Environment and Development Economics 9: 447–454 © 2004 Cambridge University Press
DOI: 10.1017/S1355770X04001627 Printed in the United Kingdom

Summaries

Sharing rules and the commons: evidence from Ha'apai, Tonga

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The problem of the commons arises whenever an economic resource is jointly used by a group of individuals who inflict negative technological externalities on each other. An important example is the extraction (appropriation) of resource units from a renewable resource stock such as fish, rangelands, groundwater aquifers, or forests. In the absence of adequate rules, individual appropriators determine their harvesting effort by considering only the private marginal cost of extraction, which is lower than the social marginal cost. As a consequence, aggregate harvest is above the efficient level. Experimental evidence has confirmed this (non-cooperative) outcome in a variety of settings.

The resulting inefficiency can be eliminated if appropriators establish a set of rules which restrict access to the resource system directly or indirectly. Direct restrictions define who is allowed to enter the resource system at what times. Indirect restrictions include systems of harvest quotas and the specification of harvesting technologies or harvesting seasons. These restrictions are called *access restrictions* here. Empirical research has shown that access restrictions existed (or have continued to exist) in many past and contemporary societies.

This paper focuses on *sharing rules* as another class of rules which reduce inefficiency in the commons. Sharing rules are rules which prescribe that each resource user give part of his or her harvest to other individuals as a gift. Sharing rules have existed in several agrarian societies and are still widespread in contemporary Oceania. In a recent paper, Bender, Kägi, and Mohr (2002) have argued that *sharing rules can be a substitute for access rules*. The authors compare coastal subsistence fisheries around two islands in the Ha'apai region in the Kingdom of Tonga where access restrictions are virtually absent. While fish stocks are lower in the fishing areas of the island of 'Uiha, stocks are larger around the other island, Lofanga. At the same time, the authors find sharing rules to be stronger among the population of Lofanga than on 'Uiha. Sharing rules can be interpreted as an informal insurance system that protects fishermen against random fluctuations in fishing yields.

This paper presents an alternative interpretation of sharing rules as an *implicit resource tax*. To this end, a dynamic general equilibrium model is applied to the commons problem on Lofanga island. The model, which has

been developed elsewhere (Chakraborty, 2001), considers an agrarian two-sector economy without capital accumulation or technological change.

Labour and the stock of a renewable (Gordon–Schaefer) resource are the only factors of production. In the first sector, labour produces a manufactured good with constant returns to scale. The second sector comprises resource harvesting, which is undertaken risklessly with constant returns to scale to labour and to the resource stock. The population growth rate is endogenous; it is assumed to respond positively to the per capita consumption of the resource. Consumers maximize instantaneous utility, which is increasing in the resource harvest (equals consumption) per capita and manufacturing output. Perfect competition in the labour market ensures that all labour is allocated to resource harvesting or manufacturing. As goods markets are also perfectly competitive and the resource is harvested under open access, the resource price equals the labour cost of harvesting plus the resource tax.

The model aims to analyze sharing in societies where symmetric sharing rules prevail: each resource user is required to share the same fraction of her harvest with all other users. Sharing rules can then be interpreted as a resource tax the proceeds of which are redistributed equally among all taxpayers. The analysis assumes an implicit *ad valorem* tax where the tax rate is fixed in terms of units of the manufactured good per unit of harvest. The tax proceeds are redistributed equally to all consumers on a per capita basis.

The resource tax generates two effects in the model. First, it induces a static reallocation of labour from harvesting to manufacturing because it reduces the private marginal net return to harvesting. As all individuals expend less effort on harvesting, the resource stock is higher than without a tax at the long-run equilibrium. At the same time, the population size adjusts in such a way that harvest (equals consumption) per capita remains the same as before. However, the amount of labour allocated to manufacturing is higher, which results in an unambiguous increase in individual welfare. Simulations reveal that the resource tax raises the equilibrium level of the resource stock by up to 49 per cent and individual welfare by up to 13 per cent.

