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PRICING THE NEW ZEALAND FISH STOCK UNDER A QUOTA MANAGEMENT SYSTEM

R K Linder*, H F Campbell**
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Discussion Paper 4/89

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* Professor of Agriculture (Agricultural Economics), University of Western Australia.

** Professor of Economics, University of Tasmania.

*** Senior Economist, New Zealand Fishing Industry Board.

1. INTRODUCTION

The background to this paper is an on-going dispute between the New Zealand fishing industry and the New Zealand government about the economically justifiable level of payment by the industry to the government for the right to catch fish in New Zealand territorial waters. Perhaps not surprisingly, this dispute has at times become rather heated, and even litigious. A beneficial side effect of the litigation for economists has been the insights provided about the reasoning underlying government policy-making as revealed in otherwise confidential documents appended to the judgements handed down by the court.

To date, the dispute has centred on widely different estimates of the annual value of the various fish stocks to the New Zealand economy. For instance, in some government documents, it was estimated that in 1987 this value could have been as high as $80 million. On the other hand, the industry argued that in 1987/88 it made an economic loss in excess of $50 million. While some discounting for ambit claims might be called for, substantial differences of opinion clearly exist. From the court proceedings referred to above, it is clear that the government took much more notice of prices paid by fishermen for the right to catch fish, while the industry placed much more credence on the results of a government conducted survey of fishing profitability. The primary purpose of this paper will be to review and reconcile the apparently conflicting evidence from these two sources.

If and when current differences about the valuation of fish stocks are resolved, another dispute that is likely to come to the fore is how much of this value should government charge the industry for the right to try to catch fish. As this issue is the focus of another paper currently under preparation, only passing reference will be made to it in this paper.

2. THE NEW ZEALAND QUOTA MANAGEMENT SYSTEM.

New Zealand has led the world in the wholesale adoption of Individual Transferable Quotas (ITQ's) on catch to regulate exploitation of almost all fish stocks. The ITQ is a conditional transferable property right denominated in tonnes of catch of a specified fish stock which is allocated to fishermen in the form of the right to harvest "surplus production". Consequently the sum of all ITQ's for a given fish stock determines the corresponding Total Allowable Catch (TAC) which serves as the basis for an economics oriented system of fishery management relying on limiting output directly rather than on inefficient input controls. Such a fishery management system has long been advocated on theoretical grounds as offering the best prospects for an economically efficient and administratively effective system which prevents over-capitalisation of catching capacity as well as protecting the naturally occurring fish stock. The world is now watching the New Zealand experiment with considerable interest to judge whether this system performs as well in practice as is predicted by theory.

The Quota Management System (QMS) is described in detail by Clark and Major (1988) and Clark (1989), as well as being analysed in some detail by Anderson (1988). Hence only selected aspects pertinent to this paper will be summarized briefly here. The system was first developed in 1983 for a limited number of deepwater fish stocks, and then extended in 1986 to almost all remaining significant fish stocks. For most species, ITQ's were allocated on the basis of past tonnages harvested, although some quota was sold to industry via a tendering process. In some fisheries, the Government also reduced the TAC by buying back some of the allocated quota.

As the basic property right involves an entitlement in perpetuity to catch the specified annual tonnage of fish how and when the quota holder wishes, the system ought to provide incentives to harvest the catch at minimum cost. Whether such a system also results in the most economically efficient outcome will depend inter alia on the costs of enforcement. Furthermore, because this property right can be freely traded, quota owners, including the government managers, can lease their quota on an annual basis, as well as buying or selling quota in perpetuity. The details of all such trades, including tonnage traded, price per tonne, and transaction date have to be registered with the Ministry of Agriculture, Forestry and Fisheries (MAFFISH) as part of the QMS. Some of these trades over the past two years were made through a computer exchange set up by the New Zealand Fishing Industry Board to facilitate quota trades, but apart from government to industry trades, most were arranged privately.

The system is flexible in the sense that the government can adjust TAC's in advance of the season. Note though that since the ITQ property right is denominated in tonnages rather than as a percentage of the TAC, the TAC can be adjusted only by government trading in quota.

In all cases, the ITQ's are conditional property rights to catch fish. These rights are conditional in the sense that an annual "resource rental" (i.e. royalty) is payable by quota holders to government. The level of this royalty is set in advance of the season and it must be paid whether the fish are taken or not. Hence the royalty must be paid on the TAC regardless of natural conditions, and at the present level regardless of economic conditions. This means that all the risks associated with a season's fishing are borne by the industry.

While the government also can adjust the resource rental from season to season, once these adjustments have been made the system is relatively inflexible. Thus even though the government bears some of the risk through its trading in quota, since most of the quota is in private hands it is the industry that bears most of the inter-seasonal risk as well.

3. THE BASIS FOR SETTING RESOURCE RENTALS

We now turn to the contentious issue of the procedures used by government to set resource rentals, since it is disagreement over the proper level of these resource rentals that has been at the heart of the above mentioned dispute.

A prerequisite to any rational discussion of this issue is agreement about the (tax) base on which resource rentals should be levied. In the New Zealand Fisheries Act (1983), the term "resource rental" refers to a charge levied on industry for the right to make use of the stock of fish contained in New Zealand territorial waters in pursuit of the fishing industry's commercial objectives. Unfortunately the Act does not contain any explicit direction on the fundamental question of the appropriate tax base, possibly because those framing the Act did not conceive of resource rentals as a tax. Therefore in the following discussion we first define the appropriate tax base from the perspective of economic theory, and then briefly discuss potential problems associated with any alternative approach.

In economic theory, the term "resource rent" (or natural resource rent) refers to the value which the fishing industry creates from the opportunity to exploit the fish stock. In principle, resource rent can be measured by the difference between the revenues earned and ALL costs associated with exploiting the natural resource. This rent can be expressed either as an annual cash flow or as a capitalized sum. As a capitalised sum, natural resource rent can be regarded as the market value of fish in the sea, (or for that matter, minerals in the ground, or timber in natural forests).

To avoid confusion in this paper, the term resource rental will be reserved to denote the charge levied on the industry for access rights to exploit the fish stock in the sense used in the Act, and the value to the national economy of this access right will be referred to henceforth as fishery management rent or management rent for short. It is defined as the price ultimately received for the fish less all long-run average costs of catching, processing, and marketing the fish if all inputs are paid their marginal value product, and less any super-normal profits earned from processing or marketing.

The justification for using this latter term is spelt out in Anderson (1988). His argument is that in an open access fishery where all potential fishermen are free to enter the industry, the value of "natural resource rent" will be driven down to zero because new entrants will continue to increase the pressure of catching activities on the fish stock until such time as all rent is dissipated. There is ample empirical evidence to support the view that the most significant characteristic of an unmanaged fishery is economic over-fishing in response to perceived opportunities for economic profit which cannot be realized because of competitive forces. As a result, fish in the sea would have no net value in the absence of efficient management because, in the long-run, the revenues obtained from sale of fish would be balanced by the costs of harvest and bringing the product to market.

Consequently, it is only by a management authority limiting access to the fishery that natural resource rent (i.e. management rent) is generated. Note that this argument is the main justification in economic theory for all government intervention into the management of fisheries, as by doing so they can restrict the fishing pressure on the fish stock and thereby generate value to society from use of the fish stock. In other words, it is the conjunction of the naturally occurring resource of the fish stock in combination with management of access rights to exploit this natural resource that creates potential value. It is for this reason that this value will be referred to as fishery management rent in the paper.

As noted above, it is not clear from the New Zealand Fisheries Act (1983) or from other material available to the authors whether the Government accepts the premise from economic theory that fishery management rent is the appropriate base for setting resource rentals. There is a suggestion in some of the Government papers that the tax base should be so-called super-normal profits. There are two problems with this point of view.

First, fishery management rent is strictly speaking a cost of production rather than a component of super-normal profits. This should be quite evident in the New Zealand case. That part of the fishery management rent generated by the QMS and captured by Government in the form of resource rentals clearly is a cost to the industry. The remainder will be capitalised into the value of the ITQ's which, like other factors of production, need to be held by fishermen in order to catch fish. This is true whether or not the fishermen actually own the ITQ and/or were originally "given" it. From the point of view of a fishing firm, ITQ's are directly analogous to other capital assets such as a piece of real estate on which rent is charged for the use of the property. Hence it is immaterial whether the "owner" of the resource is the public sector or a private individual or organization. What is important is that property rights in the resource are created, held by some entity, and have to be acquired AND retained, either by lease or purchase, in order to generate resource rent in the form of an income flow for the owner of the resource.

Second, it is generally accepted that there are a number of potential sources of super-normal profits, such as monopoly market power, privileged information, etc. Consequently, even if fishery management rent were regarded as a component of super-normal profits, any procedure for basing resource rentals on measured super-normal profits would most likely result in other components of super-normal profits also being subject to resource rentals. Since such other elements of super-normal profits are legitimately subject to normal income or profits taxes, making them first subject to resource rentals at a rate greater than the normal business profit taxation rate might involve a degree of double taxation.

Given the above arguments, we proceed in the rest of this paper to assume that fishery management rent is the appropriate tax base for setting resource rentals. There are two consequent issues. One is the correct imputation of fishery management rent in any given year from the available evidence, and the second is the proportion of estimated annual fishery management rent that Government should try to capture if it is concerned with sound economic management.

In practice, fishery management rent can be expected to fluctuate from year to year for a variety of reasons, including changes in the general rate of inflation, fluctuations in the real price of fish, technological change affecting the efficiency of catching operations, changes in the size of the fish stock which have consequential effects on the catch rate for any given level of fishing effort, and the extent to which the industry's catching capacity is in balance with possible, and/or economic, and/or allowable size of the catch. As a corollary, there is no necessary inconsistency between success of the QMS in generating long-run positive fishery management rent, and negative fishery management rent in one or more particular years. Whether resource rentals collected by government also <u>ought</u> to fluctuate from year to year in sympathy with fluctuations in annual fishery management rent is a complex issue that will not be addressed here.

Under Section 107G of the New Zealand Fisheries Act (1983), the Minister can recommend variation of resource rentals provided that :

"in making any recommendation under sub section (1) of this section the Minister shall have regard to :-

(a) the value of individual transferable quotas for the species or class of fish :

(b) the net returns and likely net returns to commercial fishermen for fish caught; including any difference in operating costs of foreign owned New Zealand vessels and other New Zealand fishing vessels:

(c) any relevant changes in total allowable catches:

(d) any submissions made to the Minister under sub section (6) this section :

(e) such other matters as the Minister considers relevant"

While sub-sections (c), (d), and (e) above appear to give the Minister considerable latitude in the criteria he considers relevant, so far as can be determined from released documents the primary considerations taken into account in setting resource rentals for the 1987/88 and 1988/89 fishing seasons were "the value of ITQ's" and, arguably, "the net returns and likely net returns to commercial fishermen for fish caught". In order to make judgements about these two items for the 1987/88 fishing season, the Minister had available to him the following kinds of evidence :

- comprehensive information on trading prices for perpetual and annual quota
- industry profitability as calculated from the Annual Enterprise Survey conducted by the Department of Statistics.

