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TO WHOM SHOULD THE RENT ACCRUE?

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ABSTRACT

Resource rentals can be viewed as a tax on resource rents (i.e. on net income derived from the use of a resource) or as royalties or access fees to a resource. The Icelandic Fishery Management Act requires that vessel owners pay a "catch fee" (*veiðigjald*), which is one of the first attempts to explicitly use resource rent generated in fisheries as a base for government revenue. This paper discusses firstly how the Fishery Management Act defines the catch fee and secondly the effects the fee may have on incentives. An alternative method of taxing the resource rent is proposed and an assessment is provided as to whether the fee is high enough.

Keywords:

Resource rentals, Catch fee, ITQs, Icelandic fishery management

JEL-codes: D33, D63, H21, Q22, Q28

Introduction
Resource rent can be defined as income from resource extraction in excess of extraction and exploration costs including return on capital employed, see Grafton (2004). Resource rentals can either be viewed as a tax on resource rents or as a royalty or fee for the privilege of accessing and utilizing the resource. Icelandic fisheries are a potential and actual source of resource rentals. With optimal utilization, resource rentals could be instrumental in imposing an equitable distribution of rents among the citizens of Iceland. A lower rental rate would reduce the economic benefit to the general public and inflate the benefits accruing to those who exploit the resource, thereby increasing the value of fishing rights. Hence, a heated debate has developed for and against the implementation of resource rentals in Iceland[2].

Various terms have been used in Icelandic discourse to refer to resource rentals specific to the fishery sector: *veiðigjald* (catch fee), *auðlindagjald* (resource fee), *auðlindaskattur* (resource tax) are examples of terms used in the debate. Advocates of the implementation of resource rentals tend to use terms that associate rentals with a fee, while those opposed tend to refer to them as a tax. Hence, it is hard to find a name that is commonly agreed on. "Fishing fee" is sometimes used as a catchall term. In this paper, "catch fee" will be used as synonymous to resource rentals specific to the fishery sector as currently applied under the Icelandic Fishery Management Act.

Holders of fishing rights have been opposed to the implementation of resource rentals because they reduce the value of their quota holding, all else being equal. Outside of the fishing industry, opinion has been in favour, based on considerations of social equity. Advocates have pointed out that higher resource rentals will make the fishing industry more accessible and attractive to young entrepreneurs by lowering the price of fishing rights and thus reducing the capital requirement for new entrants.

Economists specializing in public finance usually stress that resource rentals are less harmful to economic incentives than most other forms of taxation. That is because, in theory, correctly adapted resource rentals will affect rent (income to users of the resource) but do not impose a wedge between buyer and seller prices. Hence, resource rentals will redistribute the income in the economy, but should not distort price-signals and incentives to the same extent as do more commonly used types of taxes[3].

The organisation of the remainder of this paper is as follows: First, a short history of legislative activity leading up to the introduction of the catch fee is given, followed by a discussion of how the Fishery Management Act defines the fee. Thirdly, I discuss the effect the fee has on incentives. The so-called amortization proposal is commented on briefly and finally, I evaluate whether the catch fee is high enough.

The Resource Committee, the Revision Committee and the Amendment to the Fishery Management Act
Further to an amendment to the Fishery Management Act passed by Icelandic Parliament (Althing) in 2002, the vessel owner holding a quota right is required to pay a catch fee (*veiðigjald*). This amendment was a long time in the making before being passed as law. In the debate leading up to parliamentary elections in 1999, the issues of fishery management and resource rentals were poised to take centre stage and it was clear that the advocates of policy change were in a strong position. To defuse that threat, the government decided to establish the so-called Resource Committee, in which all the political parties represented in the Althing had representation. The Resource Committee's mandate was to deliver recommendations regarding the definition of public stewardship of natural resources and furthermore, to advise how to ensure that potential rent from such resources would find its way to stakeholders, including the general public.

