Capitalization of Fishing Industry Though Quota Markets

(A Case Study of Iceland)

MS Thesis for fulfillment of degree in International Banking and Finance

at Bifrost University, Iceland

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Spring semester

2011

I confirm that the thesis is my own work and I alone am responsible for the work carried out in order to produce the thesis.

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Keflavik, April 26, 2011

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Special thanks to:

Ragnar Arnason

Thorarinn Gudbergsson

Abstract

The thesis is aimed to answer the question, how a fishing quota system can facilitate capitalization of a fishing industry and be used to finance new shipbuilding in the fishing industry. The main hypothesis is that the fishing quota system is an effective instrument to increase effectiveness of the fishing industry, but due to natural limitations rooted in the nature of fishing quotas they are of limited liquidity as financial asset and highly vulnerable to political and economic volatility. A fishing quota sets limits to NPV of a fishing company both in time and value, but in its capacity constitutes a crucial part of financial guarantees for renovation of the fishing fleet.

The topic of the thesis is of particular relevance in the view of the current debates about future of the Icelandic system of fishery management. Recommendations made of the basis of this research are believed to be useful in the policy making process as well as for fishermen community in Russia expecting changes due to the end of quota allocation period in 2018 and a recently launched campaign to encourage building of fishing vessels on Russian yards supported by the Russian Government.

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1. INTRODUCTION

As early as in 1911 Danish economist Warming published an article where he put forward the idea that fishing grounds generated rents in the same way that real estate generated land rent. A “slight” difference however is that until the fishing grounds are common property the rent is lost (W.Warming, 1991). Later economists elaborated the theory of fishery economics with major input made by A.D. Scott (Scott, 1989), R. Arnason (Arnason, 1995), M. Patterson (Patterson, 2008) and others The literature investigating prices of fishing quotas and their relationship to dividends and other factors is extensive and mostly contributed by Newell, Papps, Sanchirico (R.G.Newell, 49 (2005)), as well as by Campbell, LeRoy, Fama and Icelandic authors: Arnason, Gylfason, Gunnlaugsson, Knutson, Heidarsson.

The thesis, primarily based on Icelandic experience, focuses on efficiency of a fishing industry achieved via the ITQ system. It discloses the driving forces of the effectiveness of fishing and though this of financial gains both short and long term. The main problem it addresses is whether a proper tailored fishing quota system could create financial resources for investments into renovation and building of new fishing vessels and how. Both of permanent and leasing quotas prices interaction is investigated to show the extent that the annual quota allocation and permanent quota share value influence a fishing company owners to decide about increasing effectiveness of the fishing vessels through renovation or replacement of old vessels. Quota property rights are linked to fishing vessel ownership in Iceland. Correlation between a fishing vessel and quota she is capable and allowed to harvest and potential conflict between capacity and actual allocation is of particular importance for a fishing company and banking sector that credit fishing industry. Dichotomy of collateral that includes a vessel and a quota assigned to her leads is of particular importance for the analysis. Short term and long term benefits are to be considered within the framework of the whole economy as increased indebtedness of a fishing industry signals about outflow of capital from this sector of economy. Especially in volatile markets pledged vessels and quotas fall in their value. Political questioning of legal status of property rights to harvest may result in their further devaluation. That is why the thesis dwell upon social aspects of ITQ system, in particular a conflict between private property rights and rights to common property that is prone to raise instability and undermine perspectives of further investments into the industry. A highly internationalized fish trade is in this respect examined as a factor growing dependence and vulnerability for an open, export oriented economy like of Iceland.

The thesis aims to answer following question: can an ITQ system be used to capitalize the industry and what risks ITQ development bears? On the basis of available information prices of quotas are analyzed in order to identify factors that led to the rise of the quota market and its current decline. They are subjected to catch forecasts, price on fish and fish products in general, the concentration of fishing quotas and legal restrictions for few newcomers to enter the fishing industry and demand for capital from other sectors of economy.

The thesis is believed to have practical value for banks and investment institutions offering in-depth analysis of financial performance of a fishing company owing quotas and fishing vessels by providing understanding and mechanism of evaluation of a fishing company's credit capacity. It may bring practical implications for governmental authorities as regards subsidies to fishermen for new shipbuilding and renovation of capital assets, and tailoring of fishery management system in general.

An international dimension of the topic of the thesis is particularly educating as Icelandic experience in the ITQ system is believed to have universal application, and may be of interest to fishing communities that introduced similar management systems in New Zealand, Australia, USA, Canada, Chili, Peru, etc. (see Annex 1. for the map of ITQ management systems worldwide) or its partial variations like in Norway or Russia where quota systems have some limitations as regards transferability. Quota systems in international waters are introduced by international organizations like NAFO, NEAFC and others to preserve fish stocks beyond EEZ of coastal states. And their number is believed will be growing with the next likely candidate zone in South Pacific.

The government of New Zealand passed the Fisheries Amendment Act of 1986, creating a national ITQ system. The system initially covered 17 inshore species and 9 offshore species, which together expanded to a total of 45 species by 2000. Under the system, the New Zealand Exclusive Economic Zone (EEZ) is geographically delineated into quota management regions for each species based on the location of major fish populations. Rights for catching fish are defined in terms of fish stocks that correspond to a specific species taken from a particular quota management region. In 2000, the total number of fishing quota markets stood at 275, ranging from 1 for the species hoki to 11 for abalone. As of the mid-1990s, the species managed under the ITQ system accounted for more than 85 percent of the total commercial catch taken from New Zealand's EEZ (Newell, 2005, p. 4).

Quota regimes are particular importance for prevention of overfishing of individual species, like blue fin tuna, and some others.

The thesis draws where applicable comparisons between Icelandic ITQ system and quota system that Russia is currently building up. Icelandic practice gives useful lessons as to what to expect as regards capitalization of a fishing industry through fishing quota rights in other countries. Russia with its system of individual quotas allocated in 2008 for 10 years can benefit from Icelandic experience to make balanced decisions in relation to post-2018 period of quota system prolongation, and creation of genuine quota markets. Implementation of Russia's ambitious strategic program of renovation of the fishing fleet and rehabilitation of fishing vessel building by local shipyards is strongly linked to issue of quota allocation. The current discussion of introduction of "quotas under keel" principle with allocation of extra fishing quotas for new builders of fishing vessels received equivocal response from Russian fishing communities. The fishermen aim to preserve the current system untouched till 2018 and later add arguments to the hypothesis of the political and social consent as a factor of increasing value of fishing quotas as assets.

2. NATURE OF INDIVIDUAL TRANSFERABLE QUOTAS AND EFFICIENCE OF FISHERIES

2.1. Characteristics of property rights

This chapter shows the linkage between higher quality property rights on fish quotas and higher efficiency of fisheries. Based on extensive existing literature it lays theoretical background for creating incentives to invest into fixed capital (in particular newer and more efficient vessels) by enhancing security, exclusivity, longitude and transferability of fishing rights.