Notwithstanding compelling evidence of negative management rents from the industry profitability survey, fishermen continue to pay positive prices to acquire quota held in perpetuity, and also pay positive prices for the right to the annual lease of such transferable quotas. Apparently government officials have deduced from this quota trading information that positive management rents are currently being earned in the industry which justified aggregate resource rentals in excess of $20m for 1987/88 and of the order of 20 per cent higher for 1988/89. Estimated resource rentals for the 1987/88 season are reported in Table 1, from which it can be seen that the predicted total rental payable was $20.77 million.

There are two approaches to attempting to resolve this apparent contradiction. One is to use the standard economic theory of fishery management to derive predictions about the generation of rent in a managed fishery. The other is to analyse the empirical information which is available in an attempt to reconcile the apparently conflicting evidence. Most of the paper takes the latter approach.It discusses the correct imputation of fishery management rent from evidence on industry profitability and quota trading prices, and demonstrates that there is no inconsistency provided that evidence from both sources is interpreted correctly. Since the reasons why it maybe rational for fishermen to pay positive prices for acquisition of quota held in perpetuity differ in many material respects from those reasons why it maybe rational to pay positive prices for the annual lease of individual transferable quotas, these two sources of information will be treated separately.

4. ECONOMIC THEORY OF RENT GENERATION IN A MANAGED FISHERY

Before considering the empirical evidence on fishery management rent,we briefly review the economic theory of fishery rent. In Figure 1 we reproduce a diagram which was used, inter alia, by Anderson (1988) to analyse the difference between an open-access and an optimally managed fishery. For simplicity the analysis assumes that the fishery is exploited by a large number of identical vessels or "firms". Figure 1(a) illustrates the short-run average total cost and average fixed costs of a typical firm in long-run equilibrium. The minimum point of the short-run average cost curve also is he minimum long-run average cost denoted by c. At this point, average fixed costs are denoted by K.

Figure 1(b) shows the relationship between the value of the average product of fishing effort, (VAPE), and total fishing effort defined as the number of vessels times the amount of effort contributed by each vessel. The value of the average product of fishing effort is the price of fish, assumed to be a constant in this model, times the catch per unit effort. The VMPE curve represents the value of the marginal product of effort, measured as fish price times the marginal physical product of effort.

In the open-access fishery, effort enters the fishery in response to perceived opportunities for earning economic rent. This drives down the value of the average product of effort until all rent has been dissipated. The open-access equilibrium is at Eo where the value of the average product just equals the opportunity cost of effort. By contrast, in a fishery managed so as to maximise the flow of rent, effort will be set at a level, E*, so that the value of the marginal product of effort just equals its opportunity cost. When we use the diagram to compare the open-access with the optimally managed fishery we employ the technique of comparative static analysis. This involves comparing the initial pre-management equilibrium with the new equilibrium once management is established, with no analysis of the process whereby the system moves from the initial to the new equilibrium. The reason for emphasizing this latter point is that the move from Eo to E* involves significant changes in the biology and economics of the fishery which take time to occur. This means that analysis based on Figure 1 can be misleading if it is used to make predictions about the short-run in which the adjustment process is still occurring.

The main adjustment which occurs as a result of optimal management is the reduction in effort from Eo to E*. This has two effects in the long-run: one is a reallocation of effort to more productive uses elsewhere in the economy (provided that it is competitive); and the other is an increase in the productivity of the effort which continues to be devoted to the fishery. In the long-run a fishery management rent is predicted to emerge. It is measured in a number of ways in Figure 1. The simplest measure is the area FDBC which is the value of the average product of effort less opportunity cost per unit of effort, and multiplied by the optimal level of effort. It is also measured by area ABC which is the value of the total harvest less total catching costs. A third, and less obvious measure is area BGH, and it is worth explaining in detail why this is so. In the initial open-access equilibrium there is no economic rent generated by the fishery. This means that the value of total output, measured by area AHEoE* is equal to total cost, measured by CGEoO. It follows from this that area BGH must equal area ABC which is a measure of management rent. Thus areas FDBC, ABC, and BGH are equal to one another and equal to the flow of management rent per period.

An intuitive explanation of why the fishery management rent can be measured by the area BGH lies in the reallocation of effort to more productive uses elsewhere. The effect of optimal management is to exclude Eo-E* units of effort from the fishery. In the long-run this amount of effort can produce goods valued at BGEoE* elsewhere in a competitive economy. Another effect of excluding this amount of effort from the fishery, however, is to reduce the value of harvest by BHEoE*. The net gain is BGH which is a measure of fishery management rent.

It can be seen from the above analysis that the generation of fishery rent depends both upon the reallocation of effort to other areas of the economy and on the recovery of the fish stock, leading to higher catch rates. While these two effects can be expected to occur in the long-run, there are reasons to believe that neither will occur in the short-run. Much of fishing effort consists of industry specific capital which has no productive use elsewhere in the economy, and the fish stock will take time to grow. In the short-run, a reduction in effort from Eo to E* will reduce the value of the catch by area BGEoE* in Figure 1(b). However, because of fixed costs, this will be only be partially offset by an increase in value of output elsewhere in the economy measured by the area BGML. The loss to the economy in the short-run is given by area LMEoE*. This area can be regarded as a case of investing in a management system which will yield long-run benefits.

The improvement in catch per unit effort which results in the value of the average product of effort rising from its open-access equilibrium level, OC, to its level under optimal management, OF, is caused by an increase in the size of the fish stock. A reduction in fishing effort will obviously allow the fish stock to grow but this process takes a period of time which depends on the biology of the stock. Initially when management is introduced the catch per unit effort will be less than that implied by a value of the average product equal to OF, and in the extreme case it will still be at OC in the short-run. If a Quota Managemnt System (QMS) is introduced and sets a TAC equal to the the optimal harvest in long-run equilibrium, then the amount of effort which can be devoted to the system in the short-run will be higher than E* because catch per unit of effort is still at OC. This means that the losses described in th eprevious paragraph will be mitigated somewhat. However, even in the short-run, effort will be in the range E*<E<Eo and some losses will occur.

To recapitulate, the short-run effect of fishery management is to impose a loss on the economy which could approach the size of area LMEoE*. This area can be regarded as the cost of investing in a system of fishery management which will yield a long-run flow of benefits measured by the area AEC. The incidence of the cost of the system depends upon institutional arrangements, analysis of which is beyond the scope of the present paper. In the remainder of this paper, we examine empirical evidence in an attempt to assess the short-run effect of the QMS.

5. IMPUTATION OF MANAGEMENT RENT

In the analysis presented in the previous section of the paper it was concluded that in the short-run a QMS would impose costs rather than yield benefits. This means that fishery management rent, which is the tax base upon which resource rentals are levied, is negative in the short-run. Which sector of the economy bears these short-run costs depends on institutional arrangements, but it is reasonable to expect that at least a portion will be borne by the fishing industry. We now examine the three sources of evidence available; the industry profitability data, the price of perpetual quota, and the price of annual lease quota.

(a) Industry Profitability Data

Imputation of the size of the management rent from industry profitability data comprised two steps. The Department of Statistics carried out a survey of fishing industry profitability for the period to 31 March 1988, and industry and the government jointly funded a study by Jarden & Co. of the required rate of return on assets for the fishing industry. Aggregate industry revenues, costs, and asset values as estimated from the industry survey are set out in Table 2.

Since the profit figure reported in Table 2 is a measure of accounting profit, it is necessary to make adjustments to derive estimated economic profits. Of the various expenditure items, interest payments are not an admissible expense in calculating economic profits since the opportunity cost of the entire capital base will be estimated separately. To impute the opportunity cost of capital, an estimate of the required rate of return on capital needs to be applied to an appropriate measure of asset value. Of the various measures listed in Table 2, historical book value will be an underestimate because of inflation, while undepreciated replacement cost will over-estimate true value. Valid arguments in support of either of the other two measures could be mounted, but as there is little difference between the two, and because the government has accepted market value as a reasonable measure, we will do likewise.

A "weighted average cost of capital" (WACC) needs to be applied to the market value of assets in order to arrive at the opportunity cost of capital. The Jarden study referred to above estimated the WACC to be 19.2% after tax. Again, government and industry are in dispute over the validity of this estimate, with industry arguing for a rate in excess of 23%, and government contending that the correct rate is 15.5%. As it is outside the scope of this paper to review the claims and counter-claims in any detail, we simply utilise the Jarden estimate without further comment. Opportunity cost of capital as estimated by this approach is $102.6 million. By adding back interest payments (which are a portion of capital cost already accounted for in the WACC), and by deducting estimated opportunity cost of capital from post-tax accounting profit, we arrive at an adjusted profit figure of -$37 million for economic profit in 1987/88.

There are several grounds for believing that even this large loss understates the true economic loss incurred by the industry in 1987/88. First, to the extent that accounting depreciation was based on historical cost asset values, it will understate real depreciation. Second, conventional accounting procedures commonly under-estimate true economic costs (ie the marginal value product of the input). For instance, owner-operator's of fishing firms often have highly developed catching skills which are not fully recompensed by their salary payments. Anderson (1988) dubs these unrewarded expenses "high-liner rents". Whatever they are called, the represent under-payment of the true cost of catching fish, and thereby overstate both accounting and economic profit.

Finally, for reasons spelt out in more detail later in this paper, it is likely that fishery management rent will be lower than economic profit (or loss). In essence, the reason is that economic profit can include other components, such as super-normal profits, in addition to fishery management rent. It is for these reasons that the industry claims of losses as large as $81 million have some credibility. On the other hand, we have not heard any convincing arguments that support the view that economic losses were substantially less than $37 million in 1987/88.

(b) Prices Paid for Perpetual Quota

Some idea of the characteristics of the market for quota can be gained from Table 3 in which trades for ITQ of selected fish stocks are summarised. For each species, this Table contains the average price paid for perpetual quota, the median price, and the highest and lowest decile price in the 1986/7 and 1987/8 seasons. Aggregate quota value of the fishery as a whole can be estimated by multiplying median price by the respective TAC for each species, and then summing across species. Unfortunately, data available at the time of writing was incomplete, and so only provided lower bound estimates of aggregate value. The estimated capitalised value of the fishery derived from 1986/7 data was $550 million while the 1987/8 data suggest a value of $765 million.

Before conclusions are drawn from the data reported in Table 3, some reservations about its reliability should be noted. According to industry sources, statistics on trading prices for ITQ cannot be taken at face value because the prices recorded on the registration forms are often fictitious. Some trades take place between different legal entities which are under common managerial control at purely nominal prices, while other trades are really barter transactions with no money changing hands. Preliminary analysis of quota trading data has revealed numerous anomalies which support this point of view.