An interim report containing review papers by several scientists, but no policy advice, was delivered prior to the elections in 1999, see Forsætisráðuneytið/ Auðlindanefnd (1999). The

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[2] Similar debate is also waged in Norway, albeit on different grounds and by a different constellation of players, see Anon. (2006). Norwegian big vessel owners seem to be willing to accept to pay a resource rent tax (resursrenteskatt in Norwegian) in exchange for the political guarantee that quotas will be made transferable and permanent.
[3] A wage tax would insert a wedge between the price employers pay for use of one unit of labour and the pay that employees take home as a consequence of supplying one unit of labour.

final report was not delivered until September 2000, see Forsætisráðuneytið/Auðlindanefnd (2000). For the fisheries, the majority of the committee advised rentals either in the form of an annual catch fee calculated in Icelandic kronur (ISK) per allotted cod-equivalency (CE) kilo, or a retrocession to the state each year of a given quota share for subsequent auction. However, following a preliminary provision in an earlier amendment to the Fishery Management Act in 1999, the Ministry of Fisheries had established a second committee called the Revision Committee, with a mandate to evaluate and possibly revise the Fishery Management Act, see Sjávarútvegsráðuneytið/Endurskoðunarnefnd um stjórn fiskveiða (2001). The majority of a split Revision Committee adopted the Resource Committee's suggestion to use the proposed catch fee per CE kilo to alleviate public tensions created by the Individual Transferable Quota (ITQ) system, inaugurated previously and still in use. Existing vessel owners were "grandfathered" into the system, so that free quotas were allotted to them. The Social Democratic Party, one of the leading opposition parties in the Althing, consequently put on its program the adoption of the alternate system proposed by the Resource Committee, the so-called amortization rule.[4] The Minister of Fisheries finally proposed the Amendment to the Fishery Management Act containing a payment formula based on the recommendations of the majority of the Revision Committee. This formula, given in equations (1) and (2) below, was represented as a compromise, but was in effect more or less dictated by a vessel-owner friendly government.

Catch fee, the Icelandic version of a resource rental

The text of law gives the verbal formula for the fee. The mathematical formula is:

$$R_{t-1}^{catch} = \left[(1 - 0.398) P_{t-1}^{catch} Q_{t-1}^{catch} - 6,218 \frac{P_{t-1}^{oil}}{P_{2000}^{oil}} - 17,568 \frac{CPI_{t-1}}{CPI_{2000}} \right] \quad (1)$$

Here the calculated resource rent at time t-1 is given as R_{t-1}^{catch}; P_{t-1}^{catch} is the ex-vessel price of catch; Q_{t-1}^{catch} is the quantity measured in terms of CE kilos; P_{t-1}^{oil} is the price of oil at time t-1[5]; and CPI_{t-1} is the consumer price index at time t-1. The subscript "2000" indicates that the value of the index in question should be the average value for that year. Note that 0.398 was the assumed crew share of catch value in the year 2000, ISK 6,218 billion was the assumed oil bill and ISK 17,568 billion was the assumed cost of inputs other than labour and oil in 2000.
The catch fee is levied as ISK per allotted CE kilo. The formula for that rate is:

$$CEfee_t = 0.095 \frac{R_{t-1}}{E_{t-1} Q_t^{catch}} \quad (2)$$

The size $E_{t-1} Q_t^{catch}$ indicates estimated and/or allotted quotas for the period t at the beginning of that period. Application of (2) is made more difficult as quotas for some species (for instance capelin) are not yet determined when the fee-rate is fixed. The catch fee according to (1) and (2) amounted to 3.14 ISK per CE kilo for the fishing year 2004-2005. If fully implemented, it would have brought in ISK 1.5 billion in 2004-2005 but a planned phased introduction is in effect, such that the full fee will only be paid in 2009.
It is useful to compare the catch fee and the cost of leasing a kilo of cod quota for one year. The lease price of a kilo of uncaught fish should be high enough to leave a fisher holding the right to fish indifferent between fishing and leasing it to someone else. In other words, it should be at least as high as the difference between the ex-vessel price of a kilo and the cost (including cost of labour and management) of bringing that kilo on shore. Thus, the lease price gives a rough indication of the amount of the resource rent (i.e., net income) in a fishery. It is

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[4]The amortization method was originally proposed by a group of academics and people from non-fishing business organizations.
[5] Platt's notification for Diesel Barges FOB Rotterdam Gasoil 0.2%S. The text of law does not explicitly say if the price index should refer to price development denominated in USD or ISK. The first three times the fee was levied, the Ministry of Fisheries' based the calculation on price development denominated in USD, cfr. corresponence with Arndís Steinþórsdóttir (2006).

interesting in this respect to note that the lease price per CE kilo was in excess of ISK 100 during the 2004-2005 fishing year, hence the resource rental collected for the public purse is apparently less than 3% of the actual rent generated. This is noteworthy, as the above formula gives the reader the impression that the lawmaker's intention was to collect 9.5% of the resource rent for the public coffers.[6] It should be kept in mind that the figures in equation (1) are explicitly set out in the text of law, so that changing them would require passing a bill through parliament.