There are three main categories of options to manage fisheries: taxes, input controls and output controls, for example, product quota.

As observed by Wesney (Wesney, 1989, p. 164) taxes may be used to offset the real costs imposed by individual investment decisions on the fleet as a whole, to bring social and private costs into alignment. Each fisherman will then adopt an efficient scale of operation and it will result in improved returns. But taxes are indirect method of controlling total catch as a tax based management is to take into account all significant changes from new technologies, cost and price changes, and fluctuations of fish resources. Feasibility of its implementation is costly and depends on political considerations.

Limitations on inputs is also indirect method of controlling total catch, and it may embrace a variety of forms such as limits on the number of licensed vessels, vessel size, engine power, gear type, area closures and time closures. These restrictions increase the cost for individual fishermen and tend to be very complex to keep the system under control. Despite obvious disadvantages an input control management system was introduced in number of national and international fisheries due to specifics of their fisheries.

The method of controlling total catch through a total quota or total allowable catch (TAC), allocated among fishermen as individual transferrable quotas (ITQs), promotes economic efficiency because fishermen make their own basic decision on how to most efficiently harvest their individual quotas. Compared to the indirect methods of controlling the total catch, the quota system tends to minimize the level of government intervention, leaves the questions of how, when and where to catch fish mainly to the individual fisherman, and most importantly, provides direct control over the total catch.

A right for a share (in annual numbers – catch or annual quota) in the total allowable catch falls in the category of rights to explore natural resources, and in case of fish stocks, renewable resources. Some economists draw parallels between property rights on resources in oil and gas industry and fishing industry with a “minor” difference that fish stocks in principle could be regarded as a renewable resource.

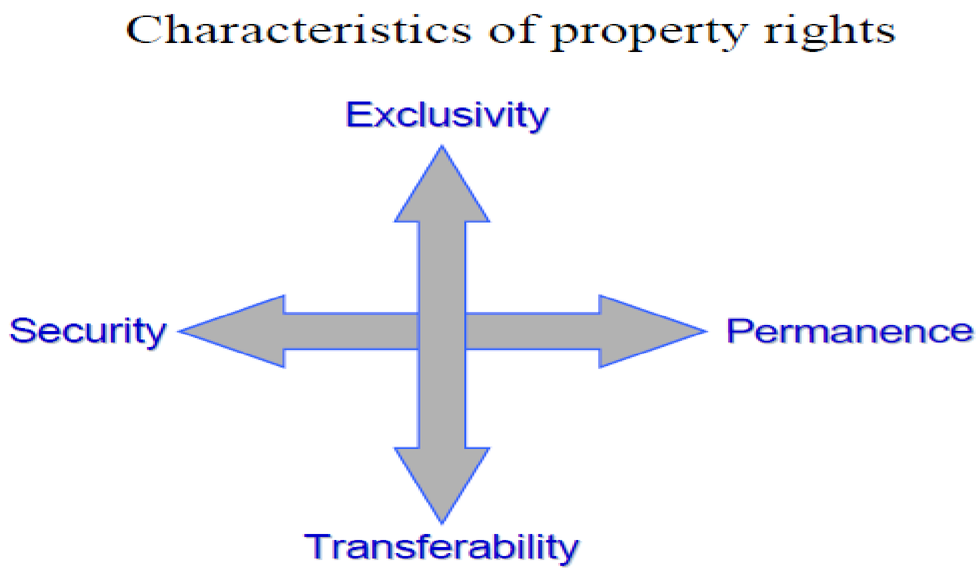
An individual transferable quota is a legally defensible right to catch, land, and market a quantity of fish over a certain period of time, held by an individual or a company, and tradable in asset markets in the usual way (Neher, 1989, p. 1). These characteristics qualify an ITQ as a private property right. ITQ belongs to a larger class of rights based regimes where individual people or their collectives hold legal or traditional rights to fish, such as territorial use rights in fisheries (TURFs), restrictive licensing of inputs (vessel and gear licenses), enterprise allocations of fish quotas (as in Canada and Australia), and fee fishing arrangements as in the Pacific Islands where rights of access are leased to foreign fishers (Neher, 1989, p. 1). Hugo Grotius, a founder of international law, put forward conditions of exhaustibility and enforceability as critical for property rights. With the development of fishing technologies and accessibility of fish stocks these conditions are now in place to fully define the property rights on the high seas. Control of fishing capabilities and protection of fish stocks are added with the third and most critical objective, to generate net cash flow from the fish resource. The fisheries should generate resource rent and constitute social wealth to make property rights to fish of market value. Thus a transfer to a regime of ITQs constitutes a process of enclosure and privatization of the common resources of the ocean. Through allocation of the ITQs property of the state devolves to the individual and company levels, when harvesting rights becoming private property. This change improves efficiency and allows a net benefit to exceed administrative cost thus creating a resource rent to divide between fishermen and society. Thus rent makes it possible to further increase efficiency of fishing through capitalization of fishing industry.

A property right is not a single variable. As pointed out by Scott (Scott, 1989) any property right consists of a collection of different attributes or characteristics. The number of distinguishable characteristics that make up a property rights is very high. However, according to Scott the most crucial property rights characteristics are:

- Security or quality of title
- Exclusivity
- Permanence
- Transferability

These characteristics were deliberately studied by fishery economists and following Arnason (Arnason, 2004) and they could be depicted by the following graphics.

Figure 1. Characteristics of property rights. (Arnason, 2004, p. 21)

