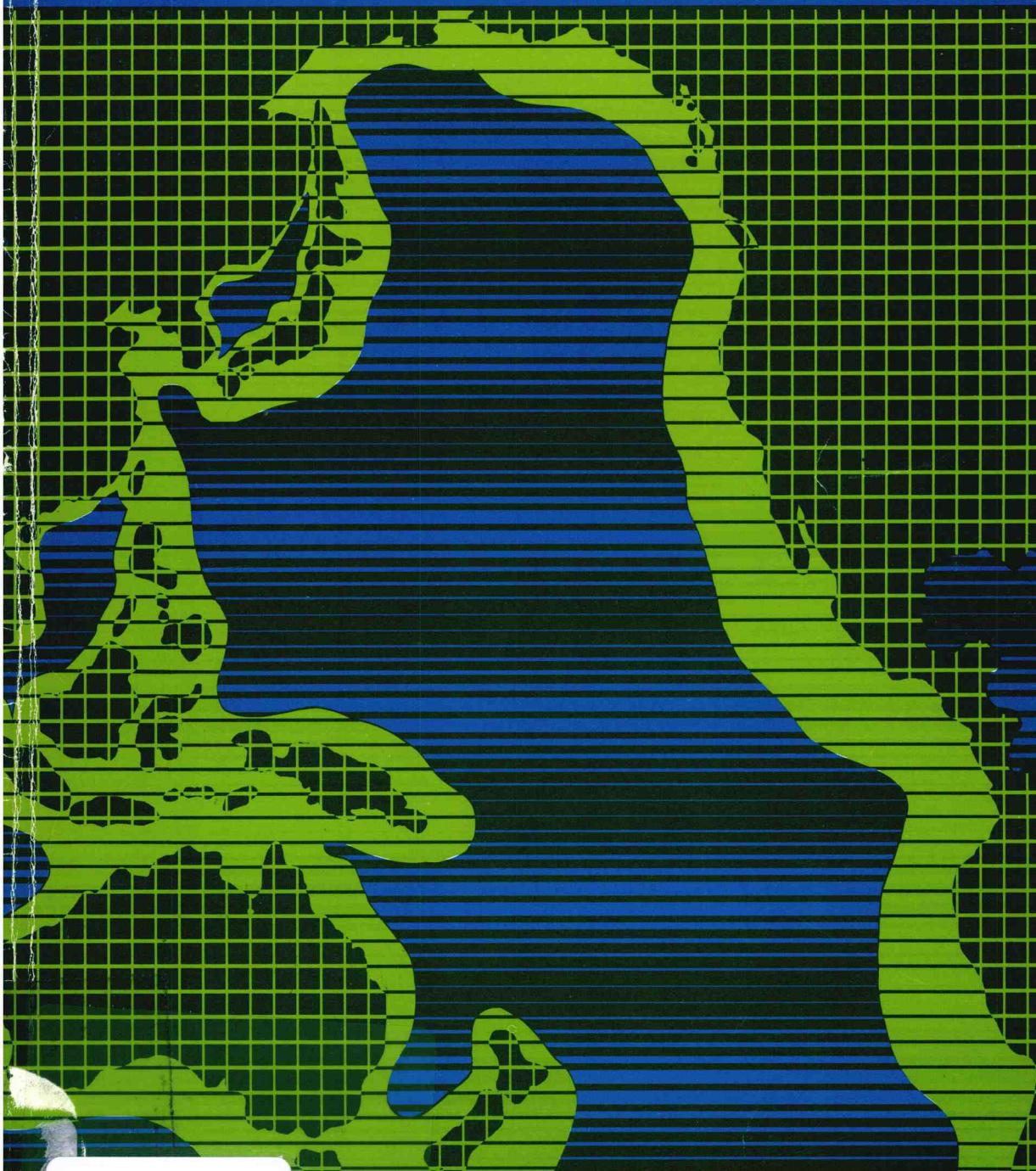# Renewable Resources in the Pacific

Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981

Renewable Resources in the Pacific

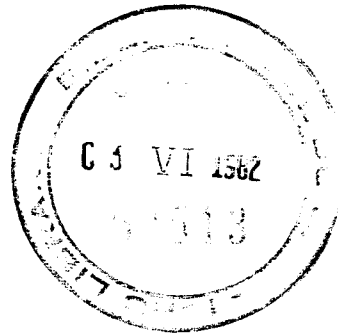### Proceedings of the 12th Pacific Trade and Development Conference, held in Vancouver, Canada, 7–11 September 1981

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Fiscal Policies and Resource Rents
in the Extraterritorial Oceans

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A new law of the sea was essential if the potential economic value of the old extraterritorial seas were to be put to the service of humanity. The informal *Draft Convention* from the Third Law of the Sea Conference went a long way toward developing a system that avoids the dissipation of economic rents for the natural resources in the oceans. It does this mainly through the creation of the 200-mile exclusive economic zones (EEZs) for coastal states. For the ocean resources that remain outside the extended sovereignty of nation states, principally a minor part of world fisheries and the deep-sea polymetallic nodules, new international regulatory systems have been required. The new law of the sea provides for a flexible system of fisheries management based on regional organizations. More detailed arrangements were laid down for deep-sea mining. If deep-sea mining turns out to be highly profitable, the proposed arrangements will restrict its expansion but leave a considerable part of economic rent with investors. This might eventually be seen as a weakness of the system, which could be reduced through the introduction of general income tax obligations and competitive bidding for leases. If deep-sea mining turns out to be a marginally profitable activity in favourable conditions, the proposed fiscal arrangements will not be an important deterrent to development.