Decisions to hold ITQ in perpetuity are clearly long run decisions. Obviously then, it will only be rational to acquire such assets as long as the capitalised value of the <u>expected</u> stream of annual willingness to pay for quota exceeds or is at least equal to the purchase price. In this context, a distinction needs to be made between willingness to pay for quota on a short-run or on a long-run basis. For reasons to be discussed below, annual willingness to pay for quota on a short-run basis is likely to exceed annual fishery management rent by a considerable margin. Many of these reasons do not apply to the long-run, but nevertheless there are some grounds why even long-run willingness to pay might exceed long-run fishery management rent, and we will return to these matters shortly.

First however, we briefly review the reasons why annual fishery management rent might be expected to grow over time as such expectations will be capitalised into prices paid for ITQ held in perpetuity. Due to the difficulties of imputing fishery management rent in any given year from these capitalised prices for quota in perpetuity, government has now indicated that in future it will rely mainly on prices paid for annual lease of ITQ's.

One reason why the expected annual management rents are likely to increase over time is because inflation results in an increase in the general level of prices. Inflation of itself is not material to the analysis of quota trading prices as long as the discount rate used to capitalise annual willingness to pay is consistent with expectations about inflation embodied in projections of expected annual management rents. It is common in economic analysis to assume a risk-free real discount rate of about five per cent to which must be added an appropriate allowance for commercial risk. In the Jarden study, the weighted average cost of capital was estimated to be just over 19% pa. Given an inflation rate at the time of about 10 per cent, this implies a risk premium of just four per cent which many industry members would regard as too low. If the risk inclusive real discount rate were 10 per cent, And if real fishery management rents were not expected to change over time, then but only then could annual fishery management rent be imputed from competitive market trading prices for ITQ in perpetuity simply by dividing by ten.

The second likely source of changes in the level of annual management rent are a direct consequence of implementation of the Quota Management Scheme itself. These effects include both short run and long run effects. As suggested by the analysis in the previous section, in the short run any reduction in the total allowable catch below historical levels will leave the industry with an excess of fishing capacity. The immediate effect of this excess capacity is to increase the average cost to the industry of fish caught. To the extent that the industry was previously in long run equilibrium such that the average cost of catching fish just equalled prices received, then the immediate effect of implementation of the Quota Management Scheme would have been to raise average financial costs above returns from catching. In other words, the industry would have been forced to operate in the short run with negative management rents. Correctly interpreted, the evidence presented in Section 5(a) suggests that this is the situation currently facing the New Zealand industry.

In the somewhat longer run, there will be two other developments which will gradually eliminate the negative management rents, and actually generate positive management rents. The first of these is industry restructuring or capacity rationalisation whereby industry's decisions to invest and/or disinvest in fishing capacity will over time bring the capacity to catch fish back into line with total allowable catch as specified by the quota management scheme. As these two levels come back into balance, average cost of catching fish will decline back to minimum long run average levels. If there has been no interim change in the real price of fish and/or in catch rates, this restructuring would just eliminate negative management rents.

However, any quota management scheme which succeeds in its avowed objectives will over time correct any over-exploitation of the fish stock and lead to an increase in its size. Catch rates and hence the average returns from catching fish are positively related to stock size, so success of the quota management scheme in solving the problem of over-exploitation of the fish stock will simultaneously generate positive management rents in future years. Any analysis of quota trading prices which fails to take account of these consequential effects of implementation of a quota management scheme is seriously flawed.

There also are other reasons for expecting management rents to increase over time. Once the ITQ system becomes effective, rents generated by technological change should not be dissipated by over-fishing, so firms will have a greater incentive to invest in new technology which improves the productivity of catching activities.

Agriculture is probably the industry which provides the best indication of how this will effect future rates of productivity improvement in fishing. In both industries, there are relatively large numbers of small firms, and both industries involve exploitation of a natural resource stock, namely the stock of fish in the case of fishing, and land in the case of agriculture. All of the results from studies of the rate of return on capital investment in agriculture consistently show very low rates of return (i.e. typically around 3% per annum on total invested capital, including the value of land). The other way of viewing this evidence is that land prices are over capitalised, that is they give an overestimate of the current profitability of farming.

It is generally agreed that there are two main reasons why this should be so. One is that farmers value farming as a way of life, and are prepared to accept lower returns in order to continue to enjoy the lifestyle. There is an obvious correspondence to the situation for small, owner/operator fishermen. The other generally agreed reason for the depressed returns in agriculture is that productivity keeps improving as a result of research and development. As a result, farmers expect the returns of farming to keep rising over time, and these expectations get capitalised into land prices. It seems reasonable to assume that a similar situation will henceforth exist in the New Zealand fishing industry with capitalised prices for ITQs being the equivalent of capitalised land prices in agriculture.

However unlike agriculture, there are good grounds for believing that the real price of fish will increase over time, which is another way of saying that the actual price of fish is likely to increase at a rate faster than the rate of inflation. The grounds for predicting real fish prices to increase over time are twofold. One is that the supply of fish from the ocean is highly inelastic, because there is limited environmental carrying capacity available to sustain a fish stock. The other reason is that the demand is likely to increase or shift outwards over time. Two forces are driving demand to shift over time, one being the high income elasticity of demand in combination with rising real incomes. The other reason is a shift in tastes towards fish and away from red meats on health grounds. In any industry where an increase in demand meets inelastic supply, real prices will increase.

To demonstrate that high positive trading prices for ITQ in perpetuity are not inconsistent with negative fishery management rent in any given year, the net present value of the stream of annual willingness to pay for quota given assumed values for the variables discussed above was calculated over a 40 year period. As this term is less than the "life" of the property right, this procedure is expected to result in a slight under-estimate of actual willingness to pay for quota in perpetuity. For the purpose of this exercise, it also was assumed that annual willingness to pay equalled annual fishery management rent. The effect of this assumptiom also will be to under-estimate quota trading prices. The results are reported in Table 4.

In an attempt to generate numbers with at least some semblance of realism, the initial annual level of catch revenue was set at $750 million to approximate reported aggregate revenue in 1986/87 (Fishing Industry Board, 1988). Initial catching costs were varied iteratively so as to end up with an estimated capitalised value of aggregate quota between $800 million and $1,000 million. As a result of this procedure, initial catching costs were assumed to be $846 million, resulting in an initial fishery management rent of -$96 million.

Conservative assumptions about the various dynamic forces discussed above were then made in order to project how these initial values would vary over time. Without further analysis it is difficult to know just how long it will take for restructuring to reduce average costs of the catching industry. For the purpose of analysis it was assumed that average costs would fall by a total of 10% spread over a five year period.

Allowance also was made for the fact that the introduction of the quota management system should have a beneficial effect on the size of the fish stock, and hence on catch rates. Again assumptions about the likely increase in size of the fish stock, and about the time lags necessary for such an increase to eventuate, had to made without the benefit of any specific analysis of New Zealand fisheries. Actual values will depend on the biology of the species of the fish involved, on the extent of over-exploitation of the fish stock prior to implementation of the quota management system, and on the extent of the reduction in catch levels mandated by total allowable catches. In other fisheries, a total increase in catch rates of up to 30% is not uncommon. For the purpose of this exercise an eventual increase in the fish stock, and in consequence the catch rate, of only 10 per cent was assumed to take ten years to eventuate.

Other assumptions made include a general inflation rate of 10%, a risk-inclusive nominal discount rate of 20 per cent, a mere 1% annual rate of increase in catching productivity due to technical progress, and only a 1% per annum increase in the real price of fish due to forces already discussed above.

As a result, there is a positive net present value of willingness to pay for quota of over $900 million which contrasts dramatically with an initial negative management rent of nearly $100 million. To sum up, the analysis described above clearly demonstrates that there is nothing inconsistent between payment of large positive prices for individual transferable quotas in perpetuity on the one hand, and negative current fishery management rents on the other. Recent estimates of the current capitalised value of all individual transferable perpetual quotas held by the industry are of the order of $800 million as reported in Table 3. If we use the conversion ratios derived from Table 4 to impute management rent, this implies that the current level of management rent in the New Zealand fishing industry may be considerably more negative than the industry survey suggested. Admittedly, this estimate is highly speculative, but it is striking for its approximate consistency with the estimates of current management rent derived from the recent survey of industry profitability.

To this point, it has been assumed that annual willingness to pay for quota is synonymous with and equal to annual management rent attaching to the individual transferable quota. Most of the reasons why annual willingness to pay exceeds annual management rent are much more important in the context of short run decision making, and therefore will be deferred to the next section in which the determinants of prices paid for the annual lease of individual transferable quotas will be discussed.

There is however one more general reason why annual willingness to pay for quota will exceed annual management rent in the context of both short run and long run decision making. This arises because of the considerable uncertainty faced by fishermen both about the cost of catching fish, and about the financial returns from doing so. Notwithstanding this uncertainty, resource rentals are set and must be paid _ex ante_ (i.e. before the start of the fishing year). However, the payment of the resource rental and the act of holding the quota per se, do not create any obligation to attempt to catch fish irrespective of the actual return from doing so.

In other words, holding quota is analogous to holding an option in the financial markets to purchase shares at some future date. It is generally accepted that capital markets are efficient in processing available information, so the expected value of future price movements will be zero. However, notwithstanding these expectations, it is common knowledge and has been repeatedly documented by empirical investigation as well as supported by theoretical analysis that a positive price is paid in the market for such options to purchase shares. It is rational to do so because again there is no actual obligation to take up the option if future price movements prove to be unfavourable. Consequently, the positive prices at which such options typically trade provide a partial measure of the cost of market risk.

Likewise, given that holding quota only provides the option to fish, annual willingness to pay for quota by rational fishermen will exceed expected management rent by a premium which is equivalent to option prices in the share market. Therefore the first step to be taken to impute the size of the expected management rent from prices at which quota are traded is to deduct an appropriate option premium. The size of such an option premium will be equal to the expected value of the avoided losses by not fishing if and when future returns do not cover variable costs.In the long-run, if unfavourable scenarios such as a collapse in fish prices and/ or stocks materialise and force quota holders to mothball some or all of their quota, it may be possible to avoid certain semi-fixed costs as well as variable catching costs. Moreover, as more distant future events are typically regarded as more uncertain, this option premium is likely to be larger with respect to long-run decisions than for short-run decisions. Without further research though, it is only possible to speculate about the possible size of such an option premium.

In the next section we turn to a separate body of evidence, namely that from trading in annual leases of individual transferable quotas.

(c) Prices Paid for Annual Lease of Quota.

