the two regimes

We now turn to the paper's main focus, which is analysis of the CPR's insurance properties. To do this we reinterpret the static model above in a stochastic framework. Now suppose that, ex ante, all agents in the economy are identical but face idiosyncratic and independently distributed random shocks in external income earning opportunities. All notation from the previous section is identical, but we now interpret θ for each individual as that person's draw from the aggregate

distribution $f(\theta)$. Thus, ex ante, each individual is identical and knows only the distribution from which their realization of θ will be drawn. Ex post, each individual knows their own value of θ.

4.1. Ex ante welfare without private insurance

Consider the welfare of a representative agent from such a population under the two different regimes; commons and private property. Proposition 3.2 shows that agents with low realizations of θ may have lower income in an equitably privatized commons than under CPR.

In such situations, where the low θ agents are worse off under private property, there is a trade-off between the insurance properties of the commons and the efficiency gains of private property (which increases expected income). For sufficiently risk averse individuals, welfare falls with privatization. Of course, when income of the low types rises with privatization, private property will always be Pareto preferred.

This supposed trade-off between insurance and efficiency properties of the two regimes thus far assumes no chance for insurance under privatization. The next two sections will show that, even with insurance, the poor may have lower incomes after privatization. The implication will then be that, for sufficiently high risk aversion, ex ante welfare also falls with privatization.

4.2. Privatization with insurance: asymmetric information and full enforcement

When ex ante welfare falls with privatization in the absence of private insurance, it is not immediately clear why a form of private insurance institution would not arise in lieu of the CPR, upon privatization, to protect income in low states. For example, with complete insurance markets, this could be ensured by binding contracts written ex ante that require individuals with high realizations of θ (the rich) to make equalizing transfers to those with low θ realizations (the poor). Since expected income is higher under privatization than under the commons, it is clear that with sufficiently good state (θ) contingent contracting, the privatized outcome would always dominate the commons.

In this section and the next we pursue two alternative, and more realistic descriptions of insurance possibilities. Here we assume that an agent's θ realization is not known by other members of the community. However, actual individual labour allocations are observable, and contracts can be made contingent on those allocations and enforced. Individuals are thus able

to insure each other by writing contracts, ex ante, which condition ex post transfers on the observables. This is a relatively well organized insurance framework for an LDC. In the next section we consider a more informal framework where individuals share good information about each other, but where there is no formal enforcement of contracts.

We thus look for the existence of a scheme making the low types at least as well off, ex post, as they were under the commons. If such a scheme exists, then, ex ante, all individuals are better off. If not, then with sufficiently high risk aversion, all individuals are worse off. Note that analysis of such schemes is equivalent to assuming the existence of a tax and transfer system which attempts to affect an ex post redistribution from the rich to the poor, by conditioning transfers based on labour allocations. This follows because either system attempts a transfer that is contingent upon an observable that is chosen by individuals and not θ. In what follows, we thus refer equivalently to a private insurance scheme and a tax and transfer scheme.

Since we seek to demonstrate the general impossibility of a private insurance scheme doing better than the commons, it is easiest to do this in the context of a two type example. If it is not possible in this two type world, it will, of course, also not be possible in more complex environments.

Consider a binary distribution of types $f(\theta)$ called low and high, denoted θ_L and θ_H respectively, where $\theta_L < \theta_H$. These occur with frequency L_L and L_H respectively, such that $L_L + L_H = N$, which, as before, is the population size. The production function $Y(\cdot)$, is defined equivalently as before, but we assume that $\theta_L < \frac{Y(L_L)}{L_L} = \theta^c < \theta_H$. This implies that the unique equilibrium under commons would have all of the low type working on the CPR and all of the high type working outside. Since there are only two types in the population without loss of generality we consider a transfer scheme under private property taking on two values, T_L and T_H, which, subject to incentive compatibility, will target the low and high types respectively. Under the scheme, denote the labour allocations to the resource by an individual of each type by l_L and l_H respectively. For the θ_L types to be as well off under the scheme, as before, it is necessary that:

$$\theta_L (1 - l_L) + T_L \geq \theta^c. \tag{4.1}$$

The incentive compatibility constraint for the high types is:

$$\theta_H (1 - l_L) + T_L \leq \theta_H (1 - l_H) + T_H, \tag{4.2}$$

where $T_H = \frac{Y(\widehat{L}) - L_L T_L}{L_H}$ and $\widehat{L} = L_L l_L + L_H l_H$. Note that for there to exist efficiency gains from privatization it is necessary that $\widehat{L} \leq L_L$. We now show that the incentive compatibility constraint cannot generally hold while ensuring that the low types are weakly better off:

Proposition 4.1. *When θ is not contractible, there always exists a distribution, $f(\theta)$, under which privatization, coupled with any tax and transfer scheme that conditions transfers on observables, does not yield a Pareto improvement, i.e., conditions (4.1) and (4.2) cannot both hold. This is more likely to occur when high type agents are substantially more productive than low type agents, and when their incomes under privatization are close to the incomes of poor agents under the commons.*

Proof: see appendix.

It is worth reiterating the precise comparison here. On the one hand, there is completely unregulated common property, with a full tragedy of the commons. On the other, we have a privatizing agency with both the ability to decide the aggregate allocation of labour on the privatized resource, and the authority to tax individuals without limit. In designing the insurance scheme under privatization, the allocation of labour to the resource could be chosen to be efficient, if this aids in providing insurance, but, as long as it is feasible, it is not limited to being so. Recall also that we have not allowed any possibility for individuals to opt out of the transfer scheme ex post. Under the conditions stated in the proposition, however, it is not possible to do better than the common property allocation in maintaining the incomes of the poor. An immediate implication of this proposition is that, with sufficient risk aversion, ex ante welfare cannot rise with privatization.

The intuition for this result can be seen with a simple example. Suppose that, under the commons, the only people working on the commons are poorly endowed agents. Suppose also that the income they earn on the commons is almost the same as the income earned by the richer agents in the economy working outside. This is, thus, a highly equitable income distribution under common property. Now, suppose that a more efficient allocation of labour to the commons requires reducing the labour input to the commons of the poorly endowed agents. Since their outside opportunities are low, to prevent a fall in their income, they must be given a large transfer from the better-endowed agents. Given the size of the transfer required, however, the latter may then find it in their interests to mimic the poor. Mimicking the poor is all the more interesting to

the rich the closer the income of those working on the common property to the rich's pre-transfer earnings, and the lower the outside earning opportunities of the poor. Since both of these factors necessitate a larger transfer to maintain the poor's income. But, in order for the scheme to be feasible, mimicry must be ruled out so that the size of the transfer satisfying this may not be large enough to make the poor as well off as they were under the CPR.

The proposition above has also an important corollary: if privatization entails some cost, no matter how small, common property strictly Pareto dominates private property under the conditions in Proposition 3.1.

It is also worth noting that the form of tax and transfer scheme considered here is formally equivalent to a scheme in which the privatizing authority attempts to allocate land holdings (and therefore rents) to those working the land, provided that the authority possesses no informational advantage; that is, land holdings can only be allocated on the basis of observed labour supply decisions. In this interpretation of the model, instead of allocating each individual an equal share of the resource prior to θ realization, the privatizing authority tries to target the poor by allocating ownership shares after private information about θ is revealed to individuals. It bases this targeting on individual labour supply decisions. Thus the privatizing authority, in attempting to preserve the incomes of the poor is, in fact, trying to do better than "equitable" privatization, by allocating resource holdings only to those working the resource. This also does not guarantee a rise in the incomes of the poor.[7]

4.3. Privatization with insurance, full information and limited enforcement

We now analyze the effects of privatization when individuals fully share information about each other but lack formal enforcement institutions. In a sense, this corresponds to a polar opposite case of market incompleteness to the one analyzed in the previous section where enforcement was good but contractible information was limited to observables. Here we have in mind a village based rural community where it is conceivable that each individual's realization of θ may be known to all others in the community but binding contracts conditioning on these θs do not exist.[8]

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[7] Such schemes are also formally equivalent to regulation of the wages and quantity transacted on the labour market; that is, redistribution to the poor by regulating the realized wage above the equilibrium wage, and forcing the well off to purchase a minimal amount of labour. The equivalence follows since there are equal informational constraints and instruments available in both cases.