L'établissement d'un nouveau droit de la mer constituait une mesure essentielle pour mettre au service de l'humanité la valeur économique de l'exploitation des eaux extra-territoriales. L'avant-projet informel de la IIIᵉ Conférence sur le droit de la mer va très loin dans la mise en oeuvre d'un système de droit de propriété des ressources maritimes visant à éviter le gaspillage de la rente économique. Ce système repose principalement sur la détermination d'une "zone économique exclusive" de 200 milles réservée aux états riverains. Quant à l'exploitation en-deçà de cette zone, qui concerne une faible partie des pêches mondiales et les nodules métalliques qui tapissent les grands fond océaniques, il a été nécessaire d'instaurer de nouvelles législations internationales. Le nouveau droit de la mer permet à des organismes régionaux d'exercer une gestion des pêches très souple. Cette formule paraît rationnelle et la politique fiscale établie offre une gamme de choix aux futures organisations. La politique internationale de la conférence a élaboré des clauses plus détaillées en prévision de l'exploitation minière des océans. Si ces opérations s'avèrent très rentables, la convention proposée limitera les activités des investisseurs mais elle leur garantira une grande part de rente économique. Ce peut être là la faiblesse du système qui pourrait cependant être corrigée par l'imposition de taxes sur le revenu et la mise en enchères des permis d'exploitation. Mais si l'exploitation minière des fonds marins ne devenait qu'une activité marginale, les mesures fiscales proposées ne devraient pas constituer un frein au développement.

For nearly 8 years, the Third Conference on the Law of the Sea has been meeting under United Nations auspices in an attempt to establish a system of law for the nonterritorial oceans and to delimit individual nations' sovereignty in the oceans. Early in 1981, Ambassador Koh of Singapore, who chairs the conference, expressed hope that a session in August would reach agreement on the long negotiations, based on an informal draft of August 1980. However, the new United States administration is reviewing the United States' position on the draft and has warned that this timetable is unrealistic.

Nevertheless, the progress that has been made so far in negotiations provides substantial insight into the system of law that is likely to be established and therefore allows one to say something about systems of fiscal policy that would be appropriate under the new law. The 1980 draft discusses in considerable detail fiscal arrange-

ments in deep-sea mining but is less specific for fisheries. Although the Reagan administration has taken strong exception to some elements of the draft arrangements on deep-sea mining, the fiscal arrangements do not seem to be a main contention at this stage, presumably because they favour the interests of private investors from the advanced industrial countries (Jagota 1981). However, if the United States sends other issues in the draft back to the negotiating table, other countries may take the opportunity to reopen discussion on the fiscal arrangements.

The issues revolving around the fiscal arrangements have been introduced in earlier Pacific Trade and Development conferences (Alexander and Christy 1977; Gorham 1978). Although the issues concern the whole of the international community, they have a special relevance for the Pacific: the Pacific is the most important habitat of the highly migratory species of fish, especially tuna, whose management will be greatly affected by the new arrangements; and the Pacific at this stage seems to provide the most favourable sites for the mining of polymetallic nodules from the ocean floor. The prospective new law of the sea has already precipitated the formation of one new subregional resource management agency, the Forum Fisheries Agency, in the southwest Pacific region.

Natural Resource Rents

A characteristic of natural resources is that in favourable circumstances they can generate economic rent, that is, their exploitation can yield income in excess of the sum of the supply prices of all the economic inputs that are necessary for the activity.

The favourable circumstances include the presence of a system of law that restricts entry into resource exploitation through the establishment of property rights. In the absence of controls on access to a resource, more and more other resources will be applied to its exploitation, beyond the point where the marginal cost of inputs exceeds the value of the incremental resource-based production, until total costs of inputs equals total value of output (Gordon 1954). At this point, by definition, the common-property resource yields no rent.

The theory of economic rent applies to both renewable and nonrenewable resources, although there are characteristic differences between the two types of natural resources that become important to the analysis of economic rent in some circumstances. The classical theory of resource rent was originally developed for a

renewable resource: agricultural land, which, with good management, could be cropped continually without loss of productive power. Part of the classical interest in resource rent was that it was potentially a source of nondistorting taxation.

In the classical theory, renewable-resource rent arose from the fact that the quality of the resource determined its ability to generate output. Economic rent was a measure of the differential and depended on the amount by which the unit cost of production on a specific piece of the resource (land) was below that on a marginal piece.

Clunies Ross and I (forthcoming) have recently demonstrated that the classical concept of economic rent is directly applicable to nonrenewable (mineral) resources in terms of total output over long periods but not in terms of annual output. In place of a rising marginal cost of production in a single time period from renewable resources, one must think of a rising marginal cost of production over the whole of the economically relevant future. Prices and unit costs from different times must be made relevant to the present by the application of appropriate discount rates. For mineral resources, this means that the marginal resource is the highest-cost mineral deposit being exploited not only at a particular time — as is the case with renewable resources — but also indefinitely.

Although the conceptual bases for rents from renewable and nonrenewable natural resources find common ground on the simple classical assumptions, the characteristic difference is that nonrenewable resources are not sustainable at any economically realistic level of production. A renewable resource takes on this property of a nonrenewable resource when either the environmental or biologic components necessary for renewal are destroyed by too-high levels of production. The destruction may be to the physical environment. Environmental destruction is exemplified by soil erosion; biologic, by overfishing. To avoid biologic destruction, scientists have introduced the concept of maximum sustainable yield, unique to renewable resources. The classical theory of rent can be applied only to levels of production at or below the maximum sustainable yield of a renewable resource.

Common-Property Resources

Uncontrolled access to natural resources dissipates economic rents in two ways that are common to renewable and nonrenewable resources and a third that occurs only with renewable resources. In the first, resources continue to be

attracted into the expansion of production from the common-property resource until average cost of production equals price, when, by definition, the resource yields no rent. In the second, additional resources are attracted into exploitation of a natural resource even when they are unnecessary to the full utilization of the resource — that is, there is wasteful duplication of investment. The investment is attracted by the opportunity to share in the economic rents even when the additional investment adds nothing to total output. The extreme case is pure duplication of investment, which occurs when production units race each other to deplete a nonrenewable resource or the periodic yield of a renewable resource. Examples include oil producers drilling the same field, thousands of diggers bearing the overhead costs of migration in a gold rush when hundreds could have fully exploited the field over a longer period, or a large number of boats producing in a short time a catch that could have been managed in a proportionately longer time by a small number utilizing their capacity more fully. In the third, when the price of the resource-based product is higher than is necessary to induce production at the maximum sustainable yield, total output actually contracts, and potential economic value is dissipated to an even greater extent than with either the first or the second way.