A summary of trading prices for annual lease of quota for selected fish stocks is reported in Table 5. As with the prices for perpetual quota reported in Table 3; high, low, median, and average prices are reported. An lower bound estimate of aggregate willingness to pay for annual lease quota of $59 million for the 1986/7 season, and of $75 million for the 1987/8 season was obtained by multiplying the median price by the corresponding TAC for each species for which data was available.

In recent correspondence with the industry, the government has indicated that it intends to rely even more heavily in future on trading prices for annual lease of ITQ's as the basis for setting resource rentals. While this might seem like a sound approach in theory, there are several reasons why it is unlikely to provide reliable and accurate estimates of actual fishery management rent.

Most economists would accept that in a deterministic and certain world the price of quota in the annual lease market will measure management rent provided that the market is competitive and in long-run steady state equilibrium, and provided that quota trades are not conditional on trades of other assets such as vessels, or otherwise distorted by tax or regulatory considerations.

Unfortunately, the current annual lease markets in the New Zealand fishing industry do not conform to the sort of ideal and stylized market described above. In the first place, the industry is operating under a set of cost conditions which are not conducive to a competitive equilibrium. More importantly, changes brought about by implementation of the QMS guarantee that the industry will be going through a period of adjustment for a few years. Secondly, price, cost and catching conditions facing the industry are, and will continue to be stochastic even after industry has adjusted to the QMS. Hence the market operates in a climate of highly imperfect information. Thirdly, trade in quotas is likely to be distorted by tax or other considerations.

There is one fundamental fact which underlies all of the above caveats about using annual lease prices to set resource rentals. In contrast to decisions to buy individual transferable quotas in perpetuity, almost by definition decisions to lease quota on an annual basis will be dictated by short run rather than by long run considerations. Hence willingness to pay for quota in the short run will be determined primarily by the margin between additional revenue obtainable as a result of lease of the quota and the incremental or variable costs associated with utilisation of the leased quota. In addition, to the extent that there is uncertainty about future returns and/or costs, willingness to pay will again be inflated by the option premium, although possibly not by as much as for long run decisions.

We now review some of the evidence which can be used to gauge the extent to which the annual lease market departs from the economist's stylized model, and then we discuss the consequences of basing estimates of fishery management rent on annual quota leasing prices. We start by considering the effect of industry disequilibrium and lack of competition in a deterministic world. Then we discuss the effects of conditional trades. Finally we examine the working of an annual lease market in a stochastic world where traders have access only to imperfect information.

The transition from an unmanaged to a managed fishery involves a period of industry disequilibrium. The standard fishery economics model predicts that a significant characteristic of this disequilibrium will be excess capacity in the catching sector. The Fishing Industry Board conducted a survey of capacity utilization in August 1988. Each of the respondents indicated that they had excess capacity in the harvesting sector, roughly in the order of 25-30%. Anecdotal evidence about depressed prices for boats and fishing gear is consistent with this depiction of excess capacity. The costs of capital committed to the industry in the form of boats, gear, knowledge about location of productive fishing grounds, etc. are "sunk costs" (ie they cannot be withdrawn from the industry without substantial loss). While the industry's capital base is contracting, individual firms will be making their decisions on the basis of variable costs. This means that quota prices in the short-run can be bid up to a level equal to the difference between product price and average variable cost of production. This is a level well in excess of management rent.

The requirement in the Act to balance catch with quota at the end of each month creates what is undoubtedly the most extreme example of a situation where almost all costs are sunk costs. Most operators catch a range of species and the catch-mix may not match the mix of species quota held. Vessels which exceed their quota for a species are required to purchase additional quota to cover the excess before the proceeds from the sale of the catch are released to them. When the need to acquire quota arises, willingness to pay for quota on a short term basis can exceed management rent by a sum which includes all otherwise variable costs as well as all fixed and overhead costs involved in catching fish. Indeed, because resource rentals themselves are payable quarterly in advance, even these costs are fixed and cannot be saved during the course of the year. Furthermore once the fish have been caught, literally none of the costs involved in catching them are variable any more, in other words all are sunk. In the circumstances it is rational for fishermen to be willing to pay any price for quota up to the port price for delivering the fish.

No doubt many trades for annual lease of individual transferable quotas are not made in such dire circumstances as those described above. For instance, a firm might anticipate the need to lease additional quota in order to balance likely catch with quota entitlement several months in advance of the need materialising. In such circumstances, costs of labour, fuel and other operating costs will most likely be variable, but other costs such as administration, the opportunity cost of capital invested in shipping and office space etc, depreciation of plant and equipment, plus any contractual obligations of a long term nature which cannot be avoided simply by electing not to put out to sea and try to catch fish, will be fixed. The firm's willingness to pay for quota in the short-run will not take these fixed costs into account with the result that willingness to pay will exceed current management rent.

The degree of market concentration in the New Zealand fishing industry is not consistent with the assumption of a competitive market. The percentages of total quota held in 1986/87 by the six largest quota holders for three major species were Hoki - 76%; Orange Roughy - 75%; Squid - 59% (New Zealand Fishing Industry Board, 1989). When a market is highly concentrated many transactions which occur are not "at arms length". This means that the recorded price is a notional price which may well be set at a level consistent with a firm's tax or other objectives, or even chosen at random. Thus recorded price under these circumstances need bear no relationship to management rent.

The concentration in ownership of quota reflects similar concentration in the processing sector which results from the existence of scale economies. For instance, because the ability to catch fish can generate extra returns in other sectors of the industry, such as processing and/or marketing, a vertically integrated firm may be willing to acquire extra quota because it has excess capacity in its processing and/or marketing arms which can generate positive gross margins if extra fish are caught and not because it is associated with any positive management rent derived from catching fish. Consequently the gross margins from these post harvest operations also can get incorporated into the willingness to pay for annual lease of quota, and must be deducted to impute management rent. Significant scale economies are inconsistent with competitive equilibrium. As a result, the marginal willingness to pay for quota (approximated by wholesale product price less the marginal cost of catching and processing) will exceed management rent (ie approximated by port price less long-run average catching costs. The reason for this is that, in contrast to the competitive model, marginal cost is below average cost when scale economies are present.

Catch quotas are highly complementary to other inputs in the industry such as vessels and processing capacity. Sales of vessels together with quota are reasonably common, particularly in a market in which there is excess catching capacity and where the possession of quota is the critical limiting factor. In these circumstances the important consideration to the trading parties is the overall price of the transaction - the price of vessel <u>and</u> the quota, so the recorded price of quota is a notional price which again may bear no relationship to management rent.

An examination of annual lease trading prices for hoki quotas in the 1986/87 and 1987/88 suggests that at least some recorded prices bear no relation to management rent. We chose hoki quota as an example because it is a major species which is caught in a single zone and has been subject to a significant number of trades. In 1986/87, 62 trades representing 58% of total trades in hoki quota, took place at a price in excess of $400 per tonne which we have used as a rough estimate of the port price of hoki. For the 1987/88 fishing year, the number of trades at a price higher than $400 per tonne had dropped to 10, representing 6% of trades for that year. Since management rent per tonne of fish is measured by port price less unit catching cost, quota prices in excess of port price are clearly not measuring rent.

In addition to the above considerations, Anderson (1988) has carefully explained how what he calls 'highliner rents' and what otherwise can be regarded as under payment of fishing skills also are likely to be incorporated into the price paid for annual lease of ITQs.

We now leave the deterministic world portrayed by the simple model of market equilibrium and turn to a world in which prices, costs and catching conditions are subject to changes which can be treated as occurring at random from the point of view of the industry. In this stochastic world quota holders can be assumed to have expectations about the likely values of economic and environmental variables, and hence about the value of quota. Since different holders will have access to different information, and since the underlying process which is assumed to generate the information is stochastic, there will be a wide range of views about quota value and there will no longer be a single market price reflecting the value of quota to the marginal buyer and seller.

When we examine annual lease quota trading prices we find a wide dispersion in the range of observed prices for quota for the same species in the same zone at the same point in time. These observations are consistent with a market operating under imperfect information as described above. Again, an example is provided by trading in hoki quota. Figure 2 shows the high, low and average prices for each month in the 1986/87 and 1987/88 seasons. A competitive market operating under good information would be unlikely to yield such a diverse range of prices for a uniform product during a time period when the underlying factors determining asset value can have changed little.

The detailed analysis of the functioning of a market under imperfect competition can be very complex, and is beyond the scope of this paper. A simple search model would predict that an individual's asking price for quota will take on more extreme values the lower are the opportunity costs of not making a trade and the lower is the quality of information about the market clearing price of quota. As the fishing season progresses more and better information about the value of annual lease quota becomes available. If the information is favourable (better than expected price or catch) asking price will be raised, and this better quality or "harder" information will result in a smaller dispersion of prices. The opportunity cost of holding quota may rise or fall over the season depending on whether catch is worse or better than expected : if worse, the quota holder may find that there is no market in the quota late in the season because the TAC cannot be taken; if better he may find strong demand for quota by vessels which need extra quota at the end of the season to cover higher than expected catches.

Bearing in mind that many of the prices depicted in the graph of minimum, average and maximum prices are notional, the general trend of prices appears to bear some relation to the model described above. The main hoki fishing season is in July and August. Prior to that we would expect a considerable amount of uncertainty and a wide range of views about the prospects for the season. The wide range of prices prior to the main part of the 1986/87 and to a lesser extent, the 1987/88 season reflects this uncertainty. As information becomes available during the main season the range of prices narrows as would be predicted by a simple search model. Since the management rent is in principle measured by prices generated in a competitive market under perfect information the prices observed during the latter part of the season would be a better indication of management rent if all of the other conditions for the ideal and stylized market were satisfied. However, this is most unlikely to be the case because realised catch may exceed or fall short of expected catch.

The extent to which it might be necessary to discount trading prices for annual lease of quota to obtain a measure of current management rent can be very large indeed. To illustrate this point, consider the case of the very short-run when nearly all costs are fixed because they have already been incurred. In these circumstances, management rent might be equal to only 5% of the port price for fish, so willingness to pay for annual lease of quota would need to be discounted by about 95% to arrive at the true value of management rent. Moreover, if management rent was negative, in excess of 100% of the price received for fish might need to be deducted from the price paid for annual lease of an ITQ in order to correctly infer the current level of fishery management rent.

Without more time to carry out an analysis of the structure of fishing industry costs, it is not possible to identify in detail the magnitude of these costs under all possible circumstances. Data on the costs of deepwater trawling for four representative vessels are provided in New Zealand Fishing Industry Board (1988, Table 6.5). On average for these vessels, the cost of crew, fuel and repairs equal 48% of catch value , which is a proxy for total cost. On the same basis, all non-capital costs average 77% of total costs. Aggregate data on costs of catching fish also are available from surveys conducted by the Board, and these data are summarised in Table 6. Even given the conservative assessment of such costs in the medium rather than the very short term, at least 19% of fishing costs seem sunk. For more short term decisions, this percentage would be higher.

