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Incomplete Markets, Excluded Goods and Natural Resource Management

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Problems in natural resource management arise when markets do not work effectively to resolve the inefficiencies associated with the way resource access rights are currently specified. In most cases, this can be linked to incomplete markets. In order to assess potential management options it is important to consider the characteristics of the good or goods that are in essence, missing from the market. This paper explores a taxonomy of goods and services, based around exclusivity and rivalry, to assist in determining when intervention in the form of regulation, property right solutions or market interventions are suited to deliver an optimal or improved social outcome.

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Introduction

Public policy in natural resource management seeks to increase the return to society from an endowment of physical and biological resources within a political jurisdiction. The need for public intervention arises primarily for two related reasons. The first is when arrangements governing resource access do not provide the greatest return to society. The second is markets do not always work effectively to resolve the inefficiencies associated with the way resource access rights are currently specified and allocated. An understanding of why markets do or do not achieve an efficient allocation of resources is essential to designing better institutional arrangements for managing our natural resources.

Market failure has been attributed to two sources; externalities and collective consumption (Zerbe and McCurdy 1999). Policy instruments designed to address externalities have generally taken three forms: the first two are market intervention in the form of regulation, taxes or subsidies as suggested by Pigou (1932); the creation, abrogation or attenuation of property rights initiated by Coase (1937). Thirdly, collective consumption has given rise to the concept of a public good that has been argued as the motivation for the direct provision of services by governments (Samuelson 1954).

There has been considerable debate regarding the justification for and the effectiveness of these instruments in natural resource management. A number of economists have concluded that this debate has been hampered by terminology. The concept of an externality, public and private property rights and public goods are often used in an ambiguous manner. Randall (1983) argued that abolishing the terms common property and public goods would lead to a considerable gain in clarity. Quiggin (1988) raised the issue that a range of access rights can be defined over what is commonly referred to as common property and these common property rights are important in natural resource management. Anderson (2004) puts forward a view that consideration of externalities simply masks the problems that gave rise to resource misallocation and the term should be removed from the literature. Zerbe and McCurdy (1999) argue that the concept of market failure is of no practical value and that the assessment of the effectiveness of government intervention comes down to a consideration of institutional arrangements and transactions costs.

The extent to which public resource policy can be guided by first principles remains an open question. However, there appears to be general agreement that more precise definition of terms is needed to set out the advantages and disadvantages of alternative policy instruments and avoid overselling simple prescriptions. To this end it can be worthwhile to explore some alternative perspectives on the role of markets in natural

resource management. In this paper, we look at the problem of incomplete markets as introduced by Greenwald and Stiglitz (1986) in the light of the taxonomy of goods proposed by Randall (1983). The motivation for this is straightforward in that the characteristics of the good or goods that complete the market constrain the choice of effective policy instruments. While transactions costs must still play a key role in the evaluation of policy choice, the framework does help to clarify the links between institutional arrangements governing resource access and markets.

Incomplete markets and composite goods

Most problems in the allocation of natural resource can be linked, in one way or another, to incomplete or, in the extreme, missing markets. Incomplete markets occur when a traded commodity is a composite, and one or more of the primary goods that make up that composite are not traded. Such composite commodities arise from three sources. One is jointness in production, for which the classic examples are air and water pollution. A second is jointness in consumption, for example, packaging of consumer goods and the problems associated with waste management. Lastly, composite commodities may also arise when goods are joint in both production and consumption. This is often the case with renewable resources such as fish stocks, where the resource is both a consumptive good and a capital good that propagates the resource.

Markets may be incomplete because of the failure or inability of institutions to cost effectively establish exclusive property rights over the complete composite good or over each of its components. This non-exclusivity leads to a misallocation of resources. Again, drawing on the example of an open access fishery, property rights are not defined over the stream of future returns generated from those fish that are not caught and remain a part of the breeding stock. This can lead to the over exploitation of the resource.

At the same time, a composite good may be made up of primary goods that have both rival and non-rival characteristics. Water volume and quality is an interesting example as it shares characteristics of both a rival and non-rival good. If, for example, saline surface water is diverted for irrigation, it will not immediately affect the salt concentration of water still available to downstream users. In this sense, water quality is non-rival. At the same time, upstream water use can have an impact on the volume of water available for downstream users and this rival characteristic determines the extent to which downstream users are affected by a change in water quality.

The thesis of this paper is that the policy options available to complete a market are largely determined by characteristics of exclusion and rivalry in the missing primary

good or goods. The classification scheme suggested by Randall is central to this argument.

The Randall Taxonomy

It has been common practice to classify goods and resources using a suite of terms such as private goods, public goods, club goods, common property, communal property and property. These terms have often been defined by example as opposed to any intrinsic or optimal characteristics and as a consequence have lost meaning as they have found their way into the policy arena. Randall (1983) argued that the concepts of exclusive and non-exclusiveness and rivalry and non-rivalry represent the characteristics of goods and resources that matter in a public policy context.