When application of ancillary resources yields positive but diminishing increments in resource-based produce, none of the additional inputs duplicates existing productive capacity. This level of production is exemplified by the exploitation of a fishery below the intensity required to generate maximum sustainable yield or the exploitation of a mineral deposit. (I have assumed that the resource is sufficiently small for its output not to affect world prices of the resource-based product.)

In Fig. 1, unit prices and cost of production are shown on the vertical and quantities of production on the horizontal axis. MC represents the marginal cost and AC the average cost of producing the natural resource-based product. With uncontrolled access to the resource, output expands until average cost equals the given price, OP at OQ_2. However, the addition of productive inputs to expand output beyond OQ_1 is associated with unit costs in excess of the price of the product. The total excess cost of producing beyond OQ_1 is represented by the horizontally shaded area BCD.

The economic rent generated by exploitation of the resource is maximized when production is confined to OQ_1, where at Q_1 the marginal cost of
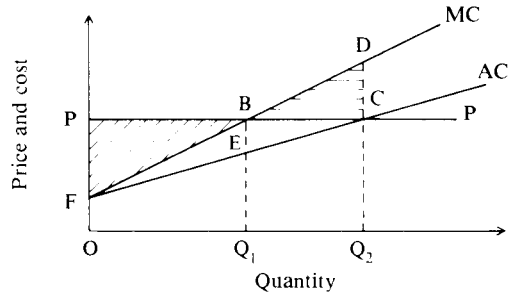
Fig. 1. Dissipation of economic rents in the common-property resource: no decline in total output and no pure duplication.

production equals the product price. The total economic rent is the total surplus of revenue over production costs, at point Q_1 (described by the obliquely shaded area FBP). The area FBP equals the area BCD.

I should distinguish the dissipation of rent described in Fig. 1 from the more extreme case where there is pure duplication of productive effort so that at least part of the additional resources applied to exploitation yields no output, quite independently of considerations associated with overexploitation of a renewable resource.

In practice, uncontrolled access to a natural resource is likely to lead to the dissipation of economic value simultaneously through the first and second ways. When the resource is renewable, the first and second processes of dissipation will be, if product price is sufficiently high, accompanied as well by the third.

Fig. 2 describes how, in the application of increased productive capacity to the exploitation of a renewable resource beyond a maximum (corresponding to output OQ*), production falls. Average costs continue to rise. The marginal cost curve is discontinuous at point OQ*: marginal cost is infinite. So long as the product price
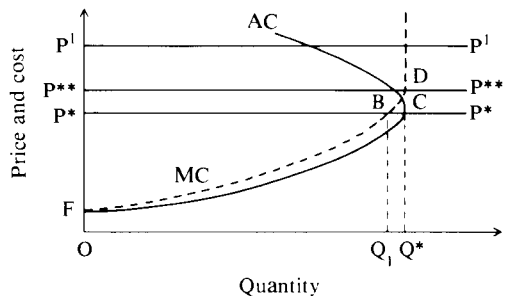

Fig. 2. Dissipation of economic rents in the renewable common-property resource: possible decline in total output and no pure duplication.

remains below OP*, the analysis is similar to that for Fig. 1: productive effort is expanded until average cost equals price and, beyond the point B at which marginal cost equals price, causes dissipation of renewable-resource rent. The maximum sustainable yield of a common-property resource is always an inefficient level of production at the price that encourages it; at this price, economic rent would be maximized if production were restricted to OQ_1, corresponding to the point at which marginal cost equals the price OP*.

Renewable resource rents could be maximized at the maximum sustainable yield only at a price equal to or greater than OP**, greater than OP*, at which price equals the marginal cost of production at the maximum sustainable yield.

Resource rents are maximized when access to the resources is restricted so that price is equated with marginal costs of production or when production is restricted to the maximum sustainable yield when price exceeds the marginal cost of producing the last marginal contribution to maximum sustainable yield. In most modern societies, mechanisms have been established for restricting access to land-based natural resources in the interests of economic efficiency through the assertion of state ownership, with exclusion rights being granted to private investors by agreement with the state (for example, minerals in all Pacific countries except the United States) or with the establishment of a system of private property rights (for example, agricultural land). The conferences on the law of the sea have been working toward the establishment of a system of property rights that will allow the exploitation of extraterritorial ocean resources by private investors by agreement with various international authorities. The new system requires mechanisms for limiting access to ocean resources to generate economic rent and to secure appropriate distribution of that rent. A closely related matter is the relationship between resource rents and the rents from monopoly in commodity markets.

Resource Rents and Monopoly Rents

The consumer is an often-forgotten participant in the exploitation of resources; in fact, conflict may arise between producers and consumers. Although demand is infinitely elastic over the relevant range of production, consumers are indifferent to the level of production; however, when price is responsive to the level of production, consumers benefit from higher levels of production even if resource rent is dissipated. Much of the fisheries-management literature overlooks this distinction and proceeds as if rent

maximization through the equation of marginal cost and marginal revenue defined an economically efficient level of production (Young 1977:115-117 and the references cited therein). This is the opposite error common among modern libertarian neoclassical economists who tend to see all resource rents as monopoly rents (note the popular statements of Milton Friedman on OPEC).

I propose that:

• Producers and consumers taken together are better off (abstracting from the possibility of the marginal utility of money being greater for consumers than for producers) by restricting production to the level at which marginal cost of production equals price, than with the normal outcome in the common-property resource where output expands to equate average cost and price. Consumers alone are better off with the common-property resource, so long as productive effort in relation to the exploitation of a common-property resource is not greater than is necessary to produce the maximum sustainable yield.

• Producers and consumers taken together are better off when marginal cost is equated with price than when producers use monopoly power in the product market to equate price with marginal revenue, although producers alone may be better off, in a similar position, or worse off through restricting production to equate marginal cost with marginal revenue.

• The interests of consumers coincide with the interests of producers in restricting maximum productive effort to the level that is necessary to produce at the maximum sustainable yield.

Fig. 3 compares welfare effects to equating marginal cost and price with the common-property resource equation of average cost with price,[1] in a world that is defined as in Fig. 1 in all respects other than the downward sloping demand curve.