Second, the model is able to generate cyclical behaviour, as population size and the resource stock may adjust cyclically to their long-run equilibrium values. However, both variables adjust monotonically to long-run equilibrium if the tax rate is sufficiently high. Simulations show that, in the case of Lofanga Island, cyclical fluctuations of population and the resource stock are weak even in the absence of a resource tax, which is due to the high intrinsic growth rate of the local fish stocks.

Exact measures of income in a hyperbolic economy

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This paper illustrates both how different five measures of income can be, and how important hyperbolic discounting can be in avoiding a dilemma

https://doi.org/10.1017/S1355770X04001627 Published online by Cambridge University Press

between two classic approaches to intergenerational equity. The illustration uses a theoretical, non-trading economy with an explicit functional form for the dependence of the economy's production on a stock of human-made capital, a flow of non-renewable resource depletion, and time in the form of an exogenously growing stock of technological knowledge. Results are calculated for the economy's 'optimal' path, that is chosen as if to maximize present value; that is, the sum of the discounted wellbeing (utility) of a typical person over the rest of time, using a hyperbolic utility discount rate. Such a discount rate declines as the inverse of a linear function of time, rather than being constant as usually assumed. The rate of technical progress in production, if present, is also hyperbolic, with the same decline over time as the discount rate.

The five measures of income considered are welfare-equivalent income, wealth-equivalent income, sustainable income and (green) net national product (NNP), all as reviewed by Asheim (2000), and Sefton–Weale income, after Sefton and Weale (1996); all have useful properties in the theory of income accounting. On the optimal path, welfare-equivalent income, wealth-equivalent income, Sefton–Weale income and NNP at any moment typically form a strictly decreasing series of values, except in the special case where optimal consumption is constant, when all income measures equal consumption. With no technical progress, one can also show that NNP and sustainable income are not generally equal. A plausible numerical example reveals dramatic differences among the measures, with for example wealth-equivalent income being initially about 15 times sustainable income, and forever about 20 times NNP. These clear differences between income measures are seen as support for the view that there can never be a best, exact definition of income commanding universal assent, because there are many different purposes in measuring income.

The two classic approaches to intergenerational equity in an economy with capital and non-renewable resources are maximin, which yields constant consumption, and optimality using a constant utility discount rate. The dilemma in choosing between them in the case of no technical progress is that constant consumption (and hence wellbeing) prevents any growth; whereas constant discounting leads to a long-run decline in optimal consumption, and hence in wellbeing. For a low enough discount rate, the hyperbolic economy avoids this dilemma by allowing sustained growth of optimal consumption. The Solow (1974) constant consumption solution is a special case of the hyperbolic economy, with zero technical progress, and a discount rate just high enough to prevent growth.

Unlike with constant discounting, there is no axiomatic foundation available to justify why an economy would be motivated to follow a path with hyperbolic discounting. However, the resulting optimal path is shown to be time-consistent, thanks to it breaking the convention that the discount factor should depend only on relative time and psychological parameters. The rate at which the discount rate here declines over time changes in a way that has a constant relationship with the economy's changing stocks of capital, resource, and exogenous technical knowledge, and this enables the hyperbolic economy's chosen development path to be time-consistent.

Sustainable development in mineral economies: the example of Botswana

GLENN-MARIE LANGE and MATTHEW WRIGHT

The Hartwick–Solow rule for sustainability requires that depletion of natural capital be offset by a compensating increase in other forms of capital. The process of transforming natural capital into other forms of capital requires: policies that promote economic efficiency in resource extraction to maximize resource rent, recovery of resource rent by an agency that will reinvest the revenues, and investment in alternative assets that will produce as much income as the natural capital they replace. Many countries have not been successful in transforming natural capital into other forms of wealth, a phenomenon known as the 'resource curse'.

Even where resource rents are reinvested, much of the rents support public sector capital, and it is not clear that the new investment is very productive. As currently measured in the national accounts, public sector capital is valued at the cost of capital, a highly questionable assumption. Given the enormous revenues that accrue to governments and their role in reinvestment, it is particularly important to assess public sector capital.