To illustrate the implications of the existence sunk costs for annual lease quota prices as a measure of current management rent, we suppose that sunk costs and other appropriate deductions are a percentage of the price received for fish. To cover all possible circumstances, the percentage deduction calculated ranged from 10% to 50% and was deducted from the immediate price paid for annual lease of quota for different species. The results of these calculations are reported in Table 7. It can be seen that even with what is regarded as the most conservative assumption possible, namely that sunk costs total 20% of the price received for fish, estimated aggregate management rent for all New Zealand fisheries is negative and very large in value. A more realistic estimate would most likely be obtained after deducting at least 30% of prices paid for fish. Again these estimates are striking for they are consistent with the figures from the industry survey of profitability.

6 CONCLUSION

In theory, a QMS can generate fishery management rent in the long-run. In the short-run however, losses will occur in the transition from an open-access to a managed fishery. Which sector(s) of the economy will incur these losses will depend upon the institutional arrangements underlying implementation of the QMS, but it is a reasonable hypothesis that most if not all of the costs of investing in a larger fish stock will be incurred in the first instance by the fishing industry.

All of the available evidence, both from quota trading prices and from a survey of industry profitability, points to the fact that current management rents in the New Zealand fishing industry are negative and large. Industry profitability data collected by the Department of Statistics suggests that the loss in 1978/88 was of the order of $40 million. In the paper, it was suggested that the fact that quota continued to be traded at positive prices during this period was not inconsistent with evidence of negative management rent. Perpetual quota prices are determined by expectations about future benefits from fishing, while annual lease quota prices are driven by short-run considerations, so neither provide a satisfactory measure of current management rent.

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TABLE 1

ESTIMATED RESOURCE RENTAL PAYMENTS FOR THE 1987-88 FISHING SEASON

		DOMESTIC FLEET			CHARTER FLEET			TOTAL FLEET
	Total Allowed Catch (Tonnes)	Est. % of TAC	Resource Rental Rate ($/Tonne)	Domest. Rental Payments ($m)	Est. % of TAC	Resource Rental Rate ($/Tonne)	Charter Rental Payments ($m)	Total Rental Payments ($m)
1.INSHORE SPECIES								
BLUE COD	1690	90%	$13	0.020	10%	$26	0.004	0.024
BLUENOSE	1213	90%	$13	0.014	10%	$26	0.003	0.017
CRAYFISH	5500	100%	$330	1.815	0%	$660	0.000	1.815
ELEP.FISH	392	80%	$19	0.006	20%	$38	0.003	0.009
FLAT FISH	5699	100%	$15	0.085	0%	$30	0.000	0.085
GREY MULLET	918	100%	$8	0.007	0%	$16	0.000	0.007
GURNARD	3752	90%	$12	0.041	10%	$24	0.009	0.050
HAP.BASS	1506	90%	$18	0.024	10%	$36	0.005	0.030
J.MACKEREL	15210	90%	$6	0.075	10%	$11	0.017	0.092
JOHN DORY	726	90%	$17	0.011	10%	$34	0.002	0.014
MOKI	77	90%	$9	0.001	10%	$18	0.000	0.001
OYSTERS	7500	100%	$22	0.166	0%	$44	0.000	0.166
PAUA	1115	100%	$105	0.117	0%	$210	0.000	0.117
RED COD	12966	90%	$9	0.105	10%	$18	0.023	0.128
SCALLOPS	5000	100%	$250	1.250	0%	$500	0.000	1.250
SCH.SHARK	1691	70%	$15	0.017	30%	$29	0.015	0.032
SNAPPER	6178	100%	$41	0.253	0%	$82	0.000	0.253
RIG	1340	100%	$17	0.023	0%	$34	0.000	0.023
STARGAZER-1	877	80%	$13	0.009	20%	$26	0.005	0.014
STARGAZER-2	1054	80%	$3	0.003	20%	$6	0.001	0.004
TARAKIHI	4746	90%	$11	0.047	10%	$22	0.010	0.057
TREVALLY	3085	90%	$11	0.031	10%	$22	0.007	0.037
B.WAREHOU	4277	80%	$7	0.024	20%	$14	0.012	0.036
TOTAL	86512			4.144			0.117	$4.262
2. DEEPWATER SPECIES								
ALFONSINO	1554	90%	$7	0.010	10%	$14	0.002	0.012
BARRACOUTA-1	22242	50%	$6	0.061	50%	$11	0.122	0.183
BARRACOUTA-2	1290	50%	$3	0.002	50%	$6	0.004	0.006
HAKE-1	1416	10%	$27	0.004	90%	$54	0.069	0.073
HAKE-2	952	10%	$22	0.002	90%	$44	0.038	0.040
HOKI-1	101250	20%	$10	0.200	80%	$20	1.604	1.804
HOKI-2	133000	20%	$8	0.219	80%	$17	1.756	1.975
LING-1	12980	60%	$33	0.257	40%	$66	0.343	0.600
LING-2	1287	60%	$28	0.021	40%	$55	0.028	0.050
OREO DORY	20120	30%	$14	0.081	70%	$27	0.380	0.462
O. ROUGHY-1	39571	80%	$120	3.799	20%	$240	1.899	5.698
O. ROUGHY-2	4000	80%	$100	0.320	20%	$200	0.160	0.480
GEMFISH	5029	30%	$14	0.021	70%	$28	0.099	0.120
SQUID(J)	18417	25%	$57	0.262	75%	$114	1.575	1.837
SQUID-1	17200	20%	$57	0.196	80%	$114	1.569	1.765
SQUID-2	21827	25%	$29	0.156	75%	$57	0.933	1.089
S.WAREHOU	5862	20%	$30	0.035	80%	$60	0.281	0.317
TOTAL	407997			5.648			10.861	16.509
GRAND TOTAL	494509			9.792			10.978	20.770

Source: Compiled by FIB Economics Division

Table 2 :
RESULTS OF INDUSTRY SURVEY FOR YEAR TO 31 MARCH, 1988

	$m
ASSETS	
Book value	419.1
Replacement value	717.3
Indemnity value	528.6
Market value	534.3
REVENUE	
Sales	731.6
Other	164.7
TOTAL	896.3
EXPENDITURE	
Fuel	98.7
Fish purchases	185.9
Hire & Charter	146.1
Rentals	20.6
Employment payments	107.7
Depreciation	22.9
Interest	48.1
Repairs	26.1
Other	214.9
TOTAL	871.0
PROFIT	25.2
Tax (30 %)	7.6
AFTER TAX PROFIT	17.7

TABLE 3 SUMMARY OF TRADING DATA FOR PERPETUAL QUOTA FOR SELECTED FISH STOCKS

SPECIES & ZONE	TAC (tonnes)	86/87 SEASON PRICES ($/tonne) Low	Weighted Av	Median	High	Est. Aggreg. Value ($m)	87/88 SEASON PRICES ($/tonne) Low	Weighted Av	Median	High	Est. Aggreg. Value ($m)
Barracouta											
1	8589	$30	$1,313	$756	$5,900	$6.49	$50	$1,018	$1,000	$1,375	$8.59
5	9010	$1,100	$1,348	$1,210	$2,200	$10.90	$370	$370	$370	$370	$3.33
7	10539	$50	$310	$350	$2,000	$3.69	$10	$562	$350	$2,000	$3.69
Flatfish											
1	1101	$400	$2,489	$2,018	$6,600	$2.22	$3	$3,486	$3,850	$5,500	$4.24
2	674	$300	$1,172	$2,100	$3,850	$1.42	$884	$2,175	$1,700	$3,000	$1.15
3	2430	$400	$2,268	$3,300	$21,373	$8.02	$99	$3,256	$3,630	$5,000	$8.82
7	1840	$100	$2,084	$1,730	$5,000	$3.18	$50	$2,226	$2,000	$3,685	$3.68
Gurnard											
1	2010	$100	$2,941	$2,000	$8,000	$4.02	$5	$3,200	$3,000	$5,618	$6.03
2	645	$180	$1,175	$1,000	$3,300	$0.65	$750	$1,834	$1,600	$2,599	$1.03
3	480	$750	$2,069	$1,650	$4,424	$0.79	$1,334	$2,143	$2,000	$3,300	$0.96
7	610	$15	$1,029	$800	$3,005	$0.49	$15	$1,095	$1,050	$3,000	$0.64
8	511	$200	$903	$762	$3,850	$0.39	$750	$860	$750	$1,600	$0.38
Hoki											
1	250028	$25	$253	$550	$4,167	$137.52	$300	$616	$650	$2,000	$162.52
Orange Roughy											
2A	5600	$3,400	$4,161	$3,833	$6,600	$21.46	$6,600	$7,066	$6,600	$7,425	$36.96
3B	38000	$90	$3,836	$3,882	$6,235	$147.52	$2,000	$3,500	$5,000	$5,000	$190.00
7A	10000					$0.00	$5,000	$5,000	$5,000	$5,000	$50.00
Paua											
5	445					$0.00	$6,000	$9,348	$15,000	$38,500	$6.68
7	250					$0.00	$841	$9,776	$19,800	$27,500	$4.95
Red Cod											
1	30	$100	$1,699	$1,060	$3,960	$0.03					$0.00
2	353	$100	$665	$600	$1,500	$0.21	$450	$965	$900	$1,000	$0.32
3	11972	$68	$631	$800	$1,970	$9.58	$99	$983	$1,000	$3,300	$11.97
7	2945	$25	$745	$500	$4,167	$1.47	$5	$948	$600	$2,000	$1.77
Snapper											
1	4714	$12	$13,401	$13,401	$20,900	$63.17	$13	$13,630	$14,000	$17,600	$66.00
2	131	$800	$2,706	$2,706	$8,250	$0.35	$800	$4,096	$5,000	$14,300	$0.66
7	330	$25	$3,223	$3,223	$8,250	$1.06	$2	$3,741	$2,200	$11,550	$0.73
8	1331	$200	$4,616	$4,616	$11,000	$6.14	$100	$2,889	$1,900	$9,900	$2.53
Squid											
1J	57705					$0.00	$500	$500	$500	$500	$28.85
1T	30962					$0.00	$1,600	$1,600	$1,600	$1,600	$49.54
6T	32333					$0.00					$0.00

TABLE 4 DETERMINANTS OF NET PRESENT VALUE OF MANAGEMENT RENT

WILLINGNESS TO PAY FOR "PERPETUAL" QUOTA FOR 40 YRS.= $904 million
[BASED ON FOLLOWING HYPOTHETICAL VALUES]