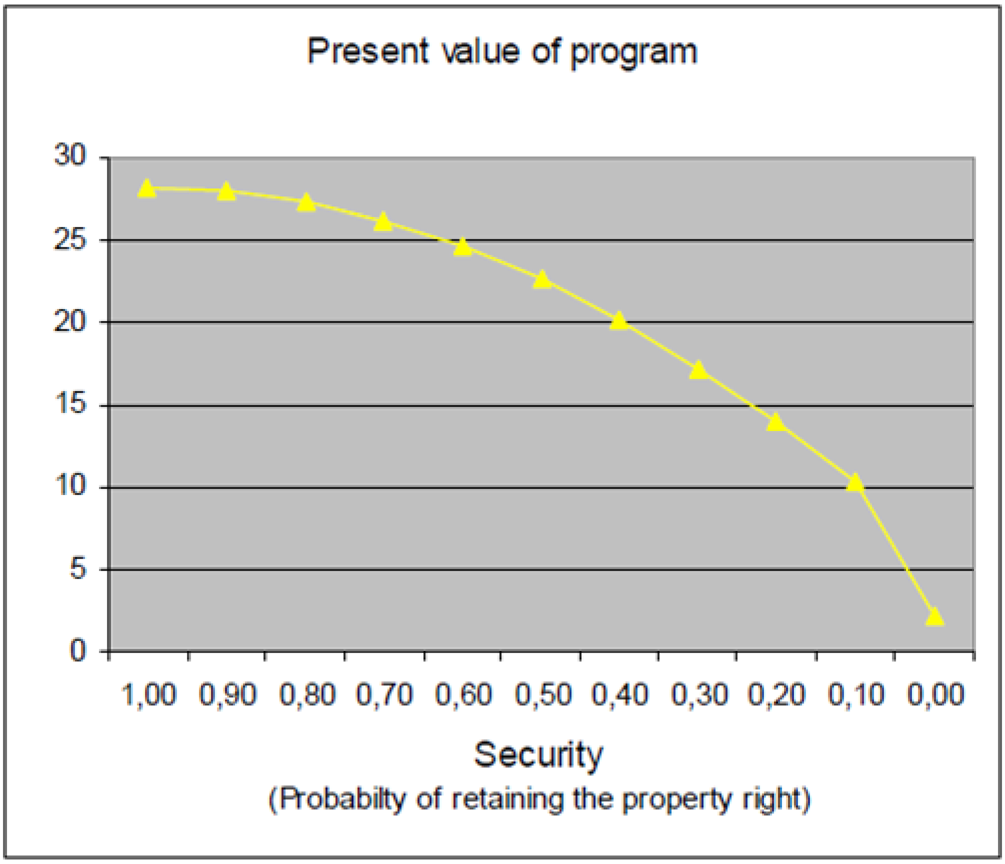


Security, or quality of title

As it was mentioned by Arnason (Arnason, 2004) property right may be challenged by other individuals, institutes or the government. Security is understood as the ability of the owner to withstand these challenges and maintain his property right. It is a kind of probability that the owner will be able to hold on to his property right. Probabilities range from zero to one hundred per cent. A 100% security means that the owner will hold his property with complete certainty. A security measure of zero means that the owner will certainly lose his property.

Economic efficiency declines monotonically with the level of uncertainty. This monotonic relationship is illustrated in the phase diagram in Figure 2 which depicts the shift in profit maximizing equilibrium curves when security is reduced (Arnason, 2004, p. 12).

Figure 2. Relationship between security and efficency. (Arnason, 2004, p. 22)



According to Arnason (Arnason, 2004) while the negative impact of less secure property rights on economic efficiency is monotonically negative, the impact on production and the quantity of the resource at each point of time is more complicated. In the case of renewable resources, insecure property rights generally lead to initially increased production rates and reduced biomass at each point of time compared to what would otherwise be the case.

Exclusivity

This characteristic feature refers to the ability of the property rights holder to utilize and manage the resource in question (his property) without outside interference. The right of a fisherman to go out fishing has exclusivity reciprocal to the number of other fishermen with the same right. An ITQ holder has a right to a specified volume of harvest from a given stock of fish over a certain time period. However, when it comes to the actual harvesting, the question of exclusivity refers to his ability to take this harvest in the way he prefers and to prevent others from interfering with this ability. Any government fishing regulations clearly subtract from this ability. The same applies to the actions of other fishermen that may interfere with his ability to harvest his quota in various ways. Poaching or illegal fishing has also devastative effect on the exclusivity. With all these three factors in place an ITQ right generally provides substantially less than 100% exclusivity to the relevant asset, i.e. the fish stock and its marine environment. It should be noted that enforceability, i.e., the ability to enforce the exclusive right, is an important aspect of exclusivity (Arnason, 2004, p. 3).

Within the framework of R.Arnason's basic model a lack of exclusivity may take several forms including:

- Seizure of output
- Taxation
- Non-exclusive access to the natural resource, i.e. absence of quota system limitation
- Restrictions on activities (in fisheries on production level through quota system)

The first two basically remove output from the property rights holder. The third removes inputs. The final one puts limitations on how he uses his property. All, however, alter the company's opportunity set and therefore, in general, modify its behavior. The present value of the program is monotonically declining in output expropriation and it converges to zero if the rate of taxation is high enough. Less than full exclusivity is economically damaging. Economic efficiency is monotonically increasing in exclusivity (Arnason, 2004, p. 17).

Permanence

Permanence refers to the time span of the property right. This can range from zero, in which case the property right is worth nothing, to infinite duration. Leases are examples of property rights of a finite duration, usually 1 year due to quota allocation by annual TAC. The duration of a property right is related to security; if a property right is over equals to its termination. But foreseeing this end of property right is very important for a company's planning horizon. Thus these two characteristics are quite distinct in a sense as a quota leasing agreement similarly provides a perfectly secure property right for a limited duration. (Arnason, 2004, p. 3).

The impact of a finite duration of the property right is what one can expect from differently managed fish resources, like in Iceland with indefinite duration of quota holding and in Russia with allocation of quotas for 10 years. A limited duration property right will induce a company to move off the socially optimal production path in order to maximize its present value of profits over the duration of its property right. As duration of the property right is reduced, the value of the fishing activities is initially reduced. According to Arnason (Arnason, 2004) at some point, roughly 15 periods, shorter duration actually leads to increased value. This is because of the assumption that after the first period of limited duration property right, the property right becomes permanent. Therefore, below certain duration of the property right, further reduction in duration increases the value of a company's fishing program.

“If, on the other hand, the regime of limited duration property rights is continued, the value of the production activity is monotonically increasing in duration converging to a certain minimum value obtainable from the initial biomass level. As predicted the value of the program converges to zero as duration of the property right approaches zero. Alternatively, if duration approaches infinity, the value of the program approaches the upper bound” (Arnason, 2004, p. 20).