DD^1 is the demand curve, CMC the marginal cost curve, and CAC the average cost curve. In the common-property resource, output is OQ_1 and price OP_1. Marginal cost of production, P_3, is in excess of the level that consumers are prepared to pay for the product at output OQ_1. Marginal cost equals price at point E, corres-

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[1]Some of the argument in Fig. 3 and 4 will be made by Clunies Ross and me in a forthcoming publication. The use of analysis along these lines in welfare economics was surveyed by Currie et al. (1971). The argument is valid so long as income effects are relatively small — a condition that would seem to be met for analysis of extraterritorial ocean resource production at present.
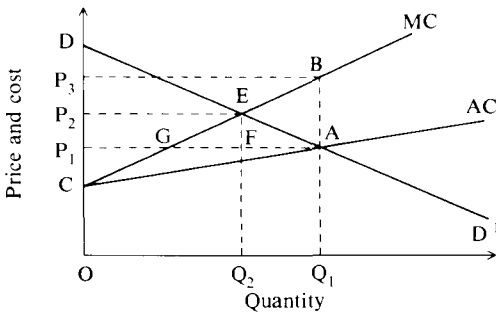
Fig. 3. Welfare effects of natural resources with exclusive property rights and common-property resources.

ponding to the lower output OQ_2 and higher price P_2. Consumer surplus is greater at the higher than at the lower output, the reduction in consumer surplus being measured by the quadrilateral P_2P_1AE. Resource rent is greater at the lower than at the higher level of output, the increase being the triangle P_2CE.

The sum of resource rent and consumer surplus in the common-property resource is the area covered by the triangle DP_1A. (There is no resource rent.) The sum of resource rent and consumer surplus when marginal cost equals price is given by the triangle DCE. The quadrilateral DP_1GE is common to both areas so that the sum of consumer surplus and natural resource rent in the common-property resource is less than the equivalent sum when marginal revenue equals price if the residual area EGA is less than the residual area P_1CG. The theory of the common-property resource indicates that the area P_1CG equals the area GAB. Since EGA is contained by GAB, the sum of the surpluses is lower in the common-property resource.

Fig. 4 compares welfare effects of equating marginal cost and price with the situation that would exist if monopoly power were used in the product market so that marginal cost was equated with marginal revenue.

The marginal cost curve CMC and the demand curve D^1 are as in Fig. 3. With competition in
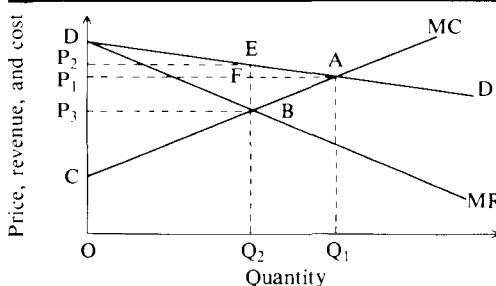
Fig. 4. Natural-resource rents and consumer surplus with monopoly and competitive product markets.

product markets, marginal cost and price are equated at A, corresponding to output OQ_1 and price P_1. If monopoly power in the product market is fully exploited, production is restricted to OQ_2, at which product price is P_2 and marginal cost of production the lower level P_3.

The sum of resource rent and consumer surplus is described by the area DCA with competition in product markets. With the exercise of monopoly power, resource rents are reduced to P_3CB and consumer surplus to DP_2E. However, monopoly rents totaling P_2P_3BE accrue to the producer in the latter situation. The total of resource rents, consumer surplus, and monopoly rents is described by the quadrilateral DCBE when monopoly power is exercised. DCBE falls within the area DCA, demonstrating that the total of consumer and producer surplus is greater with competitive markets.

The exercise of monopoly power increases total producers' rents if the monopoly rents P_2P_3BE exceed the loss of resource rents P_1P_3BA. The quadrilateral P_1P_3BF is common to both areas. The residual gain in monopoly rents P_2P_1FE may be less than equal to or greater than the residual loss of resource rents FBA, depending on supply and demand elasticities. Total producers rents are more likely to be raised through the exercise of monopoly power the greater the rate of increase in production costs for expansions of output beyond OQ_2 and the more inelastic the demand function.

The analysis of Fig. 1 and 2 becomes indeterminate when applied to a renewable resource with the possibility of producing beyond the maximum sustainable yield. There is no longer any certainty that the demand and average cost curves will cross. If they do not, price increases, productive effort increases, and production declines successively until the resource is totally depleted. Even the interests of the consumer would be served better by controlled access than by the maintenance of the common-property resource, even if control were maintained by a monopolist restricting output, below maximum sustainable yield, to equate price with marginal revenue.

Husbanding and Taxation of Resource Rents

Economic efficiency from an international viewpoint will be promoted by the restriction of access to natural resources in such a way that:

• Producers have an interest in avoiding wasteful duplication of investment and in equating marginal cost with price;

• No single producer can exercise monopoly over product markets; and,

• Above all, the productive effort does not exceed the maximum sustainable yield of the resource.

Private investors or state-owned corporations, which are directed to maximize profits, should be given exclusive rights of access to natural resources so that the *desiderata* for natural resources of a fixed location are secured. Mobile natural resources, most notably fish, are more difficult to manage, because the conferring of exclusive rights of access to particular geographic areas will not generally remove their common-property characteristics. To secure *desiderata*, some regulatory agency must enforce its view on the optimal level of output from a fishery as a whole, establish exclusive rights of access to certain levels of output rather than to the resource itself, and also enforce its view on the optimal level of fishing effort to avoid wasteful duplication of investment.

There are difficult practical problems and high transaction costs in selecting and enforcing optimal levels of productive effort and production. Apart from problems of securing international cooperation in the regulation of fisheries extending beyond the exclusive jurisdiction of a single state, the technical difficulties are considerable in ascertaining the maximum sustainable yield of a fishery, and, where the optimal economic level of production is clearly below maximum sustainable yield, in estimating the economic parameters that determine the level of output at which marginal cost equals price. The best that can be attained in any important fishery is a rough approximation to the optimal.