YEAR	CATCH REVENUE ($ mill)	CATCH RATE INDEX	CATCH EFFORT NEEDED	PRODUC-TIVITY INDEX	EFFORT INPUTS NEEDED	FACTOR PRICES INDEX	COST OF CATCH ($ mill)	MANAGEMENT RENT ($ mill)
1	$750	1.00	3,563	1.00	3,563	1.00	$846	($96)
2	$833	1.01	3,529	1.01	3,494	1.10	$913	($80)
3	$924	1.02	3,495	1.02	3,426	1.21	$985	($61)
4	$1,026	1.03	3,462	1.03	3,360	1.33	$1,062	($36)
5	$1,139	1.04	3,429	1.04	3,295	1.46	$1,146	($7)
6	$1,264	1.05	3,397	1.05	3,232	1.61	$1,236	$28
7	$1,403	1.06	3,364	1.06	3,170	1.77	$1,334	$69
8	$1,557	1.07	3,333	1.07	3,108	1.95	$1,439	$119
9	$1,728	1.08	3,301	1.08	3,048	2.14	$1,552	$176
10	$1,919	1.09	3,270	1.09	2,990	2.36	$1,674	$244
11	$2,130	1.10	3,239	1.10	2,932	2.59	$1,806	$323
12	$2,364	1.10	3,239	1.12	2,903	2.85	$1,967	$397
13	$2,624	1.10	3,239	1.13	2,874	3.14	$2,142	$482
14	$2,912	1.10	3,239	1.14	2,846	3.45	$2,333	$579
15	$3,233	1.10	3,239	1.15	2,817	3.80	$2,541	$692
16	$3,588	1.10	3,239	1.16	2,790	4.18	$2,768	$821
17	$3,983	1.10	3,239	1.17	2,762	4.59	$3,014	$969
18	$4,421	1.10	3,239	1.18	2,735	5.05	$3,283	$1,139
19	$4,908	1.10	3,239	1.20	2,708	5.56	$3,575	$1,332
20	$5,448	1.10	3,239	1.21	2,681	6.12	$3,894	$1,554
21	$6,047	1.10	3,239	1.22	2,654	6.73	$4,241	$1,806
22	$6,712	1.10	3,239	1.23	2,628	7.40	$4,619	$2,093
23	$7,450	1.10	3,239	1.24	2,602	8.14	$5,030	$2,420
24	$8,270	1.10	3,239	1.26	2,576	8.95	$5,479	$2,791
25	$9,179	1.10	3,239	1.27	2,551	9.85	$5,967	$3,213
26	$10,189	1.10	3,239	1.28	2,525	10.83	$6,498	$3,691
27	$11,310	1.10	3,239	1.30	2,500	11.92	$7,078	$4,232
28	$12,554	1.10	3,239	1.31	2,476	13.11	$7,708	$4,846
29	$13,935	1.10	3,239	1.32	2,451	14.42	$8,395	$5,540
30	$15,468	1.10	3,239	1.33	2,427	15.86	$9,143	$6,325
31	$17,169	1.10	3,239	1.35	2,403	17.45	$9,958	$7,211
32	$19,058	1.10	3,239	1.36	2,379	19.19	$10,845	$8,213
33	$21,154	1.10	3,239	1.37	2,355	21.11	$11,812	$9,343
34	$23,481	1.10	3,239	1.39	2,332	23.23	$12,864	$10,617
35	$26,064	1.10	3,239	1.40	2,309	25.55	$14,010	$12,054
36	$28,931	1.10	3,239	1.42	2,286	28.10	$15,259	$13,672
37	$32,114	1.10	3,239	1.43	2,264	30.91	$16,619	$15,495
38	$35,646	1.10	3,239	1.45	2,241	34.00	$18,099	$17,547
39	$39,567	1.10	3,239	1.46	2,219	37.40	$19,712	$19,855
40	$43,920	1.10	3,239	1.47	2,197	41.14	$21,469	$22,451

TABLE 5 SUMMARY OF TRADING DATA FOR ANNUAL LEASE OF QUOTA FOR SELECTED FISH STOCKS

SPECIES & ZONE	TAC (tonnes)	86/87 SEASON PRICES Low	Weighted Av	Median	High	Est. Aggreg. Value ($m)	87/88 SEASON PRICES Low	Weighted Av	Median	High	Est. Aggreg. Value ($m)
		($/tonne)					($/tonne)				
Barracouta											
1	8589	$41	$146	$110	$330	$0.94	$6	$83	$120	$500	$1.03
5	9010	$20	$115	$120	$200	$1.08	$11	$136	$150	$165	$1.35
7	10539	$16	$86	$50	$350	$0.53	$6	$46	$36	$350	$0.38
Flatfish											
1	1101	$165	$538	$500	$880	$0.55	$225	$517	$500	$800	$0.55
2	674	$173	$331	$303	$500	$0.20	$87	$353	$303	$2,020	$0.20
3	2430	$320	$462	$500	$540	$1.22	$10	$276	$300	$727	$0.73
7	1840	$75	$601	$110	$1,900	$0.20	$11	$212	$99	$500	$0.18
Gurnard											
1	2010	$55	$427	$400	$1,250	$0.80	$10	$323	$275	$900	$0.55
2	645	$218	$292	$218	$600	$0.14	$125	$272	$218	$1,450	$0.14
3	480	$55	$190	$125	$220	$0.06	$5	$223	$200	$400	$0.10
7	610	$38	$532	$55	$850	$0.03	$24	$91	$52	$247	$0.03
8	511	$55	$86	$75	$110	$0.04	$12	$52	$65	$247	$0.03
Hoki											
1	250028	$16	$64	$24	$1,000	$6.00	$10	$105	$60	$1,000	$15.00
Orange Roughy											
2A	5600	$180	$881	$500	$1,540	$2.80	$300	$490	$1,100	$1,100	$6.16
3B	38000	$330	$509	$440	$2,000	$16.72	$220	$245	$220	$300	$8.36
7A	10000					$0.00	$20	$186	$240	$500	$2.40
Paua											
5	445					$0.00	$7,150	$7,641	$7,150	$9,100	$3.18
7	250					$0.00	$3,000	$3,047	$3,000	$3,800	$0.75
Red Cod											
1	30					$0.00	$50	$97	$50	$143	$0.00
2	353	$87	$184	$143	$300	$0.05	$18	$126	$143	$143	$0.05
3	11972	$11	$142	$100	$180	$1.20	$7	$154	$55	$200	$0.66
7	2945	$22	$175	$28	$675	$0.08	$10	$148	$23	$3,000	$0.07
Snapper											
1	4714	$100	$2,178	$2,000	$3,300	$9.43	$3	$1,458	$1,100	$2,750	$5.19
2	131	$293	$547	$293	$700	$0.04	$41	$973	$293	$1,950	$0.04
7	330	$19	$354	$95	$1,900	$0.03	$55	$403	$100	$1,900	$0.03
8	1331	$110	$1,116	$1,000	$1,650	$1.33	$2	$951	$1,000	$2,000	$1.33
Squid											
1J	57705					$0.00	$125	$125	$125	$125	$7.21
1T	30962					$0.00	$10	$134	$114	$200	$3.53
6T	32333					$0.00	$63	$10	$63	$10	$2.04

Table 6 :
AGGREGATE ACCOUNTS FOR THE CATCHING ACTIVITIES OF ELEVEN MAJOR QUOTA HOLDERS FOR THE YEAR TO 31/3/88

	$m	
ASSETS		
Replacement value	371	
Indemnity value	247	
EXPENDITURE	$m	%
Fuel	66.5	17.1
Fish	54.1	13.8
Providoring	1.7	0.4
FIB Levies	1.2	0.3
Employment payments	30.9	7.8
Rentals, Hire & Charter	130.1	33.3
Repairs	20.1	5.2
Other	12.3	3.2
ITQ Lease	4.5	1.2
Rates & Harbour Duties	2.4	0.6
Insurance	5.0	1.3
Extraordinaries	4.6	1.2
Depreciation*	10.0	2.6
Required Return on Assets (= 19% of indemnity value)	46.9	12.0
TOTAL COSTS	390.3	

* This value appears to be based on depreciated historical cost, and almost certainly under-estimates true depreciation.

TABLE 7 MANAGEMENT RENT IMPUTED FROM PRICE OF ANNUAL LEASE OF ITQ's ($m)

Species	Total Allowed Catch (tonnes)	Median Price $/tonne	Est. Fish Price $/kg	[% of AV. TOTAL COST assumed "SUNK"]				
				10% $mill.	20% $mill.	30% $mill.	40% $mill.	50% $mill.
Barracouta								
1	8589	$120	$0.35	0.730	0.429	0.129	-0.172	-0.472
4	3010	$40	$0.35	0.199	0.093	-0.012	-0.117	-0.223
5	9010	$150	$0.35	1.036	0.721	0.405	0.090	-0.225
7	10539	$33	$0.35	-0.021	-0.390	-0.759	-1.128	-1.497
Total	31148			1.944	0.854	-0.237	-1.327	-2.417
Blue Cod								
1	30	$215	$1.50	0.002	-0.003	-0.007	-0.012	-0.016
2	10	$180	$1.50	0.000	-0.001	-0.003	-0.004	-0.006
3	120	$347	$1.50	0.024	0.006	-0.012	-0.030	-0.048
4	600	$124	$1.50	0.033	-0.057	-0.147	-0.237	-0.327
5	1190	$310	$1.50	0.190	0.012	-0.167	-0.345	-0.524
7	110	$100	$1.50	-0.006	-0.022	-0.039	-0.055	-0.072
8	60	$82	$1.50	-0.004	-0.013	-0.022	-0.031	-0.040
total	2120			0.240	-0.078	-0.396	-0.714	-1.032
Blue Nose								
1	459	$363	$2.50	0.052	-0.063	-0.178	-0.292	-0.407
2	660	$450	$2.50	0.132	-0.033	-0.198	-0.363	-0.528
3	150	$36	$2.50	-0.032	-0.070	-0.107	-0.145	-0.182
7	60	$215	$2.50	-0.002	-0.017	-0.032	-0.047	-0.062
8	20	$266	$2.50	0.000	-0.005	-0.010	-0.015	-0.020
Total	1349			0.150	-0.187	-0.525	-0.862	-1.199
Alfonsino								
1	10	$240	$1.00	0.001	0.000	-0.001	-0.002	-0.003
2	1510	$165	$1.00	0.098	-0.053	-0.204	-0.355	-0.506
3	150	$203	$1.00	0.015	0.000	-0.015	-0.030	-0.045
7	60	$203	$1.00	0.006	0.000	-0.006	-0.012	-0.018
8	20	$203	$1.00	0.002	0.000	-0.002	-0.004	-0.006
Total	1750			0.123	-0.052	-0.227	-0.402	-0.577
Elephant Fish								
1	10	$220	$1.50	0.001	-0.001	-0.002	-0.004	-0.005
2	21	$55	$1.50	0.004	0.001	-0.002	-0.005	-0.009
3	280	$644	$1.50	0.138	0.096	0.054	0.012	-0.030
5	60	$374	$1.50	0.013	0.004	-0.005	-0.014	-0.023
7	90	$140	$1.50	-0.001	-0.014	-0.028	-0.041	-0.055
Total	461			0.156	0.086	0.017	-0.052	-0.121
Mixed Flat Fish								
1	1101	$500	$1.50	0.385	0.220	0.055	-0.110	-0.275
2	674	$303	$1.50	0.103	0.002	-0.099	-0.200	-0.301
3	2430	$330	$1.50	0.437	0.073	-0.292	-0.656	-1.021
7	1840	$99	$1.50	-0.094	-0.370	-0.646	-0.922	-1.198
total	6045			0.832	-0.075	-0.981	-1.888	-2.795
Grey Mullet								
1	910	$500	$1.50	0.319	0.182	0.046	-0.091	-0.228
2	20	$500	$1.50	0.007	0.004	0.001	-0.002	-0.005
3	30	$500	$1.50	0.011	0.006	0.002	-0.003	-0.008
7	20	$500	$1.50	0.007	0.004	0.001	-0.002	-0.005
Total	980			0.343	0.196	0.049	-0.098	-0.245