Transferability

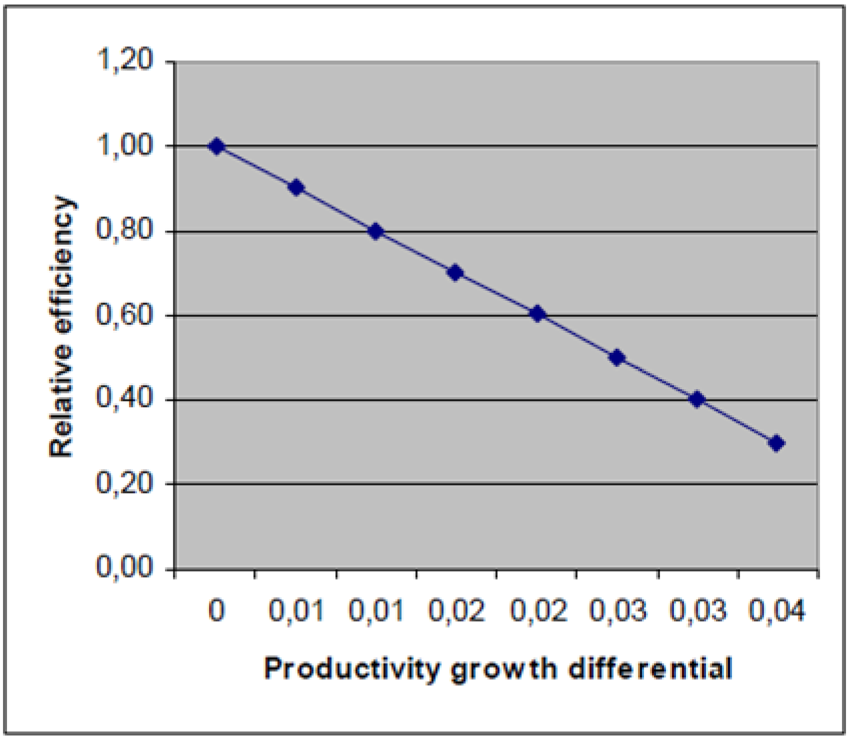
This feature refers to the ability to transfer the property right to someone else. For such limited and valuable resource as fish, this characteristic is economically important because it facilitates the optimal allocation of the resource to competing users. For economic efficiency only the companies having the best fleet (as a prerequisite to the highest profit function for the purposes of this thesis) should carry out the production at each point of time. If the property rights on which the companies base their production are transferable, private profit maximization will tend to ensure that this will be the case. If the company's quota rights are viewed as one consolidated property right with markets assumed effective, there will at each point be a market price for this property right. This price will naturally depend on the quantity of the resource. It will also evolve over time with general and company specific technical progress and development of its vessels (Arnason, 2004, p. 21).

Any limitations on tradability can reduce the social benefits derived from efficient usage of resources. If the property rights holder is the most efficient company from now to eternity, there will be no loss of social benefits. The limitations on trade will turn out to be non-binding. If on the other hand, there are or will be more efficient companies to produce, there will be social costs of the trading limitations. These costs will obviously be monotonically increasing in the efficiency differential and the closeness in time it occurs.

Economic experience shows that there is ample reason to expect existing companies to lose their advantage to newer companies over time and gradually fall behind in efficiency as this is the main reason why most companies don´t last for a long time and none indefinitely.

On this basis Figure 3 can illustrate the loss in efficiency due to nontradability. Obviously, the loss in relative efficiency is monotonically increasing in the productivity growth differential. Limited tradability would reduce this loss. Full tradability would eliminate it. If the rate productivity growth exceeds the rate of discount, the present value integral does not even converge and the relative efficiency is not defined.

Figure 3. Efficiency loss with nontradability of fish quotas (Arnason, 2004, p. 23)



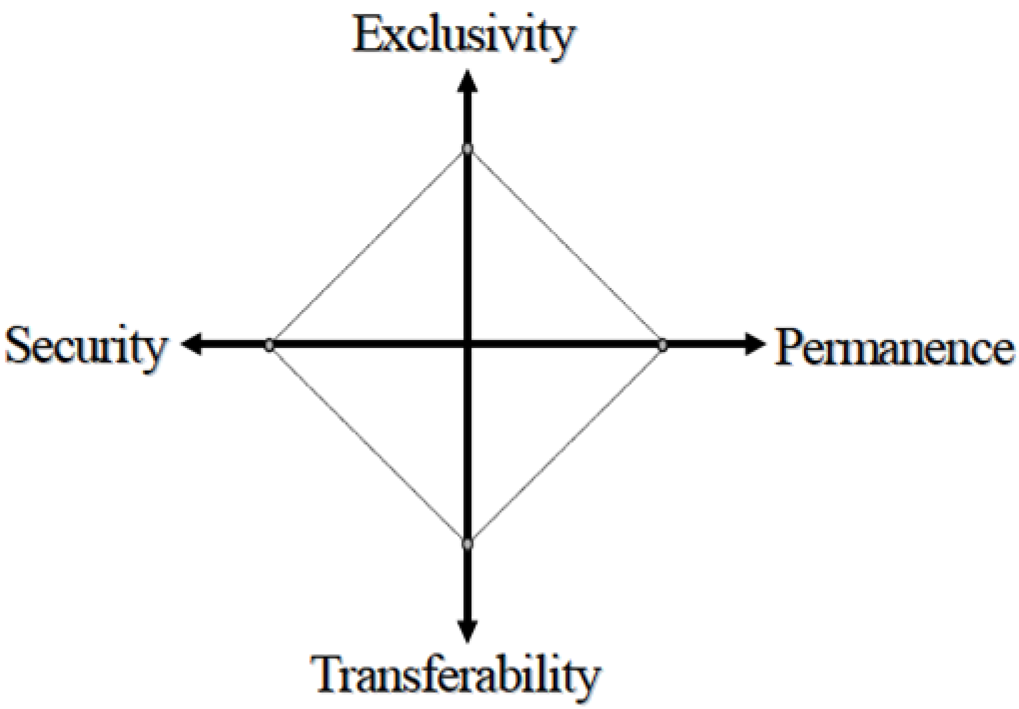
From this Arnason surmised that efficiency is most likely monotonically increasing and certainly non-decreasing in tradability. However, even with no tradability, there would normally be substantial economic rents. This is different from the other dimensions of property a-rights as we have seen.

An important feature of transferability is divisibility, the ability to subdivide the property right into smaller parts for the purpose of transfer. “Perfect transferability implies both no restrictions on transfers and perfect divisibility” (Arnason, 2004, p. 4). This observation by Arnason is very important for the Russian fisheries. In a situation when transfers of quotas are not de-jure allowed they take place in a form of M&A process. The negative side of this is that a buying company has to take over all quota rights of the seller, even those that may not be needed. Thus it is not possible to “tailor” quotas matching the buyer´s fishing fleet capacity and this makes administrative costs higher.

For this analysis permanence, exclusivity and security characteristics are of priority importance to encourage a fishing company for renovation of its fishing fleet while transferability is a major prerequisite for establishing of fish quota markets to increase capitalization of a fishing company and allow more effectiveness through investments in new technology. Thus a strategy to start full scale renovation of a fishing fleet should address first of all three first parameters, and when they are guaranteed to facilitate capitalization of the fishing industry through quota markets.