The regulatory agency enforces its views on optimal levels of fishing effort and output by various means. Perhaps the most common means currently applied are prescribing technology and limiting the fishing season. Other means are direct controls on total output and specific as well as ad valorem taxes on production that reduce net revenue to investors to levels at which they voluntarily produce at the desired level. Cooper (1976) in an interesting survey of these issues in the context of early discussions of the new law of the sea correctly condemns the prescribing of some technology or the limiting of the fisheries season as introducing new sources of dissipation of rent. However, he goes too far in criticizing the use of quantitative controls on output on the same grounds and in preferring deliberately distorting taxation for its presumed superiority in these respects. Direct controls on total output do not inhibit the application of lowest-cost tech-

nology. Moreover, when market prices are in excess of those required for economically efficient production at the maximum sustainable yield, the regulatory agency requires less information to apply quantitative controls than to apply optimal taxes. To enforce optimal quantitative controls in these circumstances, only biologic data are required. However, the application of optimal distorting taxation requires data on price and production costs, in addition to the biologic data.

When the regulatory agency controls such large amounts of a resource that prices are responsive to its own behaviour, it will be in a position to appropriate monopoly rents. To avoid the use of monopoly power, it must ensure that no single investor is granted access to such a large part of a resource that the investor's production decisions can affect price. In the case of quantitative controls on output from a large fishery, rights must be allocated among a sufficiently large number of producers to exclude this possibility.

The establishment of a suitable system of property rights can avoid the dissipation of resource rent but raises the issue of how the rent should be distributed. The regulatory agency can in principle claim the rents as a condition for granting private investors access to resources, but it is not an easy matter to collect all the rent without dissipating part of it through the distortion of investment and production decisions. There is now a large literature on this matter (Garnaut and Clunies Ross, forthcoming), but a summary of the main propositions is warranted.

Optimal Taxation

The regulatory authorities can obtain revenue by requiring that investors pay a fee before being given access to a resource (prior fixed payments) or by charging the investor royalties, or taxes, the total payments of which are conditional upon the amount of production, or of profit, or of net cash flow (conditional payments) (Garnaut and Emerson 1981). The optimal combination of prior fixed and conditional payments depends heavily on what is assumed about the risks occasioned by the commercial and political environment within which an investment decision is made and on what is assumed about the manner in which investors and governments take risk into account in investment decisions.

A great variety of forms of prior fixed cash payments and conditional payments are applied in practice by governments regulating access to natural resources within their control. Neither competitive cash bidding nor taxes on net present

value can be relied upon in all circumstances to collect the whole of the resource rent without distortion.

The most nearly ideal system of setting prior fixed payments in practice is competitive sealed tenders, as used, for example, by the U.S. federal government in the allocation of petroleum licences in known geological structures of producing oil or gas fields. This system appears to work well in allocating rights over resources with calculable risk and modest rent value (Mead 1977). However, there are problems of collecting the full economic value of rights over highly valuable natural resources by this method, especially when risk is high. Apart from considerations arising from investors' aversion to commercial risk, the collection of resource rent through competitive cash bidding is highly vulnerable to investors' fears that the fiscal rules will change after investment has been committed: bids will be discounted for fears that successful outcomes will eventually be taxed. Also when the bid required to win a lease is large, competition between possible investors may be eliminated by collusion or some other factor (Norgaard 1977). Many mineral deposits, for example, promise such large amounts of cash flow that only a few corporations can finance the bids.

Although the problem of financing prior payments could be overcome if the investor were allowed to pay from later cash flow during mining operations, this change would transform the payment from a prior fixed payment to a conditional payment. Allowing the bid to be honoured at some later time would produce a conditional payment if the bid were large in relation to the assets of the successful tenderer. If the exploration or mining activity were unsuccessful, the corporation would be driven into bankruptcy. As a profit-maximizing strategy, owners of corporations may make large bids for licence areas of high but uncertain value, in the knowledge that they must achieve outcomes in the upper end of the probability distribution of outcomes or face bankruptcy.

The most efficient systems of conditional payments are taxes on positive net present value (to prevent distortion of investment), collected as a levy on "surplus" cash flow (to prevent distortion of production from established resource-exploiting facilities). The most nearly ideal system of conditional payments currently is the resource rent tax (RRT), as defined by Garnaut and Clunies Ross (1975) and as used in recent mining and petroleum agreements and taxation legislation in Papua New Guinea and several other developing countries (Palmer 1980). The RRT does not distort production decisions for established investments: in this it is superior to conventional ad valorem and specific royalties, conventional corporate income tax, and annually progressive profits taxes. It is not collected until investment in a project has been recouped with interest at a specific rate, so that in form it is a tax on realized net present value. It can be neutral with respect to investment decisions so long as tax parameters are set correctly in relation to discount rates applied by investors to future cash flows in the evaluation of investment possibilities. However, the RRT can distort investment decisions if taxation parameters are not set perfectly, and it cannot be used to collect the whole of the resource rent without disincentives to economizing behaviour (Garnaut and Clunies Ross 1979).

Under ideal conditions (under which both competitive cash bidding and conditional payments are able to collect the whole of the resource rent without distortion), the relative reliance on prior fixed payments and conditional payments that maximize the value of revenue collected would depend on the attitudes toward risk of the investor and the regulatory agency. If the investor and the regulatory agency respond to risk consistently with von Neumann-Morgenstern utility theory and are equally averse to risk, half of the expected payments would take the form of prior fixed payments and half, conditional payments (Leland 1978). If the investor were more averse to risk than the regulatory agency, more of the expected revenue would take the form of conditional payments, but some revenue would be collected as prior fixed payments. The opposite conclusion would follow if the investor were less averse to risk.

If the investor and the regulatory agency respond to risk by applying a risk premium to the discount rates that they use to evaluate investment possibilities and if they apply the same discount rates, it is of no consequence whether expected payments take the form of prior fixed payments, conditional payments, or any combination of the two (Garnaut and Emerson 1981). If the investor applies higher discount rates than the regulatory agency, the value of revenue collected would be maximized by conditional payments and vice versa if the regulatory agency discounted future cash flows at a higher rate. The use of other common responses to risk, such as the requirement that the investment be recouped in a specified period or that there is zero or low probability of a totally unfavourable outcome, generally favours relatively heavy reliance on conditional payments (Garnaut and Emerson 1981).