TABLE 7 MANAGEMENT RENT IMPUTED FROM PRICE OF ANNUAL LEASE OF ITQ's ($m)

Species		Total Allowed Catch (tonnes)	Median Price $/tonne	Est. Fish Price $/kg	[% of AV. TOTAL COST assumed "SUNK"] 10% $mill.	20% $mill.	30% $mill.	40% $mill.	50% $mill.
Gurnard									
	1	2010	$275	$1.20	0.312	0.070	-0.171	-0.412	-0.653
	2	645	$218	$1.20	0.063	-0.014	-0.092	-0.169	-0.246
	3	480	$200	$1.20	0.038	-0.019	-0.077	-0.134	-0.192
	7	610	$52	$1.20	-0.041	-0.115	-0.188	-0.261	-0.334
	8	511	$65	$1.20	-0.028	-0.089	-0.151	-0.212	-0.273
Total		4256			0.344	-0.167	-0.678	-1.189	-1.699
Hake									
	1	2500	$150	$1.20	0.075	-0.225	-0.525	-0.825	-1.125
	4	1000	$275	$1.20	0.155	0.035	-0.085	-0.205	-0.325
	7	3000	$50	$1.20	-0.210	-0.570	-0.930	-1.290	-1.650
Total		6500			0.020	-0.760	-1.540	-2.320	-3.100
Hoki									
	1	250029	$60	$0.50	2.500	-10.001	-22.503	-35.004	-47.506
Total		250029			2.500	-10.001	-22.503	-35.004	-47.506
Hapuku/Groper									
	1	360	$530	$1.80	0.126	0.061	-0.004	-0.068	-0.133
	2	212	$675	$1.80	0.105	0.067	0.029	-0.010	-0.048
	3	270	$640	$1.80	0.124	0.076	0.027	-0.022	-0.070
	4	300	$40	$1.80	-0.042	-0.096	-0.150	-0.204	-0.258
	5	410	$280	$1.80	0.041	-0.033	-0.107	-0.180	-0.254
	7	210	$350	$1.80	0.036	-0.002	-0.040	-0.078	-0.116
	8	60	$291	$1.80	0.007	-0.004	-0.015	-0.026	-0.037
total		1822			0.397	0.069	-0.259	-0.587	-0.915
John Dory									
	1	510	$550	$2.00	0.179	0.076	-0.025	-0.128	-0.230
	2	242	$525	$2.00	0.079	0.030	-0.018	-0.067	-0.115
	3	30	$358	$2.00	0.006	0.000	-0.006	-0.012	-0.018
	7	70	$151	$2.00	-0.003	-0.017	-0.031	-0.045	-0.059
Total		852			0.260	0.090	-0.081	-0.251	-0.422
Jack Mackerel									
	7	20000	$75	$0.20	1.100	0.700	0.300	-0.100	-0.500
Total		20000			1.100	0.700	0.300	-0.100	-0.500
Ling									
	1	200	$430	$1.40	0.058	0.030	0.002	-0.026	-0.054
	2	913	$330	$1.40	0.173	0.046	-0.082	-0.210	-0.338
	3	1851	$330	$1.40	0.352	0.093	-0.167	-0.426	-0.685
	4	4300	$270	$1.40	0.559	-0.043	-0.645	-1.247	-1.849
	5	2500	$150	$1.40	0.025	-0.325	-0.675	-1.025	-1.375
	6	7000	$270	$1.40	0.910	-0.070	-1.050	-2.030	-3.010
	7	1960	$110	$1.40	-0.059	-0.333	-0.608	-0.882	-1.156
total		18724			2.018	-0.603	-3.224	-5.846	-8.467
Blue Moki									
	1	133	$180	$1.00	0.011	-0.003	-0.016	-0.029	-0.043
	3	60	$198	$1.00	0.006	-0.000	-0.006	-0.012	-0.018
	4	20	$126	$1.00	0.003	0.001	-0.001	-0.003	-0.005
	5	40	$400	$1.00	0.012	0.008	0.004	-0.000	-0.004
Total		253			0.032	0.006	-0.019	-0.044	-0.069

TABLE 7 MANAGEMENT RENT IMPUTED FROM PRICE OF ANNUAL LEASE OF ITQ's ($m)

Species		Total Allowed Catch (tonnes)	Median Price $/tonne	Est. Fish Price $/kg	[% of AV. TOTAL COST assumed "SUNK"]				
					10% $mill.	20% $mill.	30% $mill.	40% $mill.	50% $mill.
Oreo Dory									
	1	4000	$100	$0.50	0.200	-0.000	-0.200	-0.400	-0.600
	3a	10000	$92	$0.50	0.420	-0.080	-0.580	-1.080	-1.580
	4	7000	$96	$0.50	0.322	-0.028	-0.378	-0.728	-1.078
	6	3000	$96	$0.50	0.138	-0.012	-0.162	-0.312	-0.462
total		24000			1.080	-0.120	-1.320	-2.520	-3.720
Orange Roughy									
	2a	5600	$300	$1.70	0.728	-0.224	-1.176	-2.128	-3.080
	2b	1053	$198	$1.70	0.029	-0.150	-0.329	-0.508	-0.687
	3a	2689	$220	$1.70	0.134	-0.323	-0.780	-1.237	-1.694
	3b	38000	$198	$1.70	1.045	-5.415	-11.875	-18.335	-24.795
	7a	10000	$20	$1.70	-1.500	-3.200	-4.900	-6.600	-8.300
	7b	1558	$250	$1.70	0.125	-0.140	-0.405	-0.670	-0.935
total		58900			0.561	-9.452	-19.465	-29.478	-39.491
Paua									
	2	100	$5,075	$10.00	0.408	0.308	0.208	0.107	0.008
	3	57	$5,075	$10.00	0.232	0.175	0.118	0.061	0.004
	4	261	$5,075	$10.00	1.064	0.803	0.542	0.281	0.020
	5	445	$5,075	$10.00	1.813	1.368	0.923	0.478	0.033
	7	250	$5,075	$10.00	1.019	0.769	0.519	0.269	0.019
Total		1113			4.535	3.422	2.309	1.196	0.083
Red Cod									
	1	30	$50	$0.50	-0.000	-0.002	-0.003	-0.005	-0.006
	2	353	$143	$0.50	0.033	0.015	-0.002	-0.020	-0.038
	3	11972	$55	$0.50	0.060	-0.539	-1.137	-1.736	-2.335
	7	2945	$23	$0.50	-0.080	-0.227	-0.374	-0.521	-0.669
Total		15300			0.013	-0.752	-1.517	-2.282	-3.047
School Shark									
	1	560	$275	$1.50	0.070	-0.014	-0.098	-0.182	-0.266
	2	162	$300	$1.50	0.024	-0.000	-0.024	-0.049	-0.073
	3	270	$440	$1.50	0.078	0.038	-0.003	-0.043	-0.084
	4	200	$295	$1.50	0.029	-0.001	-0.031	-0.061	-0.091
	5	610	$405	$1.50	0.156	0.064	-0.027	-0.119	-0.210
	7	470	$185	$1.50	0.016	-0.054	-0.125	-0.195	-0.266
	8	310	$165	$1.50	0.005	-0.042	-0.088	-0.135	-0.181
total		2582			0.378	-0.009	-0.396	-0.784	-1.171
Gemfish									
	1	466	$343	$1.00	0.113	0.067	0.020	-0.027	-0.073
	2	865	$150	$1.00	0.043	-0.043	-0.130	-0.216	-0.303
	3	2310	$200	$1.00	0.231	-0.000	-0.231	-0.462	-0.693
	7	1481	$32	$1.00	-0.101	-0.249	-0.397	-0.545	-0.693
Total		5122			0.287	-0.225	-0.738	-1.250	-1.762
Snapper	1	4714	$1,100	$3.00	3.771	2.357	0.943	-0.471	-1.886
	2	131	$293	$3.00	-0.001	-0.040	-0.080	-0.119	-0.158
	3	30	$686	$3.00	0.012	0.003	-0.006	-0.015	-0.024
	7	330	$382	$3.00	0.027	-0.072	-0.171	-0.270	-0.369
	8	1331	$970	$3.00	0.892	0.492	0.093	-0.306	-0.705
Total		6536			4.701	2.740	0.779	-1.182	-3.142

TABLE 7 MANAGEMENT RENT IMPUTED FROM PRICE OF ANNUAL LEASE OF ITQ's ($m)