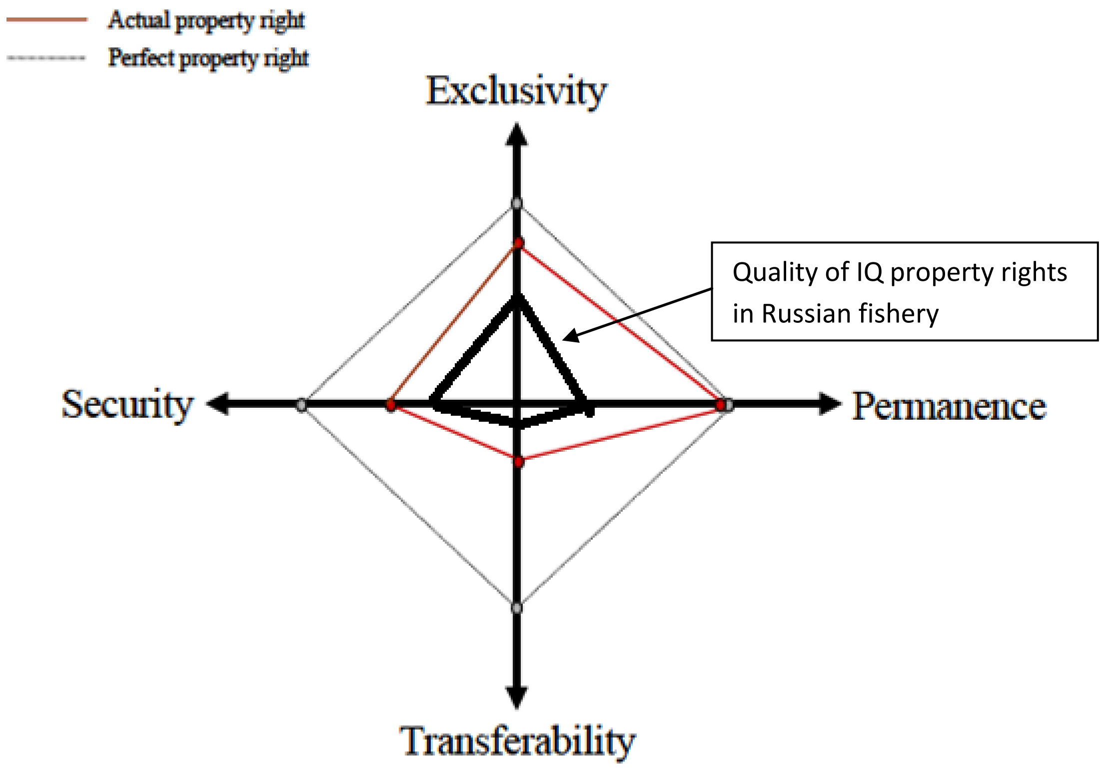
Scott (Scott, 1989) suggested visualizing these characteristics of property rights as measured along the axes in four-dimensional space. Additional to these four characteristics illustrated by Figure 4. separate axes of divisibility and flexibility were suggested by Scott (Scott, 1989, p. 14) to be added to describe a property right nature where applicable and needed.

Figure 4. A perfect property right (Arnason, 2004, p. 5).



A given property right may exhibit the different characteristics to a greater or lesser extent. To represent this, Arnason suggested measuring this on a scale from 0 to 1. A measure of zero means that the property right holds none of the characteristic. A measure of unity means that the property right holds the characteristic completely. Given this a picture of perfect property rights can be drawn as a rectangle in the space of the four property rights characteristics as the characteristic footprint of a property right. A perfect property right represents the outer limit for the quality of all property rights. It follows that the corresponding characteristic footprint of any actual property right in the same space of characteristics must be completely contained within this rectangle. Arnason illustrated this by the following figure. The bold black line inside the rectangular is added to illustrate the characteristics of fishing quota rights in Russia with no de-jure transferability and endangered security, 10 year duration and exclusivity undermined by poaching and governmental initiatives to encourage new shipbuilding through additional quota allocation.

Figure 5. The quality of a property right.



The ratio between the two areas enclosed by the two quality maps provides an idea of the relative quality of the actual property right. Henceforth, the term “quality of a property right” will refer to this ratio (which is always positive and less or equal to unity). Obviously the closer the characteristic footprint of a property right is to that of a perfect property right; the higher is its quality.

Given the multi-dimensional nature of property rights, it is obviously useful to have a uni-dimensional numerical measure of the quality of a property right. One such measure is the so-called Q-measure for property rights proposed by Arnason (Arnason, 2004, p. 5). In the case of the above four property rights characteristics, the Q-measure may be is defined by the expression:

$$(1)\ Q \equiv S^{\alpha} \cdot E^{\beta} \cdot P^{\gamma} \cdot (w_1 \cdot + w_2 \cdot T^{\delta}),\ \alpha, \beta, \gamma, \delta, w_1, w_2 > 0 \text{ and } w_1 + w_2 = 1$$

where S denotes security, E exclusivity, P permanence and T transferability. α, β, γ and δ are parameters and w_1 and w_2 are weights. The Q-measure takes values in the interval [0,1]. A value of zero means that the property right has no quality; it is worthless. A value of unity means that the property right is perfect. Note that in the formula in (1), the first three property rights characteristics are considered essential. If any one of them is zero, the overall property right quality is also zero. The fourth characteristic, transferability, by contrast, is not essential. Even when there is no transferability, the quality of the property right may still be positive.

According to fisheries economics theory the economic efficiency of the ITQ system stems from its creation of private property in harvesting rights. This suggests that the higher the quality of this property right, in terms of security of title, permanence, exclusivity, flexibility, divisibility and transferability, the greater will be the resulting efficiency of the ITQ system. A divisibility characteristic is an important sub vector of transferability in case of fisheries with limitation on sales of quotas. In absence of de-jure transferability as it is the case in Russian fisheries, the transfers of fishing quota may take place through sales and purchases of fishing companies. Thus the market for fishing quota does exist but due to indivisibility of quotas that belong to a company to acquire a significant distortion coefficient should be taken into account that adjust the price with administrative costs of acquisition procedure and more significantly with a burden of unwanted quotas that the target company is assigned. This is of particular importance for the decision makers bearing additional quotas mismatching fleet capacity and will be dwelled upon in the relevant chapters of the thesis about new shipbuilding.

Real property rights are seldom perfect. Addressing the question what happens to efficiency in the realistic interval between perfect property rights and no property rights Arnason (Arnason, 2004, p. 2) proved that that the relationship between the quality of property rights and economic efficiency is monotonically increasing. More precisely, the higher the quality of a property right, the more efficient is the associated economic activity, here in fisheries that is wholly or partly based on this property right or the object of the property right (fish).

Conclusions

Economic efficiency is monotonically increasing in three of the four main dimensions of property rights, i.e. security, exclusivity and duration with efficiency non-decreasing in the fourth dimension, tradability. This means that if security, exclusivity or duration is reduced, even minutely, there will be a reduction in the efficiency of the associated economic activity. There will in other words be a price to pay. Moreover, if any of these variables are reduced to zero, the activity will become wholly inefficient in the sense that it will not produce any economic rents. The outcome may actually be even worse. It is entirely possible, even likely, that the activity in question will simply cease. Certainly investment in physical and human capital will, barring subsidies and other public interventions, be greatly reduced as well as distorted. In the case of natural resources, the resource may even be exhausted beyond its ability to regenerate itself.