[8] Even without contingent claims contracts, a perfect capital market, in a setting where individuals face independently distributed shocks through time, would also allow insurance. By borrowing against future expected value,

Even without formal contracting possibilities, there is still the possibility of informal (self-enforcing) contracts to provide consumption insurance. Under such contracts, high type agents have an incentive to transfer income to the low type in order to avoid potential group punishments, which are threatened when opting out of the scheme. We take what may be considered the maximal set of self-enforcing contracts under privatization and assume that, in the privatized economy, there is ex post common knowledge of θ, so that ex ante contracts may specify a payment, $t(\theta)$, that varies by θ realization; thus, there is no self-selection problem here. Furthermore we assume these informal contracts are enforced by maximal ex post pecuniary group punishment. If individuals do not meet their specified state contingent transfer, t, they are excluded from any transaction with other group members; the relevant one being hiring of labour on the private labour market. We refer below to this situation as autarky. The only limit to the extent of group enforcement allowed is that which accords with the very definition of private property rights; individuals retain the inalienable right to use their private property as they desire.[9]

In contrast, on the commons, we take the minimal set of self-enforcing insurance contracts by assuming the complete non-existence of either regulated access or group insurance. That is, we assume, once again, that ex post outcomes equal $z^c(\theta)$, as defined in equation (3.3). As in the previous section, if sufficient conditions can be established under which the commons dominate the privatized outcome in this framework, then these remain sufficient when considering less extreme positions than here, in which informal insurance possibilities on the commons are stronger (as are known to exist, see McKean (1986), Dasgupta and Maler (1991) and Baland and Platteau (1997)) and those on private property are weaker (in particular, where θ is not common information).

Since there do not exist binding contingent contracts, the scheme $\{t(\theta)\}$ must be ex post self-enforcing. In particular, those agents with high realizations of θ must obtain a post-transfer

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and smoothing consumption through the capital market, agents insure against low single period realizations of the stochastic variable. However, this form of insurance is also not realistically available to low income individuals in LDCs, see for example Bromley and Chavas (1989) and Pattanayak and Sills (2001). Notwithstanding this, even with an imperfect capital market, the qualitative features of our model go through.

[9]We also exclude the possibility of non-pecuniary group punishment such as physical violence, as a means of enforcement. Fundamental to the successful implementation of private property is respect for the rule of law. In general, reliance on informal non-pecuniary group punishment like violence is inconsistent with such respect. Note also that we do not analyze the community's capacity to maintain self-enforcing contracts in a repeated framework. In the model's present context where θ denotes external labour productivity, this is not so detrimental, since lifetime variation may not be so great as to invalidate the one-period approach. However, under an alternative interpretation of θ as a consumption shock, a multi-period model would be more appropriate. In such a framework, our qualitative results still go through, however, the capacity to insure under private property is enhanced so that the condition required for private property to dominate is less strict.

income at least as great as that which they could obtain by leaving the scheme. The income they can obtain by deviating from the scheme, and being punished, is the autarky income, which shall be denoted $z^a(\theta)$. It is defined as:

$$z^a(\theta) = \theta + \pi(l(\theta)),$$

where $\pi(l(\theta))$ is the net rent generated by optimally applying one's own labour to one's own resource holding. We thus obtain an ex post participation constraint, which shall be referred to as the autarky constraint:

$$z^p(\theta) + t(\theta) \geq z^a(\theta). \tag{4.3}$$

As in the previous section we are interested in those situations where low θ individuals have lower income under private property, that is, $\exists \theta : z^c(\theta) < z^p(\theta)$ as defined in equations (3.3) and (3.2). Let θ^m denote the type that is just indifferent between privatization and CPR in the absence of a private insurance market. This is given by:

$$\pi(l^p) + \theta^m - z^c(\theta^m) = 0,$$

where $\pi(l^p)$ denotes an individual's profits from the resource, under private property. It follows from Section 3.2, that those types for whom it is always optimal to work on the resource, no matter which regime, constitute the low θ. Under private property, they receive θ^p as labour income. For those types to be made just as well off under private property, with a transfer from the insurance scheme $t(\theta)$, as they were under commons, it is necessary that:

$$t(\theta) \geq -\pi(l^p) - \theta^p + z^c(\theta). \tag{4.4}$$

Similarly there are those that previously worked on the commons and do not work on the privatized resource, but are, nonetheless made worse off by privatization, that is, those $\theta : \theta^p < \theta < \theta^m$. Such types must receive the following payment to be made (weakly) better off under the insurance scheme:

$$t(\theta) \geq -\pi(l^p) - \theta + z^c(\theta). \tag{4.5}$$

We now show that such transfers are not always feasible:

Proposition 4.2. *If the aggregate profit gain to the higher types from hiring labour as opposed to autarky is smaller than the aggregate losses incurred by the low types from privatization, then*

16

there does not exist a feasible insurance scheme which satisfies the autarky constraint, condition (4.3), *and makes the lower types at least as well off under privatization, condition* (4.4).

Proof: see appendix.

The condition stated in the proposition is rather intuitive: to be feasible, the high types should find that the income they secure by working their own share of the privatized commons is lower than their net gain to staying in the insurance scheme. Their net gain to staying in the scheme comprises their profit gain from being able to hire labour, minus the amount they must transfer to the low type individuals to make them at least as well off as they were under common property.

The proposition does not hold when efficiency gains from privatizing the resource are high. When efficiency gains are small, however, privatization largely involves a redistribution of income from the low to the high types. In that case, the aggregate profits of the high types are just equal to the income losses of the low types, so that the insurance scheme must involve an equivalent transfer back from the high to the low. However, since the autarky option increases the high types' income, this will be chosen by them, implying that the self-enforcing insurance scheme under private property fails. In that case, the low types are rendered worse off by privatization, and consequently sufficiently risk averse individuals will also be, ex ante, worse off.

Though this interpretation of the model emphasizes welfare losses to all individuals, this 'ex ante' reasoning requires a type of Rawlsian (pre θ realization) initial state, in which all individuals are equally likely to be poor. In many societies considering privatization of a common, the poor are an already identified, and relatively immobile group. In such cases, the model should be interpreted as identifying conditions under which this group are made worse off by restricted access, even if they receive an equitable share of the gains, and moreover, even if the "best" possible form of insurance arises in lieu of the commons. In the next section we consider two case studies that have reported the impact on the poor of such privatizations.

5. Relation to Observed Privatization Episodes

The two case studies here examine a form of privatization of forests. As the studies in Section 2 suggest, the share of forest income in total household income is significantly higher in landless poor households than in those with access to land. This is also true in rural India and has lead to governments creating rights regimes that favour participating communities. Kumar (2002) studies the effects of such schemes called Joint Forest Management (JFM) in halting forest degradation

17

in rural India. JFM projects are widespread, as of March 31 2001 there were 44,943 official JFM groups protecting over 11.63 million hectares of land, corresponding to 15.5% of India's recorded forest area (Kumar 2002 p.765). Unlike direct privatization or taking over of property by the government, JFM privileges the local community in determination of access to the forest. These correspond closely, at least in principal, to what we call equitable privatization. The community is made the single owner of the resource, with the right to exclude and to charge for admission, benefits and costs are allocated to community members in an equitable manner.

Kumar studies five villages located in the Ranchi district in Jharkhand state (formally part of Bihar). Wood is a key product from the forest but other important products include: oil seeds, edible fruits, staple foods, vegetables, spices, rope, leaf-plates and medicinal plants, p.769. The study proceeds by comparing the extraction rates in villages which have implemented a JFM project with those that have not (denoted NJFM villages).[10] The findings in regard to the purely environmental success of the JFM villages were striking: "Here then is the very substantial good news about jointly managed forests - there is a guaranteed flow of large sized timber into the future, while the forests remain healthy in perpetuity, supplying local ecological and global environmental services." p.772-3. In other words, it would appear that the implementation of joint forest management solved the over-exploitation problem.