This paper investigates the process of wealth transformation for Botswana, a notable exception to the dismal economic performance of resource-rich developing countries. In the past 25 years real per capita income growth has averaged 5.4 per cent per annum. Natural capital is especially important in Botswana: minerals, mainly diamonds, form the largest single component of its national wealth, and account for one-third of GDP, half of government revenue, and most of its exports.

A comprehensive measure of wealth is constructed for Botswana including manufactured capital, natural capital, and net foreign financial assets. Over the past 20 years, real per capita wealth has increased nearly 400 per cent. Botswana has adopted a policy rule for the reinvestment of mineral revenues and an associated indicator for the government budget, the Sustainable Budget Index (SBI). The SBI measures the ratio of government's recurrent expenditures to recurrent revenue, a rule-of-thumb that requires that all mineral revenues be used for the capital and development budget.

Until the last few years, the SBI shows that all mineral revenues have been reinvested, but a review of the government's capital and development budget raises questions about the true productivity of what is treated as public sector investment. The capital budget includes capital for defence, investments in non-performing sectors like agriculture, and some pure transfer payments. When these items are removed, the SBI shows that a small, but growing portion of mineral revenues are not being invested productively.

A problem with Botswana's transformation of mineral wealth into other forms of wealth is that the SBI is not based on an objective with a well-defined target. Consequently, there are no criteria for optimizing

the allocation of mineral revenues among alternative investments, or between current and future consumption. To make the longer-term strategic planning more effective, and to ensure sustainable development, Botswana would do well to reassess the SBI in terms of its long-term development objectives.

Dynamics of China's regional development and pollution: an investigation into the Environmental Kuznets Curve

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China's economy has developed rapidly over the past 20 years. Associated with this is the emergence of several serious environmental problems. We analyze the relationship between regional growth of the Chinese economy and regional pollution. The analysis focuses on three sources of pollution, namely industrial wastewater, waste gas, and solid waste. We cover the period 1982–1997 for a sample of 30 regions.

The characteristic development of the three types of pollution can be summarized as follows. For industrial wastewater, we observe a strong negative relationship between pollution and per capita income. Pollution is relatively heavily concentrated in urban areas along the coast. For waste gas, we find an overall positive relationship between per capita income and pollution, where the increase is modest at intermediate levels of per capita income. Geographically, waste gas emissions are strongly concentrated in the northern regions with its strong specialization in heavy industries. For solid waste, finally, we find a roughly equal pattern as for waste gas, with the exception that at intermediate levels of per capita income emissions decrease slightly.

The results are relevant in the context of the debate on the existence of Environmental Kuznets Curves. Proponents of the theory argue that an inverted U-shaped relationship between emissions and per capita income is likely to hold. The results of the analysis in this paper cast doubt on the validity of the theory. Furthermore, the analysis underlines the relevance of distinguishing between different types of pollution. Each pollutant develops according to its own characteristic path. This points at the relevance of taking into account typical characteristics of emissions, such as whether they contribute to a global or local environmental problem, whether they can easily be substituted, whether they cause visible harm to the environment, etc. Finally, the analysis reveals the strong regional differences in emissions that are likely to be associated with differences in the sectoral composition of economic activity in the regions.

https://doi.org/10.1017/S1355770X04001627 Published online by Cambridge University Press

With an eye to the future, the analysis underlines the fact that China's pollution situation is critical and that pollution of waste gas and solid waste is likely to increase substantially over the next decades as the economy develops further. Given the size of the economy and its speed of development, the Chinese economy can be expected soon to take over the position of the US as the biggest emitter of global pollutants, such as CO_2. On the positive side, more and more people in China are becoming concerned about production and the living environment. Only if China pays additional attention to environmental production, can it offset the substantial pressure from population, scarce resources, and rapid economic development.