The case of reduced tradability is much dramatic. Even with no transferability (which is a feature of the quota management system in Russian fisheries), there is every reason to believe that economic rents will continue to be generated. Moreover, if the agent, holding the property right, is reasonably efficient, the cost of non-tradability will be comparatively small. However, over time the relative efficiency of any firm or agent tends to decline. Therefore, at least in the long run, the cost of limited tradability can be high.

This analysis has been unable to tell of the quantitative relationship between property rights and economic efficiency between the two extreme point of no and complete property rights. It is obvious only that it is monotonically increasing in the first three dimensions of property rights and non-decreasing in the forth. To determine the exact quantitative relationship R.Arnason suggested using his Q-measure that comes close to being such an index. He concluded with the following certain clear applications to the theory of fisheries management:

“(1) Fisheries management methods that are not based on property rights are unlikely to work except in cases where there is basically no room to maneuver (like 100% taxation, complete control of the fishery and so on)

(2) The better the property rights, certainly along the first three dimensions the greater the efficiency. Thus, all deviations from perfect property rights will be economically costly. The only question is how costly.

(3) Property rights quality indices such as the Q-measure, can provide a useful indication of the efficiency of the fisheries management system in question.

(4) The invention of better property rights in fisheries and improved protection of existing property rights can be extremely valuable. Economically speaking there is a reason to encourage activity and enterprise in these areas" (Arnason, 2004, p. 23).

This theory is clearly illustrated by particular cases of property rights in fisheries of Iceland, New Zealand and Norway that all base their fisheries management on individual quota property rights. In Iceland and New Zealand the regime is a fairly complete ITQ system. In Norway, by contrast, operates an IQ system, i.e. an individual quota system with very limited transferability of the quotas. In this case Norway is very similar to the situation in Russia and to some extent could be taken as an illustration of the quality of the Russian IQ system.

In all three countries, the security of the property right is fairly high. However, in Norway, in the most important fisheries, new vessels may be allocated quotas thus subtracting from the quota shares of the other fishing vessels. Clearly this reduces the security of the Norwegian property right. In all three countries the exclusivity of the harvesting right is pretty high, really only limited by government fisheries regulations which in the case of Iceland and in particular Norway are more extensive than those in New-Zealand. Permanence of the property right differs greatly between the countries. In New Zealand the quota rights are explicitly in perpetuity. In Iceland they are of indefinite duration but there are non-trivial socio-political threats to the continuation of the system. In Norway individual quota rights are explicitly non-permanent, allocated only for a year at a time. However, since quotas are customarily allocated the previous recipients in more or less the same proportions, it may be claimed that the associated property right has gained a degree of permanence. Finally, transferability in New-Zealand is close to perfect (only foreigners excluded). In Iceland, transferability is only slightly more restricted. In Norway, as mentioned above, there is virtually no transferability of the quotas. A rough numerical estimate of the values of the property rights characteristics for these three countries based on the above description is provided in Table 1.

Table 1. Estimated quality of Property Rights in Iceland, New Zealand and Norway: Q-values

Characteristics	Iceland	New Zealand	Norway

Security	1.00	1.00	0.90
Exclusivity	0.90	0.95	0.70
Permanence	0.80	1.00	0.50
Transferability	0.90	0.95	0.10
Q-value	0.86	0.96	0.44
Q-value is calculated as: $Q \equiv S^{\alpha} \cdot E^{\beta} \cdot P\gamma \cdot (w_1 \cdot + w_2 \cdot T^{\delta})$, where $\alpha=\beta=\gamma=\delta=1$; $w_1=0.6$, $w_2=0.4$			

According to the Q-values reported in Table 1, the quality of the New Zealand quota property right, Q=0.96, is near perfect. The property rights quality of Iceland's quota rights, Q=0.86, is considerably lower but still quite high. The property rights quality of Norway's fishing rights, Q=0.44, is much lower than that of both New Zealand and Iceland. Thus, although substantially higher quality than common pool property rights for which Q-values are typically in the range Q=[0.05-0.2]), Norway's IQs must be regarded as comparatively weak property rights.

These Q-measures correspond to the efficiency of the respective fisheries. The available evidence suggests that the Icelandic and New-Zealand fisheries, that score much more highly on the Q-measure than Norway, also have much more efficient fisheries. Moreover, although the Q-measures for Iceland and New-Zealand are quite similar, the indications are that New-Zealand, which scores slightly higher than Iceland, also has a slightly more efficient fishing industry. Overall measures of property rights quality such as the Q-measure can serve as a short-hand assessment of the economic efficiency of the fisheries management systems in many countries.

Conclusions

- the higher the quality of a property right, the more efficient is the associated economic activity;
- a limited duration property right induces a company to maximize its present value of profits over the duration of its property right;
- higher quality property rights encourage long term investments into fixed capital, in particular more efficient vessels.

2.2. Development of ITQ system in Iceland

This chapter is aimed at checking the above conclusions on a real case, like fisheries in Iceland, as its "system now is seen as a model elsewhere in the world" (Mitchell, 2007, p. 130)

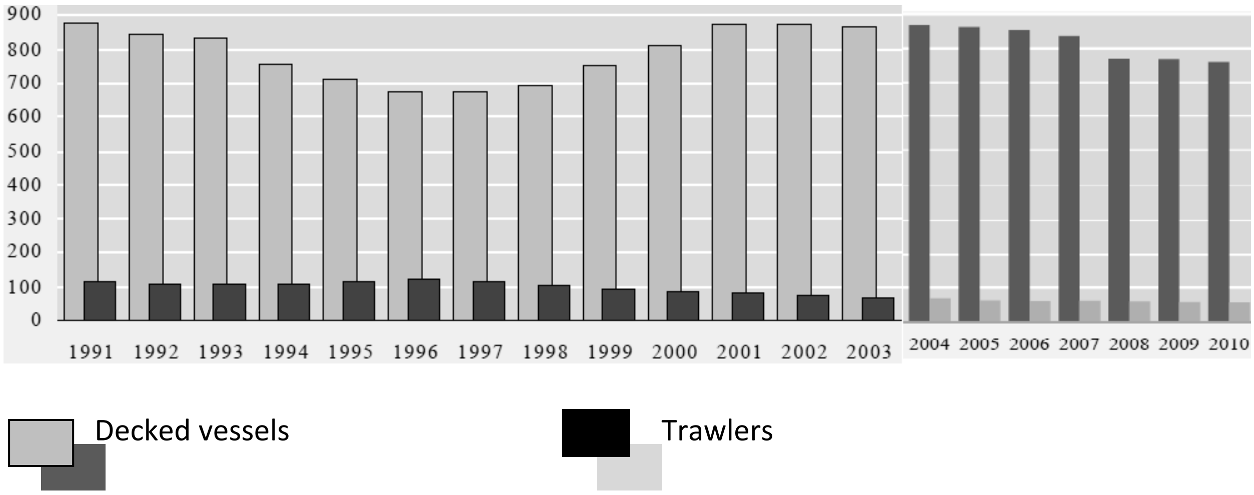
Fishery has been Iceland's most important industry during the 20th century and the country's rapid economic development has been generally attributed to the expanding fishing industry. Fish products constituted the bulk of Iceland's exports, reaching as high as 95% of merchandise exports in the 1940s and over 60% by the end of the 20th century (Bjorndal Th., 2007, p. 239).