The poor, however, bore the brunt of such environmental protection. This would, of course, be expected given their greater stake in its direct use. But, Kumar found that, even when imputing the increased value of the forest stock, the poor were still significantly worse off unless unrealistically large differences in extraction rates between JFM and NJFM forests was assumed. In particular, the landless suffered a loss in net benefits from JFM forests of 45-50%. Moreover, his finding that the poor were worse off applied even though rudiments of informal insurance schemes were observed at the village level. For instance, in the villages analyzed, there existed networks providing free (or highly subsidized) labour from the landless and marginal farmers to the large farmers, in return for "the social capital they need to cope with narrow livelihood opportunities" p.767. Such schemes are similar to the self-enforcing schemes that we analyzed in Section 4.3, in that they involve individuals with relatively good information about each other's conditions, but do not have formal enforcement to ensure compliance. The poor are worse off

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[10]Kumar (2002) did not appear to control for selection across the villages that implemented the schemes. However his familiarity with the subjects - the author was Divisional Forest Officer from 91-94 for the area - may have allowed him to exclude extraneous factors that could have been driving the process.

despite the existence of such schemes because the benefits from their operation are also skewed against them. This is because the scarce outside options the poor face imply that, for them, continued participation is essential. Since this is not the case for large land owners, they extract most of the benefit from such reciprocal arrangements. Consequently the combination of large reductions in the poors' incomes due to restricted access, and the great availability of alternatives for the large land owners, (corresponding to the conditions identified in Proposition 4.2) seem to be conspiring in this case to ensure that the commons dominate even an equitably designed privatization.

Though less directly related, the second study we consider here is the only one we are aware of which comes close to considering the issue of the counterfactual that arises when a commons is privatized. Reddy and Chakravarty (1999) analyse a survey of 233 households undertaken in 1996 to determine forest dependence in the Nainital district at the foothills of the Kumaon Himalayas in Uttar Pradesh, India. Once again, they found the poor to be more intensively using the resource, and estimated that restricting common property access by the poor would significantly worsen their welfare, as in most other analyses of restricted access. Their study's unique contribution, however, was in conducting a simulation exercise to examine the impact on the poor if, accompanying their loss of access, there were also a simultaneous increase in wages. Recall that an increase in wages was similar to a tax and transfer scheme which targeted benefits to the poor, analyzed in Section 4.2. No such increase would occur without such a scheme because privatization generally leads to a reduction in labour demand on the resource. They estimated the effects of a wage increase of 10%, and found that such an increase would not be adequate to compensate for the lost income from the commons. It is not clear from their study whether such a scheme would satisfy the incentive compatibility condition that we defined in Section 4.2, but since it seems to have only marginal impact on the poor, it seems likely that it would. It should be noted, however, that their study did not impute returns to the privatized commons back to the poor so that their calculations overestimated the size of loss. But in any case, this simulation in this case clearly identifies one element of the poors' incomes that would not be adequately recompensed under privatization.

6. Conclusion

Private property certainly has efficiency properties which dominate those of the commons. However since low income individuals tend to favour working common property resources, the commons tend to provide informal (and, of course, self-enforcing) consumption insurance for the very poor. In this paper, we have established sufficient conditions under which this informal insurance property of the commons implies that any feasible insurance scheme under private property, when there is either private information about types, or limits in contract enforcement, cannot dominate allocations under the commons. When it is lack of enforcement that limits private insurance, commons are more likely to dominate when efficiency gains are small. When it is poor information about individual types that limits insurance, it is the existence of large differences in outside opportunities between recipients and financiers that makes this more likely.

Although case studies are now emerging that allow examination of the impact of environmental conservation measures on the poor, there is a need for more systematic data sources which can quantify these changes. Though it is unlikely to be possible to track the precise form of institutional changes arising when insurance on the common is no longer available, panel data which considered household consumption levels and their variance both before and after privatization would allow estimation of such effects.