Comparing the catch fee and "ideal" resource rental

The definition of resource rent given by Grafton (2004) has been cited. A slightly different definition of the rent is given by K. Moene: "The resource rent is hence an extra profit, over and above the normal remuneration to capital owners and workers. All who are participating in the production may earn as much as they could have obtained elsewhere and still there is a surplus left", Moene (2002) cited in Hersoug (2005). Most taxes affect both the income and incentives of the payee. The incentive effect is triggered when the payee tries to minimize the impact the tax will have on profits. Taxes on pure rents, resource rents included, have many of the characteristics of a lump-sum tax, as described by Hindriks and Myles (2006) among others and as a result, they can inadvertently diminish the incentive effect. Hence, experts in public economics tend to put resource rentals high on their list of things to scrutinize, as pointed out in the report from the Commission on Green Taxes (Grønn_skattekommision) (1996), 336.

The catch fee fits Heaps, Helliwell et al. (1985) characterization of "net royalties or taxes based on hypothetical costs", which by their account is designed to ensure a high degree of rent collection without distorting incentives for effective resource use. They point out that once the rate is fixed, the individual payees keep all the cost savings they can generate. They also point out that the biggest administrative problem with this type of tax lies in the definitions of cost.

Heaps, Helliwell et al. correctly predicted that the definition of costs, and hence of the resource rent, would be problematic. This is reflected in equation (1), which is an attempt to measure the resource rent created each year in Icelandic fisheries. Using the above definition, the economic profit of the fishing firms can be defined as:

$$\Pi_t = P_t^{catch}Q_t^{catch} - P_t^{oil}Q_t^{oil} - P_t^{other}Q_t^{other} - P_t^{resource}Q_t^{resource} - W_tL_t \qquad (3)^7$$

Here, the resource rent is represented as $P_t^{resource}Q_t^{resource}$, and the opportunity cost of labour employed represented as W_tL_t. Assuming that the category "other" includes all relevant inputs except oil and access to the fishery resource, including "normal" payment for capital employed[8] and further, assuming that the industry is competitive, acting as a profit maximizing price taker on markets for products as well as for factors of production so that the expected value for Π_t is zero, then, the resource rent is given as:

$$P_t^{resource}Q_t^{resource} = P_t^{catch}Q_t^{catch} - P_t^{oil}Q_t^{oil} - P_t^{other}Q_t^{other} - W_tL_t \qquad (4)$$

[6] A possible explanation of the difference between resource rent as estimated by equation (1) and by considering the lease price of the temporary quota is that the estimate for costs other than oil and wages in the equation are too high. Note that the costs involved include cost of renewing capital. These costs would be estimated by historic accounts in the equation. The lease price should, over time, reflect the expected future cost associated with renewing capital. The lease price has been relatively stable during the years before and after 2002, see Central Bank of Iceland (2006).

[7] Note that accounting profit would be defined as

$\pi_t = \left[1-\alpha\right]P_t^{catch}Q_t^{catch} - P_t^{oil}Q_t^{oil} - P_t^{other}Q_t^{other}$ and would thus include the resource rent and would also take into account the remuneration system used in the fisheries.

[8] Normal payment for capital invested, whether supplied by owners or financial intermediaries, would be included in the "other" category.

The formula of the text of law is a crude attempt to define the resource rent, as it is based on the questionable assumption that the use of inputs other than labour and the natural resource was optimal in 2000. It is also limited by the fact that labour is not valued at its opportunity cost, but at accounting costs. Furthermore, the formula assumes that none of the inputs besides the resource are earning rents.[9]

Another issue is that the price of oil was low in 2000 compared to the latter part of the period under investigation (2006-2007). A doubling of the real price of oil will be assumed to induce a doubling of vessel-owner expenditure on oil, ignoring vessel-owner substitution of oil with other inputs. Furthermore, because the fishers are remunerated by a share system, their incomes could exceed their opportunity costs.[10] Thus, when the price of oil is high, the formula in the text of law systematically yields an estimate of the cost of oil that is higher than the opportunity cost of that input. The part of the resource rent accruing to fishers is left untouched by the catch-fee formula. On the other hand, the formula underestimates the proper remuneration for special skills that are in short supply. It would be ideal if these two effects, the overestimation of cost of oil and the underestimation of remuneration of special skills, were to cancel each other out, but that is rather unlikely. Special skills soon lose their value in a competitive industry, as competitors imitate the practices of the skilful, or as the skilful use their advantage to acquire the businesses of the less skilful and apply their superior skills to the expanded business. Hence, it seems safe to conclude that the formula is not unfavourable towards the payee of the catch fee because it is much more likely to underestimate the resource rent than to overestimate it, as is clearly indicated by the above comparison of the fee and the short-term lease price.