As a nation depending on fisheries for its livelihood, the Icelanders have for a long time been conscious of the need for fish stock conservation. Since the 1930s many different measures have been undertaken for this purpose, including gear restrictions, nursery ground closures, juvenile protection, minimum fish size limits and total quotas. Thus, biological management of the Icelandic fish stocks has probably been superior to that of many other fishing nations. The stocks have generally not been as seriously depleted as in many other fisheries. In addition to a fairly prudent biological management of the fish stocks, Iceland was one of the first nations to adopt fisheries management measures designed to improve the economic performance of the fisheries. Thus, individual vessel quotas (IQs) were introduced in the Icelandic herring fishery as early as 1976.

By 1984, almost all Icelandic fisheries had come under an Individual Transferable Quota management. Finally, in 1990, special fisheries management legislation introduced a uniform Individual Transferable Share Quota fisheries management system for all Icelandic fisheries.

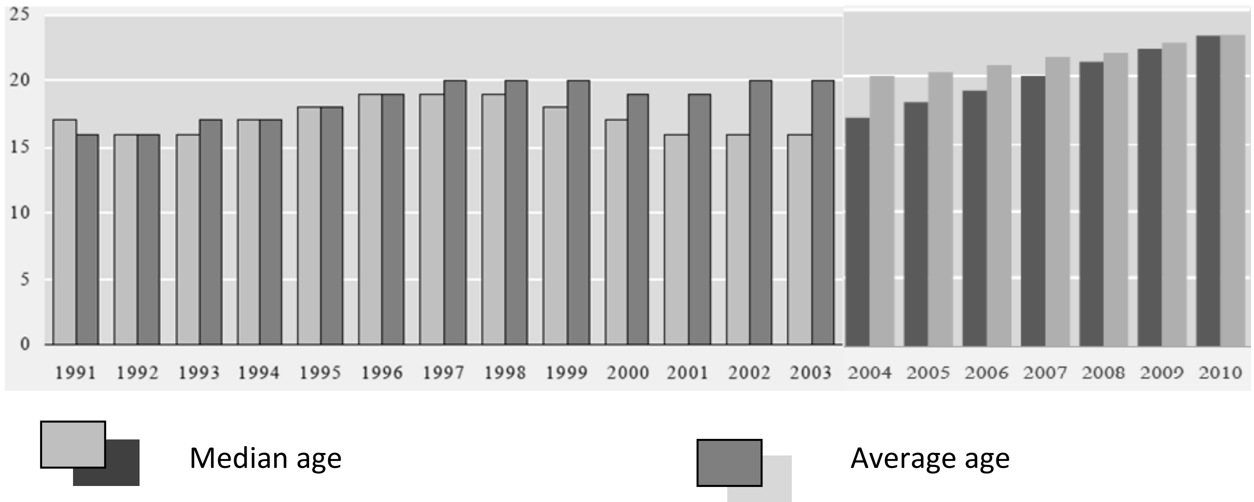
These efforts at rationalization in the fisheries have produced clear economic benefits. Arnason found (1995, p.146) that the rate of expansion in the fishing fleet has been greatly reduced and some sections of the fishing fleet have actually contracted. "Since 1980 there has been a dramatic decline in the number of fishing vessels and a smaller decline in the total tonnage (GRT) of the pelagic fleet" (Arnason, 2005, p. 256). Reduction of number of decked vessels lasted till 1997.

Figure 6. Number of decked vessels and trawlers in 1991-2010 (Statictics Iceland, 2004, 2011).



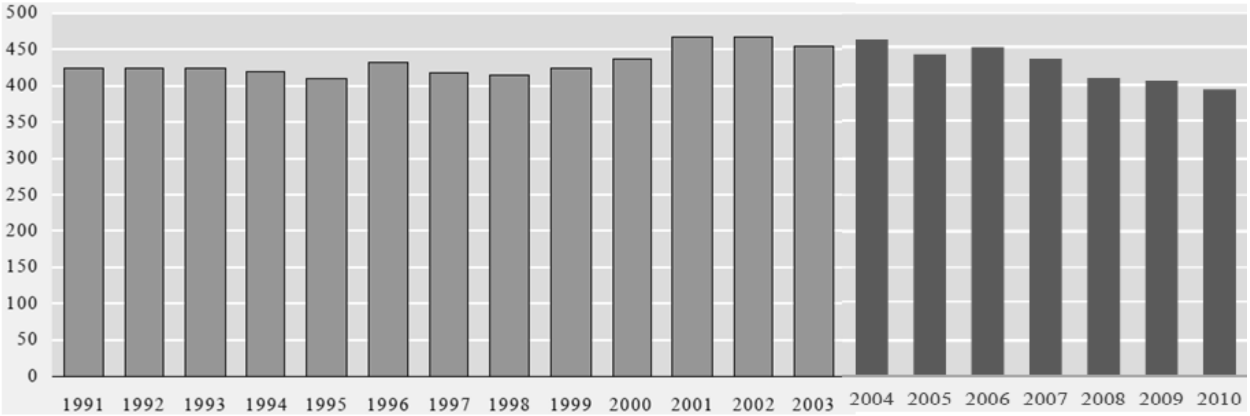
The expansion of fishing effort has also been curtailed and, in some fisheries, greatly reduced. The ITQ system led to partial renewal of the fishing fleet. The data of the following diagram on average age of fishing vessels prove the tendency to renovation of vessels especially after privatization of the banks that made funding more available. However the effect may not be so visible due to segmentation of this process.

Figure 7. Median and average age of decked vessels and trawlers in 1991-2010 (Statictics Iceland, 2004, 2011).