Bromley (1991) argues that the term property or access right refers not to a physical object or a natural resource, but to the stream of benefits or costs that are derived from that object or resource. That is, a property right is a financial asset over some or all the net returns from a productive resource. If some of the stream of benefits or costs is non-exclusive and not captured by the holder of the property right, the market for this asset will be incomplete, and the true value of that asset will not be reflected in its price. Even if these non-exclusive benefits or costs can be brought back into the market though an institutional mechanism, there is still the problem of efficiency in pricing the asset if some of the benefits or costs are non-rival.

Randall constructed a classification system based on the concepts of exclusion and rivalry that arranged goods into nine groups based on their exclusivity (non-exclusive, exclusive and hyper-exclusive) and rivalry (non-rival, congestible and rival). Conceptually all these goods can exist, but for the purpose of this paper the concept of a congestible good is only treated briefly. Congestible refers to the situation were a good exhibits non-rival characteristics for up to some limited number of users or level of use. Once this limit is exceeded rivalry sets in and intensifies as the number of users increases. The classic examples of these goods include roads, irrigation delivery channels and national parks.

Here we wish to apply Randall's classification of goods for the purpose of exploring the efficacy of alternative policy instruments in natural resource management. Whether a good is intrinsically non-exclusive or non-rival or whether the transactions costs establishing exclusivity or non-rivalry are prohibitive is not of primary concern, though such are important in the consideration of committing resources to reduce transactions costs. A simple functional definition of an excludable good is one for which the creation

and enforcement of a property right has the capacity to generate a net economic benefit. Along the same lines, we wish to consider policy instruments that can change the rival or non-rival characteristics of good.

It is also important to consider that the characteristics of excludability or rivalry can occur in both consumption and production and this has implications for the design of policy instruments in natural resource management. The benefits of improved air quality are non-rival and given their highly diffuse nature, non-excludable in consumption. Conditions that are not suited to a demand based market solution. However, where emissions into the atmosphere are identifiable and measurable, a number of options exist to change the characteristics of the unwanted good in production. For example, the capping of emissions establishes rivalry and emissions permits are excludable. Given the symmetry imposed by market equilibrium, a policy designed to complete a market in either consumption or production can be effective.

Rival goods

For resources that exhibit both rivalry and excludability the role of government can be limited to defining tradable entitlements to the use of a resource and ensuring that all benefits and costs associated with the use of the resource accrue to the holder of the entitlement. This does not preclude the use of other instruments such as taxes or regulations to address problems where these entitlements are possible to define but do not presently exist. However, governments would not seem to hold any comparative advantage in eliciting the information needed to obtain an efficient allocation of the resource in the absence of a market. While there are advantages of a tradable property right solution to an incomplete market for which the net benefits derived from that resource are both exclusive and rival, such problems are seldom encountered in economies where markets are well developed.

Hyper exclusion of rival goods requires the allocation of monopoly control to an individual firm or the retention of such control by government. The latter is perhaps the most common solution to the problem of incomplete markets in resource economics and may take a number of forms. For example, a government may retain all the rights to the resource and then allocate tradeable licences to individual firms. This is sometimes referred to as a cap-and-trade policy. Taxation and regulation are also instruments fundamentally based on hyper exclusion. The payment of a tax or compliance with a regulation may be seen as the price of licence to produce or consume, the price or conditions of compliance being set by a single agent or authority.

Many problems in resource management fall into the category of markets that are incomplete in a non-excludable good or resource. Perhaps the most common form of

this problem arises when there is incomplete jurisdiction over resource access rights. Examples include water pollution that is carried across state or national boundaries, migratory fish species that move in and out of exclusive fishing zones and global warming due to greenhouse emissions. The fact that resources are non-excludable does not preclude the use of hyper-exclusion within a jurisdiction, but the optimal solution across all jurisdictions is likely to require a degree of altruism or cooperative agreements.

Consider the example of an open access fishery. While the capture of fish for consumption is both exclusive and rival, the capital value of stock is non-exclusive and rival. The capital value of the fish that are not captured and allowed to breed cannot be assigned to individuals as the stock and their offspring will disperse, even within an exclusive fishing zone. However, if the right to fish is hyper-exclusive, it becomes possible to arbitrage the current consumption and future production value of the fish stock. This could be achieved by allocating this hyper exclusive right to an individual firm. However, this firm may be able to exploit this hyper-exclusive right and monopoly price catch. The solution that is more often proposed by economists is for governments to maintain the exclusive right and essentially contract the harvesting though a cap and trading scheme. In Australia this corresponds to a quota on the total allowable catch (TAC) and tradeable shares in that quota referred to as individual transferable quotas (ITQS).

While a TAC is a well defined and hyper-exclusive access right within a jurisdiction, fish species often migrate between jurisdictions, reintroducing the problem of non-exclusion. It may be possible for different jurisdictions to reach a cooperative agreement, such a shares in a global TAC. However, where such arrangements are not in place, a country such as Australia will not capture the full capital benefits and costs associated with changes in breeding stocks. It is, therefore, in Australia's interest to set a TAC that, from a global perspective, will over exploit the stock.