Does the catch fee affect relative prices? The case of oil

The rate of the catch fee is fixed by lagged values of the various variables and is unaffected by the use of inputs other than the quota. Hence, a contemporary change in any of the parameters controllable by vessel owners will affect neither the amount payable nor the catch-fee rate itself. The catch fee will not affect how much labour or other inputs the vessel owner engages in the short run. Thus, the catch fee does not imply short-run distortions.

Long-run consequences of various policies have been a topic of particular interest among fishery economists.[11] It is therefore of some significance to consider whether the catch-fee formula is likely to affect long-term decisions made by vessel owners. When designing new vessels, prospective owners will have to form expectations about the future development of prices, including the oil price. Assuming that a vessel-owner investor expects increases in the oil price during the lifetime of a new vessel, one would expect offhand that the owner would be well advised to invest in oil-saving techniques. When doing the calculation, however, the vessel

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[9] For example, an owner or an employee of a fishing firm might be endowed with specific organizational skills not bestowed upon other owners or employees in the sector, resulting in higher profit per unit of inputs in this firm than in other firms. By the assumptions of the Fishery Management Act, this extra profit would be indistinguishable from the resource rent.

[10] Note that if the share system should evaluate fishers' wages at levels effectively lower than their opportunity wage, the supply of fishers would dry up. Vessel owners usually have a long list of would-be fishers on their desks and wages in fishing are considerably higher than elsewhere, as reported below. Both facts are clear indications that share wages are in excess of the opportunity wage for fishers.

[11] Statements are somewhat contradictory, however. Anthony Scott, see Scott (1989) states that "durability" is one of the fundamental characteristics of property. He says: "This characteristic, in a fisheries right, helps to enable the holder to 'save' fish stock for harvest in a later year, by conservation or habitat enhancement." Later on he states: "Quota holders, collectively, will naturally take a more long-run interest in the betterment of 'their' fish stock or stocks when their individual rights have duration, exclusivity and transferability." Attention should be paid to the qualifier "collectively". In other parts of the paper, Scott convincingly argues that collective action is inadequate as a management principle. The qualifier "collectively" and its implications have some times been left out of the equation, as for instance when quoted by Ragnar Árnason, see Arnason (1995), pp. 137).

owner would note that the catch fee rate would be lowered in the event of an oil price increase. Hence, the resource rent tax formula will in effect oblige the Ministry of Finance to share some of the burden of a higher long-term oil bill. The vessel owner who will only have to shoulder part of the anticipated increase in the cost of oil will be less likely to justify costly investment in oil-saving equipment. It should also be kept in mind that the crews already share part of the cost of oil, as the share ratio is reduced in proportion to increases in oil prices. Hence, the resource tax, as formulated, will represent an additional wedge between the social cost of oil and the real cost to the vessel owners.[12] This is particularly serious because at present (2006), releases of CO_2 from the fishing fleet account for one-third of all CO_2 releases in Iceland, higher than emissions from road transport. The catch fee in its present formulation effectively works as a subsidy to vessel owners for expected future world market oil-price increases. [13]

Does the catch fee affect relative prices? The case of wages

According to Statistics Iceland, average income in fishing was 50-95% higher during the period 2000-2004 than average income in the economy in general. High wages and high income in Norwegian fisheries compared to other coastal industries has been taken as an indicator that some of the resource rent is captured by the fishers, Hersoug (2005). It seems likely that fishers in Iceland have also been able to capture some of the resource rent through their remuneration. It is therefore of interest to map the possible connection between the catch fee and possible future development of the remuneration system in the fisheries.

The law on the catch fee is not formulated so as to accommodate changes in the share ratio automatically. Hence, should the vessel owners and the fishers' organizations determine that they could solve some problems by changing the share ratio, that change would not affect the resource rental rate automatically. However, it is probable that any increase in the share accruing to fishers would be preconditioned by consultation with government. It is therefore to be anticipated that the government will pick up part of future increases in wage costs borne by vessel owners. No comparable pressure exists to renegotiate the catch fee formula in the event that vessel owners succeed in bringing remuneration of fishers down, in line with the opportunity cost of labour. Incentives to use other resources efficiently are not distorted by the tax formula per se.