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7. Appendix

Proof of proposition 3.2

Proof of first part: For any production function, $Y(\cdot, \cdot)$ and R, it is always possible to construct a set of distributions $\aleph = \{f(\theta)\}$ defined by a pair (θ^p, L^p) where $Y_L(R, L^p) = \theta^p$, for which $0 < \int_{\theta^p}^{\infty} f(\theta) d\theta < 1$ and $\int_0^{\theta^p} f(\theta) d\theta = L^p$. Note that there are many distributions in this set since the only restriction on $\theta > \theta^p$ is that $\int_{\theta^p}^{\infty} f(\theta) d\theta < 1$. Define $\widehat{\theta}$ such that $\widehat{\theta} = \frac{Y(R, L^p)}{L^p}$.

22

Since Y is increasing and concave it follows that $\widehat{\theta} > \theta^p$. The proposition necessarily holds for all distributions from the set $\aleph$ satisfying:

$$\int_{\theta^p}^{\widehat{\theta}} f(\theta)\, d\theta = 0.$$

The second part of the proposition follows immediately from (3.2), (3.3) and the definition of an equilibrium. $\blacksquare$

Proof of proposition 4.1

T_H can be re-written as:

$$T_H = \frac{Y(L_L)}{L_L} \cdot \frac{L_L}{L_H} - \frac{L_L}{L_H} \cdot T_L + \frac{Y\left(\widehat{L}\right) - Y(L_L)}{L_H}.$$

Substituting for T_H, a sufficient condition for (4.2) to fail is:

$$\theta_H(1 - l_L) + T_L > \theta_H(1 - l_H) + \frac{Y(L_L)}{L_L} \cdot \frac{L_L}{L_H} - \frac{L_L}{L_H} \cdot T_L + \frac{Y\left(\widehat{L}\right) - Y(L_L)}{L_H}. \qquad (7.1)$$

But since $\frac{Y(L_L)}{L_L} = \theta^c$, from equation (4.1), a sufficient condition for (7.1) to hold is:

$$\theta_H(1 - l_L) - \theta_L(1 - l_L) + \theta^c > \theta_H(1 - l_H) + \theta^c \frac{L_L}{L_H} - \frac{L_L}{L_H}(\theta^c - \theta_L(1 - l_L)) + \frac{Y\left(\widehat{L}\right) - Y(L_L)}{L_H}.$$

Note that this sufficient condition is hardest to satisfy for $l_H = 0$, since $\theta_H l_H - \frac{Y(L_L l_L + L_H l_H)}{L_H}$ is decreasing in l_H when $\theta_H > Y'(\cdot)$. So we impose $l_H = 0$ and consequently that $l_L = \frac{\widehat{L}}{L_L}$. Thus we obtain:

$$-\theta_H l_L > \frac{L_L}{L_H} \theta_L(1 - l_L) - \theta^c + \theta_L(1 - l_L) + \frac{Y(L_L l_L) - Y(L_L)}{L_H}$$

$$\Leftrightarrow \quad (\theta^c - \theta_H) + (1 - l_L)\left(\theta_H - \theta_L - \frac{L_L}{L_H}\theta_L\right) + \frac{Y(L_L) - Y(L_L l_L)}{L_H} > 0. \qquad (7.2)$$

The first term is negative, but can always be made small enough by choosing the appropriate $f(\theta)$. The third term above is always positive and the second term above is positive if $\theta_H > \theta_L + \frac{L_L}{L_H}\theta_L$. Thus for given $f(\theta)$ no scheme will be viable if the outside earning opportunities of the low types is sufficiently much smaller than that of the high types (so that the low types have to receive large compensations). The expression can also be re-expressed as:

$$(\theta^c - \theta_H) + (1 - l_L)\theta_H - (1 - l_L)\theta_L > \frac{Y(L_L l_L) + \theta_L L_L l_L - Y(L_L)}{L_H}.$$

23

The left hand side represents the increase in income a high type who mimics a low type would obtain under the minimal transfer T_L, which, from (4.1), is defined by : $T_L + \theta_H (1 - l_L) = \theta^c - \theta_L (1 - l_L) + \theta_H (1 - l_L)$, while the expression on the right had side represents the gains from increased efficiency on the resource. ∎