Efficiency of timber production in community and private forestry in Nepal

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In the theoretical literature, whether community management of natural resources under a common-property regime is a viable and efficient institutional arrangement has been widely debated. Earlier it was generally believed that private ownership is more efficient than a common-property system, as it was thought that the establishment of a private ownership system internalizes the externality otherwise arising from the self-interested behaviors of community members in extracting community-owned resources. However, when the cost of protecting private resources is considered, it is not clear that a private ownership system is more efficient than a common-property system. The heart of the controversy lies in whether transaction costs under a common-property regime are higher than those under a private-property regime. Clearly the issue must be resolved empirically.

We argue that the cost of resource protection is likely to be higher under private ownership than under a common-property regime because each private-property owner must exert his effort or resources to protect his property, whereas under a common-property regime protection cost may be reduced by collective action, for example in the form of mutual supervision. It must also be emphasized that the literature on common-property or common-pool resources is concerned primarily with the protection of natural resources but not with their management by means of investment, for example tree planting and subsequent care. We argue that a private ownership system, as well as other systems designed to seek profits, will provide more appropriate incentives to manage trees than a collectively managed common-property system. This is because the collective system tends to suffer from incentive problems associated with the enforcement of collective efforts to carry out management activities.

The major purpose of this article is to test the hypothesis that the collective community management system is more efficient in the protection of trees but less efficient in the management of trees than private or other profit-seeking management systems.

We take a case from the inner Tarai region of Nepal, where three management systems coexist: private forestry, community forestry with collective management, and community forestry with centralized management. While collective management relies entirely on community labor for the whole management, centralized management uses community labor for the protection of forests and hired labor for silvicultural operations, for example weeding, pruning, and thinning. We conducted our own surveys of 25 private plantations, 25 community plantations, and 52 community-managed natural forests.

We found through the regression analyses that collective community management is less costly for the protection of planted trees but allocates less labor for the management of trees than private management. These findings suggest that community management has an advantage over private management in protection due to effective mutual supervision, whereas it has a disadvantage in silvicultural operations due to inadequate work incentives. We also found that centralized management of natural forests leads to higher revenue and profit than collective management, which indicates that the profit-seeking motives of the centralized management resulted in the more efficient management of natural timber forests. Thus, these findings are clearly consistent with our hypotheses.

Although a centralized management system will be more efficient than a collective management system, the former may be less equitable than the latter, because the user group committee, which makes management decisions, can capture large shares of profits. Thus, we conclude that a socially desirable system may be a mixture of collective and private systems, in which trees are protected collectively but taken care of individually by granting tree rights to individual community members equitably.

Attitudes and institutions: contrasting experiences of Joint Forest Management in India

ZAKIR HUSAIN and RABINDRA N. BHATTACHARYA

Co-management refers to devolution of the power to manage natural resources from the State to the resource community. The implicit assumption underlying such programmes has been that resource users want to conserve natural resources, but are unable to do so because of the absence of a suitable collective choice arena. This refers to an institutional structure that enables stakeholders to create resource appropriation rules.

This assumption has led policy makers to focus on designing and providing institutions that will provide a suitable collective choice arena to stakeholders with the anticipation that this will provoke a synergistic response from them. However, policy makers often overlook the fact that failure to undertake collective action may indicate not an inability to undertake the collective action, but an unwillingness to do so. In many Third World Countries resource users are so constrained by poverty that they have a time preference biased in favour of short-run income flows. The provisioning of a resource management regime to curb resource use, without providing an alternative means of livelihood, fails to evoke any corresponding response from the resource community, as the objectives of the resource regime are unacceptable to them.

We have illustrated this problem by referring to two contrasting studies of Joint Forest Management in the villages of Matha and Belemath in India. Despite similarities in socio-economic setting and resource-use patterns between the two cases studied, the introduction of JFM led to success only in Belemath. The reason is that institutional provisioning was accompanied by deliberate attempts to change resource-use patterns in only one site. This minimized the conflict between the target of the resource regime and the preferences of the resource users. In the other site, in the absence of similar attempts, the resource regime was viewed as an instrument to curb resource use without providing any other suitable alternative.

This leads us to suggest that policy makers should focus on changing preferences of resource users by providing them with sustainable alternatives.