How does the money flow? First years

The catch fee has been levied three times so far at the time of writing. Table 1 summarizes the development of the "exogenous" factors of equation (1), while Table 2 highlights the development of the ingredients of equation (2).

Table 1: The exogenous parameters

Account period	Payment period	Catch value 000 ISK	Oil price Rotterdam (USD)	Oil price UK-Brent (ISK)	CPI
2000	Base period		100	100.0	199.1
2003–2004	2004–2005	68,184	101	99.9	229.1
2004–2005	2005–2006	69,914	159	131.2	237.8
2005–2006	2006–2007	67,909	212	172.6	248.2

Sources: Statistics Iceland (CPI, UK-Brent price), Ministry of Fisheries (catch value, oil price), Central Bank of Iceland (exchange rate ISK/USD), own calculation.

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[12]Note that the source of an oil price hike would probably matter. Price increase due to a government tax on carbon content of oil in order to curb the release of CO_2 would be paid fully by the vessel owner, unless vessel owners manage to lobby for a change in the text of the Fishery Management Act.

[13] The share of fuel-costs in the CPI is in the order of 5-6% adding leverage to the influence of the oil price in excess of what is indicated here.

The base period refers to calendar year 2000. The account period refers to the period from 1 May in one calendar year to 30 April in the next. The payment period refers to the fishery year from 1 September in one year to 31 August the next. Average CPI index and average Rotterdam oil price index are the index values actually used by the Ministry of Fisheries in calculating the fee rate, Arndís Steinþórsdóttir (2006). The index for the oil price in ISK is calculated by the author using information on monthly averages of the UK-Brent price (USD per barrel) and the monthly average for the ISK/USD exchange rate. The development of the two oil-price indexes reflects the divergent development of the USD and the ISK between the years 2000 and 2006. The ISK has appreciated against almost all other currencies, but the USD has been devalued relative to other major currencies.

Table 2 reports the actual fee per CE kilo, as calculated by the Ministry of Fisheries, taking into account the fact that vessel owners were granted temporary relief from the full rate during an implementation period. Table 2 also reports the amount of the fee excluding temporary relief.

Table 2: The Catch Fee 2004–2007, Ministry of Fisheries calculation

Payment period	Calculated rent 000 ISK	Catch fee, full rate 000 ISK	Catch fee, reduced rate 000 ISK	Cod equivalency, tons	Fee per CE kilo, ISK
2004–2005	14,608	1,476	876	441,350	1.99
2005–2006	11,261	1,035	743	485,736	1.53
2006–2007	5,873	560	429	469,653	0,91

Sources: Ministry of Fisheries

The catch fee has been reduced by 25-30% annually in nominal terms since becoming effective, in spite of the yearly increase in the fee rate[14] reflecting the effects of a higher dollar-denominated oil price and steady revenue due to a gradually strengthening local currency.

Table 3 shows how the fee would have developed had the ISK-denominated oil-price index been utilized instead of the USD-denominated index.

Table 3: The catch fee 2004–2007, author's calculation

Payment period	Calculated rent 000 ISK	Catch fee, full rate 000 ISK	Catch fee, reduced rate 000 ISK	Cod equivalency, tons	Fee per CE kilo, ISK
2004–2005	13,294	1,263	798	441,350	1.81
2005–2006	12,968	1,232	856	485,736	1.76
2006–2007	8,328	791	608	469,653	1.29

Sources: Ministry of Fisheries and author's calculation.

Comparing the two tables, it is clear that the reduction in the amount payable as catch fee as well as the reduction in the catch-fee rate itself would have been much less had the ISK-denominated oil-price index been used. The fee rate would have fallen by 29% from beginning to end, instead of 54%. The total amount payable over the three periods would have been ISK 214 million higher than the actual amount.