The imperfections of prior fixed payments and conditional payments suggest that a mixed fiscal strategy is optimal because, applied together, the two types of payment support each other. Heavy reliance on competitive cash bidding is likely to be least satisfactory when the size of the bid required to collect the economic rent is large; the application of RRT with prefixed parameters lowers the scale of the bid that is necessary to reflect the economic value of the resource. At the same time, the higher the rates at which RRT is applied, the higher the risk of removing necessary incentives to economizing behaviour; the use of competitive cash bidding to collect the residual economic value of a resource after tax payments have been taken into account reduces pressure to raise RRT rates to levels that might distort expenditure decisions.

There are characteristic differences between renewable and nonrenewable resources that suggest heavier emphasis on competitive cash bidding for nonrenewable resources than for renewable. There are two reasons for this, one depending on degrees of uncertainty about investment outcomes and the other on characteristic scales of investment.

First, the exploitation of a renewable resource has the nature of a repeatable experiment. This is especially true for fisheries, where a large part of the capital committed to investment can be moved for use in alternative locations with little cost. Expectations about the outcomes of future investment are informed by the experience of the past. Although investment outcomes remain uncertain, in general they are less uncertain for renewable than for nonrenewable resource exploitation. Because investors are normally averse to risk, and more averse to risk than the regulatory agency in relation to the outcome of a single investment, reliance on competitive cash bidding is less satisfactory the more uncertain the outcomes and, therefore, more satisfactory in relation to renewable than to nonrenewable resources.

Second, the economically efficient scale of investment, and the scale of resource rent likely to be generated by a single investment, is typically larger for the exploitation of nonrenewable than for renewable resources, mainly for accidental technological reasons. Because competitive cash bidding as a means of collecting resource rent is less efficient than conditional payments for large bids, it is more appropriate for renewable than for nonrenewable resources.

Third, applying distorting charges on revenue (specific and ad valorem duties) results in only small penalties in terms of reduced value of revenue collections for a mobile renewable resource such as a fishery, so long as the charges do not exceed certain maximum levels (the difference between price and the marginal cost of production at optimal output). The reason is that economic efficiency requires some degree of distortion of production from levels that would rule in the absence of regulation. In this respect, mobile resources such as fisheries are different from stationary resources. In the latter, regulating agencies avoid dissipation of resource rent by establishing exclusive property rights over defined geographic areas and then secure allocative efficiency by allowing production up to the point at which marginal cost equals price. The difference between price and the marginal cost of production at the optimal level of output is difficult to determine in practice. However, so long as substantial amounts of revenue are collected as prior lump-sum payments, collecting the whole rent may not be necessary if it means setting taxes so high as to risk unproductive distortion. The use of specific and ad valorem duties may, however, even in ideal conditions, lead to a less satisfactory allocation of risk between the regulatory agency and the investor and, therefore, some reduction in the value of revenue to the regulatory agency, in comparison with RRT applied in ideal conditions.

Rents and the Law of the Sea

The *Draft Convention* from the Third Law of the Sea Conference establishes property rights to the natural resources of the old high seas. So far as economically valuable resources are concerned, it does this mainly through the extension of the exclusive control of individual states over the natural resources of the sea within 200 miles of their shores, carefully defined archipelagic waters, and for mineral and sedentary living resources, the extremities of the continental shelves. This division leaves less than 10% of the world's fish catch from the oceans and deep-sea polymetallic nodules as the main economically valuable natural resources of the extraterritorial oceans. The proposed system of regulation of extraterritorial fisheries is loose and capable of development in various ways, whereas the system of regulation of deep-sea mining is extraordinarily tight and elaborate.

The extension of national control over such a large part of the natural resources of the oceans, including virtually all of the prospectively highly valuable petroleum resources, is probably as good a system as any from the point of view of

economic efficiency (that is, avoiding the dissipation of natural resource rents), especially when the transaction costs of international regulatory agencies are taken into account. However, the large benefits that it conveys are distributed arbitrarily among states, amounting to, as Cooper (1976:115) hoped it would not, ". . . one of the major missed opportunities for . . . [humankind] . . . to build towards a world community."

The new national resources in the oceans will require management in the same way as territorial land and sea resources in the past. Whether the new system will realize its potential for improving the efficiency with which natural resources are used depends on the management capacities of nation states. Most of the developing countries, especially the small islands, will face difficulties in providing domestically the new skills that are required to regulate efficiently access to ocean resources and in stretching the existing stock of old skills to cover more tasks of the old kind. The success of the new system would seem to require the development of mechanisms through which technical assistance in a wide range of scientific, economic, and administrative areas can be supplied internationally.

Extraterritorial Fisheries

The *Draft Convention* lays down some rules for claims on fisheries confined to extraterritorial waters and on those that lie partly within the exclusive economic zone of one state and partly in extraterritorial oceans or in the exclusive economic zones of other states. In both cases, the proposed regulatory system depends heavily on cooperation between states that are affected either as fish producers or as proprietors of exclusive economic zones.

The minimum geographic area over which a single regulatory agency must operate is the full extent of the fishery if the common-property characteristics are to be removed. This minimum necessary size is probably also the maximum efficient size, as the costs of establishing and maintaining an international agency grow rapidly as the number of states participating in it increases. These *desiderata* are reflected in the *Draft Convention*, which places on ". . . states whose nationals exploit identical resources, or different resources in the same area . . ." an obligation to ". . . enter into negotiations with a view to adopting the means necessary for the conservation of the living resources concerned." The *Draft Convention* directs such states to ". . . cooperate to establish subregional or regional fisheries organizations to this end" (United Nations 1980:43, Article 118).

The end point of this cooperation is ". . . to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental and economic factors. . . ." (United Nations 1980:43, Article 119). The group enjoined to cooperate reflects the interests of producers rather than natural resource proprietors and, therefore, would maximize production rather than resource rents. These rules are inconsistent with the emergence of rents of fisheries in extraterritorial waters until product prices are sufficiently high to prompt productive effort in excess of that required to produce at the maximum sustainable yield. Most professional opinion is that this point is at least several years away for the main extraterritorial fisheries of the Pacific.