Species		Total Allowed Catch (tonnes)	Median Price $/tonne	Est. Fish Price $/kg	[% of AV. TOTAL COST assumed "SUNK"] 10% $mill.	20% $mill.	30% $mill.	40% $mill.	50% $mill.
Rig									
	1	540	$500	$2.00	0.162	0.054	-0.054	-0.162	-0.270
	2	64	$375	$2.00	0.011	-0.002	-0.014	-0.027	-0.040
	3	330	$400	$2.00	0.066	-0.000	-0.066	-0.132	-0.198
	7	240	$175	$2.00	-0.006	-0.054	-0.102	-0.150	-0.198
	8	240	$88	$2.00	-0.027	-0.075	-0.123	-0.171	-0.219
total		1414			0.206	-0.076	-0.359	-0.642	-0.925
Squid									
	1j	57705	$125	$0.60	3.751	0.289	-3.174	-6.636	-10.098
	1t	30962	$125	$0.60	2.013	0.155	-1.703	-3.561	-5.418
	6t	32333	$63	$0.60	0.097	-1.843	-3.783	-5.723	-7.663
total		121000			5.860	-1.400	-8.660	-15.920	-23.180
Stargazer									
	1	20	$80	$1.50	-0.001	-0.004	-0.007	-0.010	-0.013
	2	31	$150	$1.50	-0.000	-0.005	-0.009	-0.014	-0.019
	3	563	$200	$1.50	0.028	-0.056	-0.141	-0.225	-0.310
	4	2000	$7	$1.50	-0.286	-0.586	-0.886	-1.186	-1.486
	5	1060	$146	$1.50	-0.004	-0.163	-0.322	-0.481	-0.640
	7	457	$70	$1.50	-0.037	-0.105	-0.174	-0.242	-0.311
	8	20	$109	$1.50	-0.001	-0.004	-0.007	-0.010	-0.013
Total		4151			-0.301	-0.924	-1.546	-2.169	-2.791
Silver Wharou									
	1	1800	ERR	$0.90	0.167	0.005	-0.157	-0.319	-0.481
	3	2600	$66	$0.90	-0.062	-0.296	-0.530	-0.764	-0.998
	4	3600	$300	$0.90	0.756	0.432	0.108	-0.216	-0.540
total		8000			0.861	0.141	-0.579	-1.299	-2.019
Tarakihi									
	1	1210	$300	$1.50	0.182	-0.000	-0.181	-0.363	-0.545
	2	1500	$293	$1.50	0.215	-0.011	-0.235	-0.461	-0.686
	3	988	$217	$1.50	0.066	-0.082	-0.230	-0.378	-0.527
	4	300	$135	$1.50	0.011	-0.034	-0.079	-0.124	-0.169
	5	140	$198	$1.50	0.007	-0.014	-0.035	-0.056	-0.077
	7	960	$70	$1.50	-0.077	-0.221	-0.365	-0.509	-0.653
	8	190	$50	$1.50	-0.019	-0.048	-0.076	-0.105	-0.133
Total		5288			0.385	-0.409	-1.202	-1.995	-2.788
Trevally									
	1	1210	$340	$1.50	0.230	0.048	-0.133	-0.315	-0.496
	2	219	$126	$1.50	-0.005	-0.038	-0.071	-0.104	-0.137
	3	20	$155	$1.50	0.001	-0.002	-0.005	-0.008	-0.011
	7	1800	$165	$1.50	0.027	-0.243	-0.513	-0.783	-1.053
Total		3249			0.253	-0.234	-0.722	-1.209	-1.697
Blue Wharou									
	1	1210	$340	$1.00	0.290	0.169	0.048	-0.073	-0.194
	2	512	$126	$1.00	0.013	-0.038	-0.089	-0.140	-0.191
	3	3215	$110	$1.00	0.032	-0.289	-0.611	-0.932	-1.254
	7	922	$40	$1.00	-0.055	-0.148	-0.240	-0.332	-0.424
	8	210	$38	$1.00	-0.013	-0.034	-0.055	-0.076	-0.097
Total		6069			0.268	-0.339	-0.946	-1.553	-2.160
GRAND TOTAL		609013	$0		29.55	-17.56	-64.66	-111.77	-158.87

FIGURE 1: Firm and Industry Equilibrium in a Managed and Unmanaged Fishery

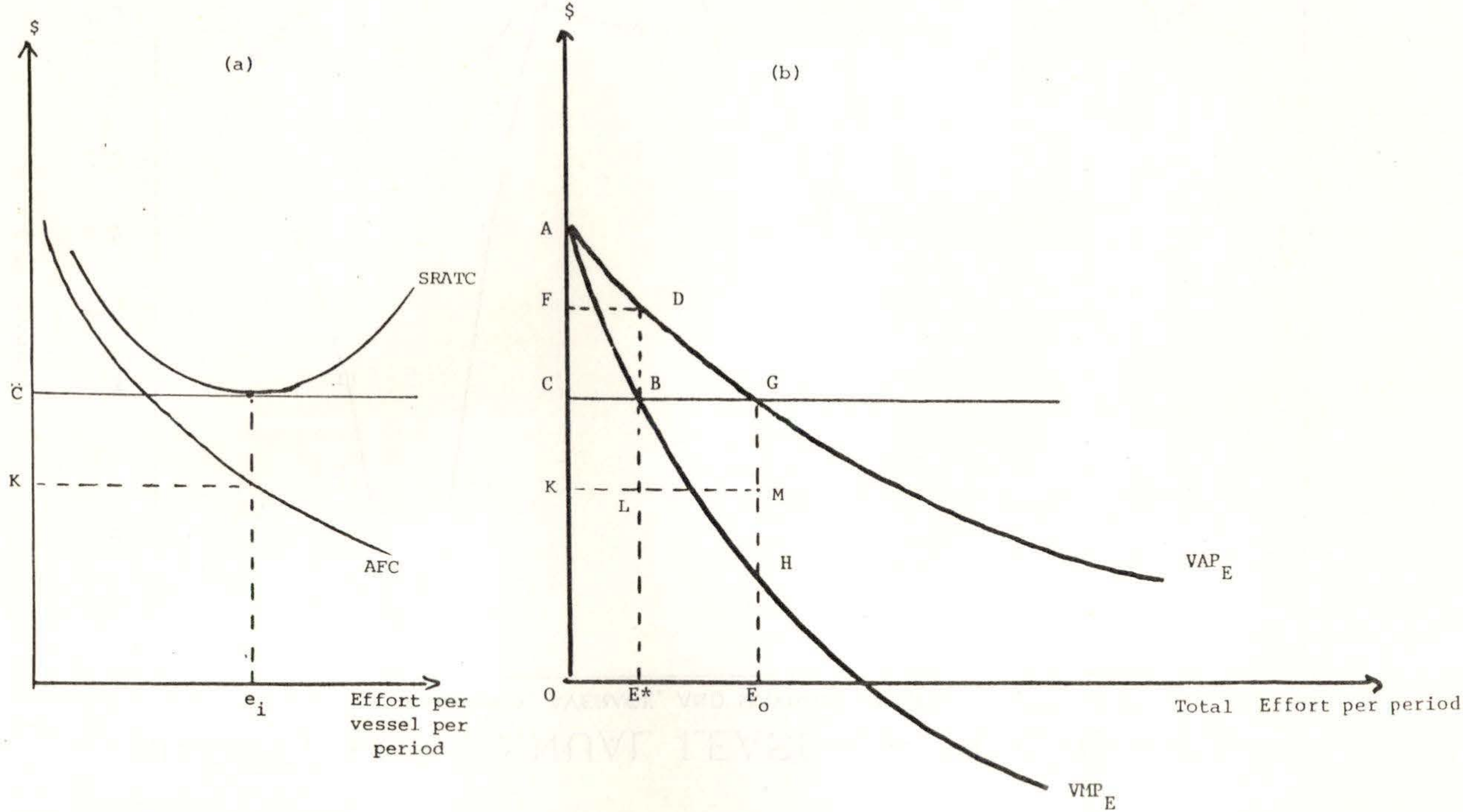
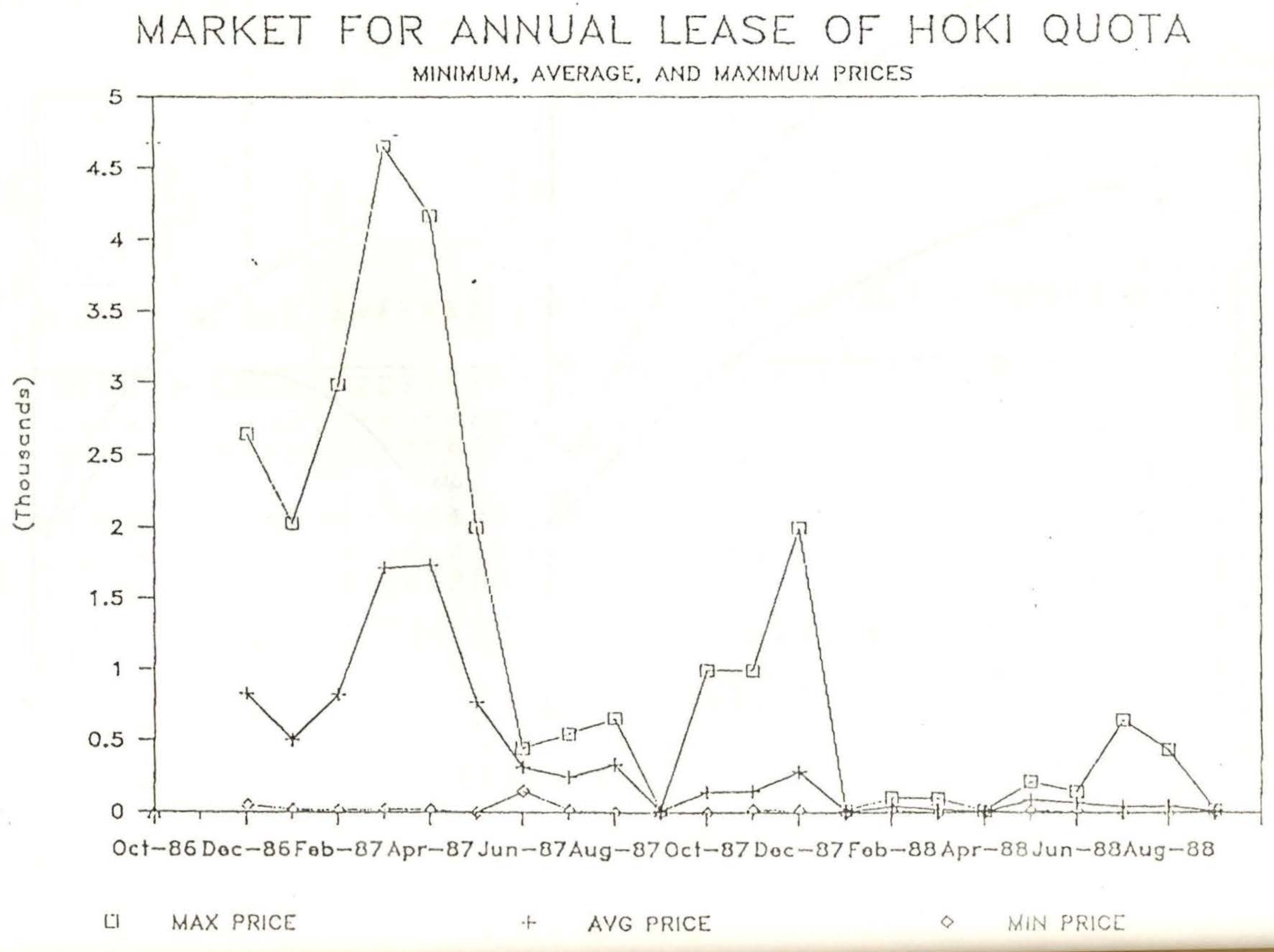


FIGURE 2.


MARKET FOR ANNUAL LEASE OF HOKI QUOTA
MINIMUM, AVERAGE, AND MAXIMUM PRICES
(Thousands)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Oct-86 Dec-86 Feb-87 Apr-87 Jun-87 Aug-87 Oct-87 Dec-87 Feb-88 Apr-88 Jun-88 Aug-88
MAX PRICE
AVG PRICE
MIN PRICE