Development of the quota rental price

Several markets for quotas operate in Iceland. A market for permanent quotas exists, as does a market for the lease of quotas within a fishing year. The price of permanent quotas should reflect the expected discounted value of resource rent accruing in the fishery in the future. Ideally the price of lease quota should reflect the expected rent within the year. A would-be quota holder would not offer to lease quota for a higher price than the resource rent as defined above, i.e., an amount equal to the revenue to be collected for the catch, net of all inputs such as oil, labour or other factors of production. This decision-making process can be affected by the possibility that an investor who already has committed capital in a vessel may consider the opportunity cost of capital as sunk-cost, and ignore it when bidding for quotas. If the fishing fleet has considerable excess capacity, this approach can be widespread enough to affect the

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[14] The fee rate was 6% of calculated rent in 2004-2005, 6.6% in 2005-2006 and 7.3% in 2006-2007.

market price. By 2004-2005, the bulk of the Icelandic fisheries had been regulated by individual vessel quotas for almost 20 years. Hence, excess capacity could be a problem in given segments of the fleet, but not in the fleet as a whole. It thus seems safe to assume that in the Icelandic fisheries, the yearly lease price of quota roughly reflects the expected resource rent.   Table 4 compares the catch fee as calculated by the Ministry of Fisheries (utilizing the USD-denominated oil price index), and the quota rental price.

Table 4: Short term lease price of quota and the catch fee

Payment period	Quota rental price, ISK/CE	Catch fee, MF estimate
2004–2005	123	1.99
2005–2006	136	1.53
2006–2007	155	0.91

Source: Ministry of Fisheries (MF), Central Bank of Iceland

Of importance in Table 4 is the divergent development of the quota rental price and the catch fee during the first three years of the catch fee collection. Clearly, using market data to estimate the resource rent in fisheries yields different results from those obtained using equation (1), since equation (1) suggests declining value of the resource rent whereas market data suggest considerable increase. Several factors could drive this result. One observer, Benedikt Valsson (2006), suggests that the ex-vessel price recorded by Statistics Iceland might, in decreasing degree, be fish-market auction prices and, in increasing degree, be results of within-firm pricing between same-owner who holds both a vessel and a processor plant.[15] A low within-firm ex-vessel price of catch will reduce share payment to crews and would serve to lower the recorded ex-vessel value of catch and at the same time will increase the price a marginal buyer of a temporary quota would be willing to pay. Valsson also suggests that owners of smaller vessels are reorganizing their operations as private companies in order to utilize favourable new rules in the tax code. Leaving these more esoteric explanations aside, one can also expect that vessel owners will implement new technology and manage to reorganize their operations in ever more profitable ways as time goes by. Such developments would not show up in the estimations based on equation (1), but would show up in the evolution of the short-term price of quotas.

Given the rigidity of the resource rent estimation based on equation (1), it would be of interest to review alternative methods to levy the resource rent charge.

An alternative measure: The amortization proposal

One of the many government-appointed committees that looked into the various methods of resource rent taxation offered two proposals. One of the proposals was named the Amortization Method. That method implied that holders of quotas in one year would be allotted a given percentage of that quota next year. If we assume that the amortization rate is fixed at 10%, then a firm holding 10% of the quotas in year 0 would be allotted 9% of the total in year 1, or to be more precise:

$$A_t^i = a_{t-1}^i \left(1 - d\right) TAC_t \quad \sum_i a_{t-1}^i = 1 \tag{5}$$

Here A_t^i is the quota allotted to firm i in period t; a_{t-1}^i is the share of total allowable catch allotted to the firm the year before; and TAC_t is the Total Allowable Catch in period t (fixed by the Ministry of Fisheries).

The Ministry of Fisheries would auction the quotas not allotted. Hence, if the actual catch is in excess of the allotted quotas, $Q_t^{catch} > A_t^i$, then firm i would have to buy quota in the market. A quota thus acquired would then be subject to amortization itself a year later. Hence, a firm that would maintain a given level of activity would have to buy some quota at the auction market each year.

It is possible to adjust the amortization rate so that it is equivalent in revenue terms to other forms of the resource rental. Now, the amortization method does not involve arbitrary definitions of the size of the resource rent. That part of the problem is in effect left to the traders in the

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[15] Fishers' unions have devoted considerable energy to uprooting the practice, but their spokesmen are not fully convinced that they have been successful.

quota market, who presumably will adjust their bids to the price they are willing to pay for quotas, which should reflect their estimation of the probable resource rent. Thus, unlike the catch fee, the amortization method does not involve incentive consequences.

The amortization method is similar to the "quota rental charge" proposed by Grafton, see Grafton (1992), Grafton (1995) and Grafton (1996). His proposal is to base the charge on the market value of quotas. It could be said that the amortization method is a quota rental charge in-kind. Grafton finds the quota rental charge non-distortionary, whether risk is accounted for or not. If the market for quotas is working smoothly, that conclusion should extend to the amortization method as well.