However, rising world incomes and limited opportunities to increase world fish supplies suggest that limiting production to maximum sustainable yield will generate substantial resource rents in the extraterritorial Pacific soon enough to warrant some thought now about what should be done with the rents. Leaving the resource rents to traditional fishing states or fortunate fishing personnel is hardly reasonable and would not be acceptable in the international community. One way out is to establish a regulatory agency that comprises representatives from all Pacific states rather than just the fishing states. Such an agency would need fiscal policies for the collection of resource rents — policies similar to those needed by regional groupings that include one or more states whose exclusive economic zones cover part of a fishery.

Rather different regulatory arrangements are envisaged for fisheries that extend from the exclusive economic zone of one state into the economic zones of other states or into extraterritorial oceans. The resource-owning states are to cooperate with each other in the regulation of the fishery unless the fishery extends into extraterritorial waters, in which case both resource-owning and fishing states are to be members (United Nations 1980:25, Article 63). The emphasis on resource-owning states rather than fishing states means that the objective of the agencies will probably be the generation of economic rents rather than maximum production, and this likelihood is reinforced by the absence of any explicit concern for production at the maximum sustainable yield. A special article lays down this same approach for a number of highly migratory species (mainly tuna) but places a stronger requirement of cooperation on the interested resource-

owning and fishing states: "In regions where no appropriate international organization exists, the coastal state and other states whose nationals harvest these species in the region shall cooperate to establish such an organization and participate in its work" (United Nations 1980:25, Article 64).

The different objectives of resource-owning, fishing, and fish-consuming states will often be in conflict. The first will be concerned with the maximization of economic rents, and possibly of monopoly rents as well. The fishing states, in this capacity, will be concerned with maximizing production, except where restrictions on production allow them to enjoy monopoly rents. The different interests coincide only when price equals or exceeds the marginal cost of production at the maximum sustainable yield. Some agreement may be possible if it is based on the objective of maximizing resource rent and distribution of the revenues collected by the regulatory agency.

In any case, resource rents for these fisheries will emerge earlier than for those in the extraterritorial oceans, even if restrictions on productive effort and production are set through crude political processes. How would these rents best be collected for the revenue?

An ideal system might involve the division of the desired level of fish catch into a number of parts and auctioning them for lump-sum cash payments, with limits on the total level of catch allowed a single investor. The cash bidding could usefully be accompanied by a profits tax — most ideally in RRT form or — if market price exceeds, by a wide margin, the marginal cost of production at the desired level — by an ad valorem or specific tax within the margin.

But regulatory agencies should expect to take some time in getting to this ideal position. Some of the fisheries covered by these arrangements would probably not generate genuine competition in an auction. The effectiveness of a bidding system needs to be tested case by case, with the authorities reserving, and where necessary exercising, the right not to allocate fishing quotas when the highest bid does not reflect the true value of the resource. The bidding system should be complemented by a conditional payment that would reduce the loss of potential revenue from failure of competition in bidding. In clearly noncompetitive situations, competitive bidding on prior cash payments should be replaced by negotiated lump sums.

Administering conditional payments and cash flow-based taxes such as the RRT has its own set of problems. The costs of policing the returns

upon which taxation is assessed would be justified only for fisheries with high-rent value. Until fisheries have this value, reliance should be on specific and ad valorem duties, at rates clearly within the margin between market prices for fisheries products and marginal cost of production at the level of productive effort that is expected to maximize resource rents. It may not cost the regulatory agency much in terms of the value of revenue to rely heavily on the simply administered specific and ad valorem duties, especially when they are accompanied by substantial lump-sum payments determined by auction or negotiation.

Rents in Polymetallic Nodules

The *Draft Convention* spells out arrangements for deep-sea mining of polymetallic nodules in great detail. This task was obviously necessary to secure agreement among states with widely different objectives, of which the generation of revenue for international purposes was only one and, because it was a central concern of no state, relatively minor. The result is that the arrangements are likely to yield relatively little revenue from the economic rent value of ocean resources, and an important part of whatever is generated will be consumed in the financing of the elaborate international administrative infrastructure.

Unlike the arrangements for fisheries, the *Draft Convention* makes the resources of the sea the "common heritage" of humanity, the prerogatives of which are to be exercised by an agency drawing its membership from all states that are members of the United Nations and participants in the law of the sea conferences.

The main interests reflected in the elaborate draft are those of land-based producers of nickel and the minor metals in the nodules (most importantly Canada but also a number of developing country exporters of metals), those of the major industrial countries who have sought favourable investment opportunities for their private corporations, and those of the "Group of 77" of developing countries. The last group have professed a special concern for the common heritage of humanity and have sought mechanisms through which natural resources of the ocean can be made to yield a role for a major new mining corporation, the Enterprise, to be owned by the international community, and also revenue for international development purposes.

The first set of interests is represented in the control on the expansion of production of metals from the sea (United Nations 1980:56-58, Article 151). The controls limit production to the growth in world demand for metals in the period up to

the commencement of commercial production, and then 60% of either the trend of the actual increase in demand or 3% annually, whichever is greater. The controls are only restrictive if seabed mining is successful, in which case they will introduce an element of monopoly rent into the returns of those investors who are fortunate enough to be allowed entry into deep-sea production, as well as land-based metal producers.

The second and third interests were in direct conflict, and the treatment of the Enterprise and the fiscal arrangements for private investors must be seen as a package and evaluated together. Although the fiscal arrangements viewed in isolation seem highly favourable to private investors, they were accompanied by, and were no doubt a *quid pro quo* for, requirements that private investors provide special assistance to the Enterprise. One half of the value of successful exploration by private investors must be made available to the Enterprise. This is equivalent to a 100% tax on exploration expenditure. On land, this amount would be seen as burdensome on an activity that should be encouraged but might escape this judgment in relation to mining investments that were expected to be highly profitable and lightly taxed. Private investors are also required to make technology available to the Enterprise on conditions that are not specified in detail but that can be expected to reduce the return to investors of investments in research and development.