Proof of Proposition 4.2

Feasibility implies the following aggregate budget balance condition must be satisfied:

$$\int_0^\infty t_i f(\theta) \, d\theta = 0. \tag{7.3}$$

We restrict attention to the case where $t(\theta^m) = 0$, and where $\theta_i > (<) \theta^m$ make non-negative (non-positive) transfers. It is clear that if the scheme is not feasible for this case, it will also not be feasible for other values of transfers. If each individual autarky constraint is to hold, it is necessary that it holds in aggregate:

$$\int_{\theta^m}^\infty (\pi(l^p) + t(\theta)) f(\theta) \, d\theta \geq \int_{\theta^m}^\infty \pi(l(\theta)) f(\theta) \, d\theta. \tag{7.4}$$

However condition (7.3) implies:

$$\int_{\theta^m}^\infty t(\theta) f(\theta) \, d\theta = - \int_0^{\theta^m} t(\theta) f(\theta) \, d\theta. \tag{7.5}$$

Substituting (7.5) into (7.4) and re-arranging yields:

$$\int_{\theta^m}^\infty \pi(l^p) f(\theta) \, d\theta - \int_0^{\theta^m} t(\theta) f(\theta) \, d\theta \geq \int_{\theta^m}^\infty \pi(l(\theta)) f(\theta) \, d\theta \tag{7.6}$$

as a necessary condition for the autarky condition to hold, and for the scheme's budget to be balanced. Now consider the minimal insurance transfers required to make the poor weakly better off under the insurance scheme than under common property. An aggregate implication of these conditions from equations (4.4) and (4.5) is the following necessary condition:

$$- \int_0^{\theta^m} t(\theta) f(\theta) \, d\theta \leq \int_0^{\theta^p} (-z^c(\theta) + \pi(l^p) + \theta^p) f(\theta) \, d\theta + \int_{\theta^p}^{\theta^m} (-z^c(\theta) + \pi(l^p) + \theta) f(\theta) \, d\theta \tag{7.7}$$

Combining the necessary conditions (7.6) and (7.7) yields the following necessary condition:

$$\int_{\theta^m}^\infty \pi(l^p) f(\theta) \, d\theta + \int_0^{\theta^p} (-z^c(\theta) + \pi(l^p) + \theta^p) f(\theta) \, d\theta +$$
$$\int_{\theta^p}^{\theta^m} (-z^c(\theta) + \pi(l^p) + \theta) f(\theta) \, d\theta$$
$$\geq \int_{\theta^m}^\infty \pi(l(\theta)) f(\theta) \, d\theta. \tag{7.8}$$

If this is violated for the whole population it will also be violated for any sub-set of the population which includes all individuals for whom $\theta \leq \theta^m$ and excludes some positive measure of those for whom $\theta > \theta^m$ since the exclusion of such individuals reduces the right hand side of equation (7.8) by more than the left hand side since $\pi\left(l^p\right) > \pi\left(l\left(\theta\right)\right)$ for all $\theta > \theta^p$. Since this is a necessary condition for the autarky constraint to be satisfied, its converse is sufficient for the autarky condition to fail, and for an insurance scheme which maintains low incomes at their commons level to be unfeasible. This condition can be re-written as:

$$\int_{\theta^m}^{\infty} \left[\pi\left(l^p\right) - \pi\left(l\left(\theta_i\right)\right)\right] f\left(\theta\right) d\theta$$
$$< \int_{0}^{\theta^p} \left(-z^c\left(\theta\right) + \pi\left(l^p\right) + \theta^p\right) f\left(\theta\right) d\theta + \int_{\theta^p}^{\theta^m} \left(-z^c\left(\theta\right) + \pi\left(l^p\right) + \theta\right) f\left(\theta\right) d\theta. \qquad (7.9)$$

The left hand side is the increase in profit to hiring labour, for the rich, and the right hand is the fall in income incurred by the low types after privatization.∎