Pecuniary consequences of utilizing a quota rental charge (amortization)

If we hypothesize that the quota rental charge (or amortization) method had been written into the Fishery Management Act instead of the catch fee method and that the charge had been kept constant throughout the period under investigation, what difference would that have made in terms of income accruing to the public coffers?

Again, more than one interpretation is possible. One could take formula (1) literally and assume that the intention of the lawmaker was to collect 9.5% of the resource rent (taking into account the adjustment of the rate in the interim period). A more pragmatic interpretation is to assume that the rental charge rate would have been adjusted so that the income accruing from that charge would have been the same as the income accruing from the catch fee in the period 2004-2005, and that the rental charge rate would be kept constant after that.

Table 5 reports the pragmatic and the literal version of the quota rental charge.

Table 5: Short-term lease price of quota, catch fee and estimates of a quota rental charge (QRC)

Payment period	Rate			Total payment		
	Catch fee, MF estimate ISK/CE	QRC, pragmatic ISK/CE	QRC, literal ISK/CE	Catch fee, 000 ISK	QRC, pragmatic, 000 ISK	QRC, literal 000 ISK
2004–2005	1.99	1.99	7.38	876	876	3,257
2005–2006	1.53	2.42	8.98	743	1,175	4,362
2006–2007	0.91	3.06	11.32	429	1,437	5,316

Source: Ministry of Fisheries, Central Bank of Iceland, author's calculation

The figures in Table 5 show that the quota rental charge based on the market value of quota would have resulted in an increase in income accruing to the public coffers during the period, not reduced income. In the case of the pragmatic interpretation of the quota rental rule, the income accruing would have been ISK one billion higher in 2006-2007 than income accruing based on the existing rules. If the intention of the lawmaker was to divert 7.3% of the resource rent to the general public in 2006-2007, it is clear from Table 5 that the existing law does not yield this result.

Effect of increased ex-vessel price variability on profits

Risk-averse investors and firm owners demand compensation for increased risks. It is, therefore, of interest to ask if a given method of taxation increases or decreases the volatility of profits compared to an alternative method. All else being equal, the taxing authority should choose the method that is least costly in terms of variability, based on ex-vessel prices.

The definition of profit of a single firm in the case of a catch fee is given as:

$$\Pi_t^{catch-fee} = (1-\alpha)P_t^{catch}Q_t^{catch} - P_t^{oil}Q_t^{oil} - P_t^{other}Q_t^{other} - T_t \frac{Q_t^{catch}}{\sum Q_t^{catch}}$$

(6)

$$T_t = \theta\left[(1-\alpha)P_{t-1}^{catch}\sum Q_{t-1}^{catch} - A\frac{P_{t-1}^{oil}}{P_{2000}^{oil}} - B\frac{CPI_{t-1}}{CPI_{2000}} \right]$$

T_t is the catch fee; Π_t is the profit of an individual firm. A is 6,218; B is 17,568; $\alpha = 0.398$ and $\theta = 0.095$ according to equation (1). Q_t^{catch} is catch of an individual firm while $\sum Q_t^{catch}$ is the catch of all firms.

Definition of profit in case of quota rental charge:

$$\Pi_t^{quota\_rental\_charge} = (1-\tau)\left[(1-\alpha)P_t^{catch}Q_t^{catch} - P_t^{oil}Q_t^{oil} - P_t^{other}Q_t^{other} \right]$$

(7)

Denote variance of P^{catch} as $\sigma_{P^{catch}}$ and that it is independent of time. Denote the correlation of this year's ex-vessel price with last year's ex-vessel price as $\rho\sigma_{P_t^{catch}}\sigma_{P_{t-1}^{catch}} = \rho\left(\sigma_{P^{catch}}\right)^2$.

Assume further that P^{catch} is uncorrelated with other prices affecting the profit of the fishing firm and also with volume of inputs. Assume furthermore that catches are exported and that the volume of exports is small in comparison with the world market for fish. Hence, the price of catch, P^{catch}, can be assumed to be uncorrelated with volume of catch, Q^{catch}.