The fiscal framework is highly complex. One feature is the absence of normal corporate and personal income taxes, or any version of the common sales and import duties, on the activities of extraterritorial miners and their employees. In the absence of international taxation, which had the potential for being a major source of revenue for international purposes (Cooper 1976), there is some prospect of competition for taxation jurisdiction, for example between home governments of investors and their employees and the governments that are hosts to processing facilities. However these matters are resolved, deep-sea mining will probably be treated more favourably for general taxation purposes than is land-based mining in most countries. Although this favourable treatment may not cause uneconomic overexpansion of deep-sea mining because of the production controls, it may occasion higher profits for investors than would otherwise rule. The absence of normal taxation on extraterritorial mining would seem to be undesirable on both distribution and allocation grounds. Perhaps it is not too late to effect some change in these arrangements.

A second feature is the elaborate rules for allocating production licences among private investors. They establish an orderly queuing system in which the first in is served first but only once until all have been served — a setup that would seem to preclude competitive bidding for licences. Minor prior cash payments are provided for in the *Draft Convention*, but most revenue can be expected to derive from conditional payments.

The *Draft Convention* defines a complex hybrid of ad valorem charges on sales revenue, annually progressive profits tax, and resource rent tax. The component on the annually progressive profits tax shows clear signs of having been received via Papua New Guinea's 1974 Bougainville Copper Agreement, whereas the resource rent tax component takes the form of Papua New Guinea's Ok Tedi Agreement.

The *Draft Convention* defines two parallel systems of conditional payments, between which the investor may choose (United Nations 1980:139–145, Article 13). The first is a straightforward system of ad valorem charges on revenue, of the type that is familiar from, and at rates that are fairly common in, traditional mining agreements and legislation. The second is a combination of ad valorem charges at low rates and an annually progressive profits tax, both becoming larger after the investor has recovered cash outlays with interest as in the resource rent tax. The investor declares once and for all which of the two systems it will follow within 1 year of the commencement of commercial production.

The ad valorem charges alone will be applied at the rate of 5% in the first 10 years of commercial production and 12% thereafter. The lower rates in the earlier years are designed to reduce risk and so assist financing and can also be justified in terms of revenue maximization on the reasonable assumption that private investors would apply higher discount rates to future tax flows than would the regulatory agency. The rates are sufficiently high, especially after the 10th year, to distort production decisions through their incentives to "high grading" — even on the highly profitable seabed mining operations to which the ad valorem taxation option is most likely to be applied.

The alternative fiscal arrangement is divided into a less severe early period and a more severe later period, based on the good reasons underlying the ad valorem system. The two periods are separated by the time at which cash outlays are recouped in real terms with interest at 10%/year on the basis of the formula of the resource rent tax. The use of an economic rather than temporal

basis for dividing the period of lower from that of higher taxation allows the objectives of maintaining taxation in early years to be met with lower cost, all other things being equal.

In the early period of the alternative tax arrangement, investors will be required to pay an ad valorem production charge of 2%, plus 35% of profits that represent a return on investment (indexed to current values) between 0% and 10%, 42.5% of profits that represent a return on investment between 10% and 20%, and 50% of profits that represent a return on investment in excess of 20%. In the late period, the rate of ad valorem payments rises to 4%, and the profit shares to 40% on profits representing up to 10% return on (indexed) investment, 50% on profits representing a return between 10% and 20%, and 70% on profits representing a return in excess of 20%.

The definition of investment is taken from Papua New Guinea's Bougainville Copper Agreement, but there is an automatic indexing of past outlays. Like the Bougainville Copper Agreement, the *Draft Convention* defines capital investment generously by adding in to the capital base all capital expenditure and deducting depreciation and amortization only on capital items being replaced.

The fiscal arrangements had to come to grips with the allocation of outlays and revenue to the mining component (covering mining, transport, and shipping). In this respect, the *Draft Convention* was generous to the investor by allocating profits in proportion to capital outlays in the various activities. This stipulation provides a clearcut solution to a practical problem but is hardly consistent with the theory of resource rent because the high profits deriving from resource rent are properly attributable to the mining phase that is to be the subject of the proposed fiscal arrangements.

The alternative fiscal framework should induce only minor "high-grading" effects and have less effect in inhibiting marginal investments than the ad valorem system. The balance of incentives would seem to favour the investor's election for the ad valorem system in projects that are expected to be highly profitable and the mixed system in projects that are expected to be moderately profitable. Paradoxically, the introduction of the choice of two fiscal systems probably makes the system as a whole both more distorting and less onerous in terms of expected revenue yield than a profit-based system alone.

Discussion

T.K. Shoyama: In my view, Ross Garnaut has contributed an outstanding paper to the proceedings of the conference. It blends basic economic theory about resource rent with an exposition of the principles of fiscal analysis and fiscal structure applicable to the collection of such rents. It considers the possibilities afforded by the new law of the sea not only for the collection of rents on fisheries resources but also for the collection of rents that may inhere in the seabed mineral resources, producing helpful parallels and useful distinctions between renewable and nonrenewable resources.

The paper notes that resource owners — and particularly the state — can seek to capture rents in a variety of ways as long as the rents are not dissipated by the uncontrolled entry of harvesters with excess capacity. The problem is overcapitalization, and it has been especially familiar in common-property resources such as fisheries where the state is often called upon to provide subsidies rather than being in a position to capture rents. In seabed mineral resources, or other

natural resources where rights of access can be definitely assigned, the essential approach is to provide exclusive property rights on the basis of either the prior fixed payment (e.g., disposal on the basis of competitive bid) or a series of conditional payments extending over a period of production. This latter can be in the form of specific royalties or taxes.

In practice, there is much to be said for a fiscal strategy combining both approaches, taking into account all the inherent production and market risks that the commercial producer and the fiscal authority, both, are anxious to minimize. Garnaut strongly favours the concept of a resources rent tax (RRT). Here, the most important feature is that little or no tax is payable until the initial investment has been recouped by the enterprise, together, of course, with interest. When the basic payout has been achieved, a variety of tax structures of increasing severity can be applied.

This basic approach has been applied, according to Garnaut, in the exploitation of mineral resources in Papua New Guinea, and it would be