A similar problem would exist if individuals or groups could avoid a tax or regulation. There is still hyper-exclusion over those individuals who could be potentially excluded by the tax if they fail to comply. However, those that do comply will face a greater tax burden to achieve, for example, the desired reduction in pollution or resource use.

Excludability, Non - rival goods and pollution

Markets that are incomplete in non-rival goods are common in natural resource management as, for example, the benefits of improved air quality and existence values provided by ecosystem services supporting biodiversity. Non-rivalry leads to the problem of efficiency in the provision of these goods and services. The nature of the problem depends to large extent on whether these goods and services are excludable.

In summarising the implications of non-rivalry, Randall (1983) states that non-rival goods in consumption, that are non-excludable cannot be financed by user fees or beneficiary charges. An example is the improvement of air quality through the abatement of emissions. The benefits of cleaner air and not exclusive to any single or group of individuals and they are not reduced by the consumption of others. These goods and services can be funded out of general revenue and provided by government at an optimal quantity but not at an efficient price, owing to consumers having different marginal willingness to pay and the potential that some consumers will be inefficiently excluded.

Non-rival goods in consumption that are excludable, referred to in the literature as club goods, can be provided on a user fee or beneficiary pays basis. However, either the quantity supplied or the price of joining the club will be inefficient Randall (1983). Hyper-exclusion in the form of a price discrimination is required to achieve efficient or Lindahl pricing, where each individual is allowed to join the club at their marginal willingness to pay. While an optimal set of prices may be unachievable in a practical sense, there are still potential gains in efficiency from this approach. For example, a public utility might charge industrial and household users differently to finance a water treatment plant designed meet more stringent health standards.

If may also be useful to consider the concept of non-rivalry in production. That is, where one producer's use of a resource does not limit the access of other producers to that resource. For example, the emission of water pollutants by one firm does not necessarily limit the level of emissions from other firms. From another perspective, emissions may be viewed as non-rival consumption of an environmental good, such as air quality, as an input into production as opposed to a joint output. Non-rival outputs such as emissions are, in principle, excludable as they are generally produced from factors of production that are excludable and a joint product of a rival output. However, in practice, excludability depends on the ability to monitor and attribute emissions to an individual, collective or completely diffuse source. There is a degree of symmetry

between non-rivalry in production and consumption in terms of how excludability affects efficiency.

Point source emissions are, with monitoring and enforcement, readily transformable into a rival output through a cap on the overall level of emissions. Again this cap is a form of hyper-exclusion. If the cap is set optimally, trade in emissions permits can lead to an optimal level of abatement at minimum cost. However, the solution will not be efficient if the benefits of abatement are non-rival and consumers have different marginal willingness to pay. This occurs when the damages of emissions are site specific.

Taxes are another form of hyper exclusion that provides a means of pricing the level of emissions. As with non-rival goods in consumption, non-discriminatory pricing can achieve an optimal level of pollution control but will be inefficient if producers have different marginal costs of abatement. Site specific taxes are again hyper-exclusion in the form of a price discriminating monopolist that can achieve the equivalent of Lindahl pricing, leading to an optimal level of abatement at minimum cost. While an efficient set of site taxes is most likely to be unachievable, differential taxes and subsidies can lead to efficiency gains. For example, the level of subsidies to improve water use efficiency could be linked to the salinity of drainage and groundwater discharge back into a watercourse such as the Murray River.

Non-point source pollution can sometimes be assigned to a group of individuals, as for example, nutrient seepage into a closed groundwater aquifer or run-off into a river. If measurable, nutrient pollution into an aquifer or stream is at least collectively excludable in that individuals must have access to land along the stream over the aquifer. Collective exclusion is not amenable to hyper-exclusion through a cap or quota as emissions are still non-rival in nature. The problem of achieving an optimal level of abatement can be addressed through a tax. However, as with a good that is excludable but non-rival, it cannot be priced efficiently if individuals have different marginal cost of abatement.

Concluding Comments

In this paper, we look at the problem of incomplete markets in the context of the excludability and rivalry as suggested by Randall (1983). The motivation for this is the policy options available to complete a market are largely determined by characteristics of exclusion and rivalry in the missing primary good or goods. The discussion did not lead to a prescriptive framework for policy intervention. It did, however, reveal a number of interesting links between market interventions first suggested by Pigou and property rights approach proposed by Coase. There are few instances in natural resource

management that pure system of private property rights can redress an incomplete market. Hyper-exclusive rights are often the only effective property right option to address this problem. Hyper-exclusive rights such a cap or quota have their counterparts in taxes, subsidies and regulation.

There is also a strong symmetry between pure public expenditure theory and resource economics owing to the non-rival nature of pollution in production and its abatement in consumption. The excludability of pollution is largely determined by whether the source and impact of emissions are point source or diffuse. In many cases it is possible to create a range of policy instruments to achieve an optimal level of abatement of both point source and diffuse emissions. Minimum cost abatement is also achievable with point source emission but and overall price efficiency is much more elusive.

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