An increase in the variance of the ex-vessel price, P_t^{catch}, would affect the variance of profit in the following manner in the case of a catch fee:

$$\frac{\delta\Pi_t^{catch\ fee}}{\delta\left(\sigma_{P^{catch}}\right)^2} = (1-\alpha)^2\left[1 + \theta^2\frac{\left[\sum Q_{t-1}^{catch}\right]^2}{\left[\sum Q_t^{catch}\right]^2} - 2\rho\theta\frac{\left[\sum Q_{t-1}^{catch}\right]}{\left[\sum Q_t^{catch}\right]} \right]\left[Q^{catch}\right]^2$$

$$; \quad (1-\alpha)^2\left[1 + \theta^2 - 2\rho\theta \right]\left[Q^{catch}\right]^2$$

(8)

The lower the crew share of revenue, and the higher the catch-fee as a share of last year's estimate of the resource rent, the higher the profit variance will be cet. par. The variance also increases the more this year's ex-vessel price is negatively correlated with last year's price.

An increase in the variance of P_t^{catch} would affect the variance of profit in the following manner in the case of the catch fee [equation (7)]:

$$\frac{\delta\Pi_t^{quota\_rental\_charge}}{\delta\left(\sigma_{P^{catch}}\right)^2} = (1-\alpha)^2(1-\tau)^2\left[Q^{catch}\right]^2$$

(9)

In this case, the lower the crew share and the lower the quota rental charge, the higher the profit variance will be.

Assuming that $1 > \rho > -1$ and that $\tau ; \theta$, it can be shown that change in the variance of the ex-vessel price will have a bigger influence on the variance of the profit of the fishing firm when firms pay a catch fee than when they are required to pay a quota rental charge, as

$(1-\tau)^2 = 1 + \tau^2 - 2\tau < \left[1 + \theta^2 - 2\rho\theta\right]$ when $\rho < 1$ and $\tau = \theta$. Hence, a higher quota rental charge would both reduce profits and reduce the variation in profits of fishing firms. A higher catch fee would reduce profits but would at the same time increase variation in profits. Consequently, a risk averse investor would behave differently in an environment with a catch fee than in an environment with a Grafton-style quota rental charge. The reason for this result is quite straightforward: an increase in the variability of the ex-vessel price will affect the profit of the fishing firm directly through more variable revenue. It will also affect the profit of the firm indirectly by increasing the variability of the catch fee. This second effect is not present when a quota rental charge is utilized.

Is the tax high enough? Is cost of management recovered?

Conducting fishery management is quite costly. Stock assessment is based on extensive scientific efforts conducted over an extended period of time and considerable stretches of sea. Enforcement is also very costly in terms of registration systems, policing, etc. Fishing vessels utilize costly infrastructure for navigation and for other coastal services. These costs have traditionally been paid out of the public purse. An analysis of the size of subsidies in Iceland for the year 2002 conducted by a Masters student in the Department of Economics at the University of Iceland, see Ottosson (2004), and based on definitions of subsidies offered in a recent FAO report, see FAO (2002), concluded that the combined cost of direct transfers, below-cost provision of services and specific tax exemptions for the fisheries sector totalled ISK 3.9 billion. Adding regulatory interventions that are industry-specific brought the cost to ISK 5.7 billion. This amounts to 4.6% to 6.7% of the ex-vessel value of catch. Other studies have either given similar results, see MacAlister Elliott and Partners Ltd (2001), or much higher estimates, see Hafsteinsdóttir, Ragnarsdóttir et al. (1999).

A 9.5% catch fee would have contributed ISK 2.1 billion in 2002. Subsidies of

fisheries, amount to between ISK 3.9 and 5.7 billion, depending on what is counted as subsidies.

Hence, it is clear that the catch fee is too low, even if used merely as a means of enforcing cost-

recovery.

Concluding remarks

Iceland has introduced a catch fee as a source of government revenue through the Fishery Management Act, not through the general tax code. The idea is to base the taxation on the fishery rent with an aim to gear taxation of the fishing sector towards more efficient models. Another aim was to alleviate political dissatisfaction associated with the grandfathering of fishing rights to vessel owners.

The definition of resource rent used in the catch-fee formula is crude and subject to interpretation. Moreover, it is based on data that is one or two years' old. Taxation based on a quota rental charge as proposed by Grafton and introduced into the debate in Iceland would be less distortionary than the present catch-fee method, and would also be more attractive in terms of risk-effects than the catch-fee formula. The quota rental charge could also be based on current data. It has been argued that the Icelandic catch fee is too low if costs are to be recovered. It is, however, the first attempt to use resource rent created in fisheries as a base for government revenue and such experiments are bound to be characterized by trial and error. Potentially, Icelanders will ultimately have a system where government revenue is based on rules that are less disruptive to incentives and more equitable than the rules they started out with. .

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