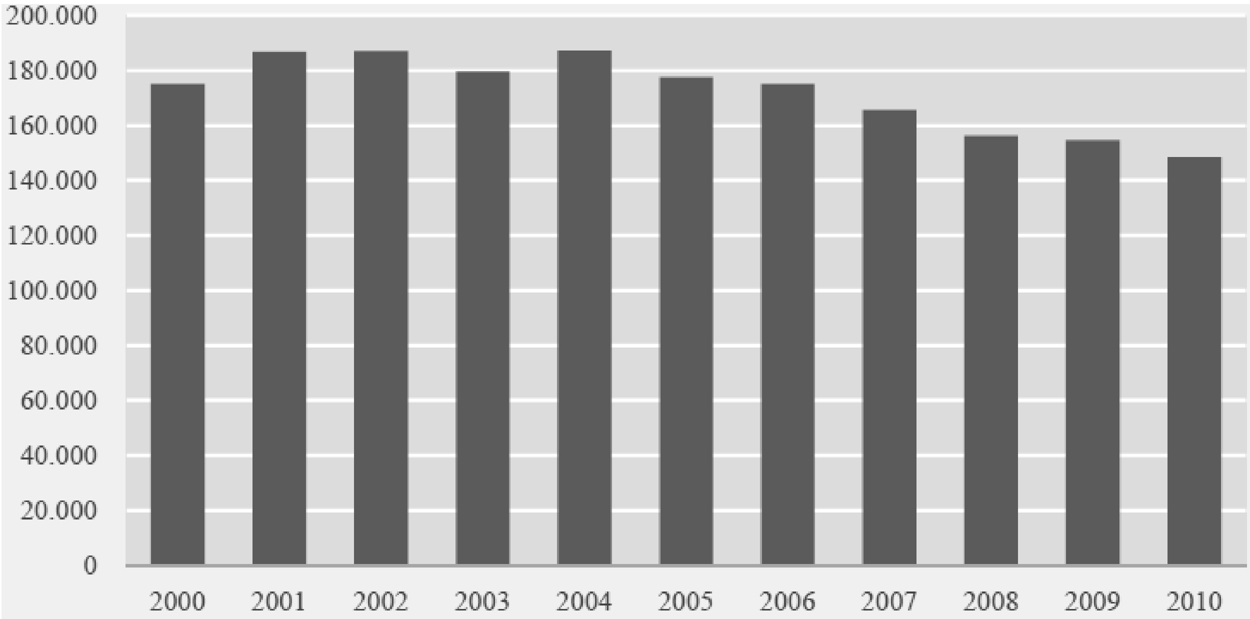
A positive impact of ITQ system on fishing efforts could be traced on the following graph of the total power of main engines on Icelandic fishing vessels (adjusted to incentives for fuel economy due to the high price of oil).

Figure 8. Power of main engines if decked vessels and trawlers in 1991-2010 (Statictics Iceland, 2004, 2011)



This positive tendency is party supported by shrinking tonnage of the fishing fleet presented by the figure below.

Figure 9. Gross tonnage of decked vessels and trawlers in 2000-2010 (Statictics Iceland, 2011).



But the overall picture of the effects of the quota management system on the efficiency of the fishing fleet must be adjusted to the shrinking availability of fish stocks and thus total weight of catch. Its significant decrease over last decade in its turn affected number and tonnage of the vessels in operations. However with increasing value of fish catch in ISK (it is to be adjusted by the exchange rate of ISK) it's reasonable to reduce TAC to preserve fish stocks even if fishing stocks are available.

Table 2. Total catch (mln. tons) and catch value (bln. ISK) by Icelandic fishing vessels in 1993-2009 (Hagstofa Islands, 2011).

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Value bln ISK	51	52	54	57	56	59	60	60	71	77	67	68	68	76	80	99	115
Catch mln.tons	1,7	1,6	1,6	2,0	2,2	1,7	1,7	1,9	1,9	2,1	2,0	1,7	1,7	1,3	1,4	1,3	1,1

The comprehensive *Fisheries Management Act 1990* closed many of the loopholes of the ITQ system. According to Arnason (Arnason, 1995, p. 134) in particular it abolished the limited effort option and brought the fishing vessels under 10 GRT into the ITQ system. Still, however, a few worrisome loopholes remain. First, fishing vessels under 6 GRT in size were offered the option of remaining outside the ITQ system provided they restricted their operations to hook and line fishing for demersal species. This exemption, generally referred to as the hook license, was to be expired in 1994 but gradually developed to an open unlicensed system with restrictions on fishing days and total catch. Second, the longline partial exemption from the quota constraint in mid-winter, initially introduced in 1984, was retained. This exemption meant that only 50% of longline demersal during November through February was counted against quota.

These exemptions distorted the composition of the fishing fleet and effort. Both types of fleet have increased their share in the demersal catch. This is especially striking in the case of hook and line fleet. This fleet has expanded its share in the catch of cod from about 5 % in 1990 to almost 10 % in 1993. For the whole period since 1984 when the ITQ system in the demersal fisheries was first introduced and fishing vessels under 10 GRT were exempted from individual quota restrictions, the small vessel fleet has more than doubled in size. Investments in small vessels accounts for 15 % of the total investment in the Icelandic fishing fleet since 1984 Similarly, with the introduction of the ITQ system in the demersal fisheries in 1984, the longline fleet expanded its share in the cod catch from about 9 % to almost 16 %. There has also been substantial investment in this fleet. For instance from 1990 to 1992 the number of long-liners employing economic bating equipment increased fivefold (Arnason, 1995, p. 134).

Felt (Felt, 1995) raises the questions as to why Iceland's fisheries are more efficient and the resource rents in the Icelandic fisheries has not been dissipated to the same extent as in Norway and Canada where the fisheries and fishing conditions are quite similar. This difference he illustrates with the following table.

Table 3. North Atlantic Fisheries: catch value per gross ton and catch value per fisherman (Felt, 1995, p. 263).

	Catch value per	
	Fleet Unit	Fisherman
	(US$/GRT)	(US $/FISHERMAN)
ICELAND	5.100	93.300
CANADA (Including West Coast and Gulf Fisheries)	2.400	13.500
USA (Including West Coast and Gulf Fisheries)	2.100	13.100
NORWAY	2.300	27.300
UK	3.700	33.900
EC	3.700	30.400

Higher flexibility of the ITQ system allowed tailoring of fish quotas that matches a vessel fishing capabilities. Felt (Felt, 1995) explained the higher efficiency of the Icelandic fisheries also by the macro-economic policy and fisheries management related to ITQ system. During the post-war period Iceland followed an exchange rate policy apparently designed to maximize personal purchasing power subject to the constraint of minimal profitability in the fishing industry. This policy implied a much higher exchange rate for the Icelandic currency than would otherwise have been the case. This led to the fishing industry suffering from chronically low profitability meanwhile personal purchasing power was relatively high. This policy funneled fisheries rents from the fishing firms to the general population via cheap imports. Thus this exchange rate policy was designed as an income distributive instrument and proved de –facto to be a resource tax on the harvesting industry, reducing the rate of capital accumulation and resource rent dissipation. Other North Atlantic fishing nations didn't follow a similar policy; on the contrary they pursued low exchange rates in order to encourage the expansion of manufacturing export industries.

Felt (1995, p.264) concluded that an early adoption of biological and economic fisheries management, compared to the other North Atlantic fishing nations, had contributed significantly to the relative efficiency of the Icelandic fisheries.

Despite strong arguments in favor of the ITQ system in Iceland some Icelandic economists saw its serious weakness. As discussed by Gylfason (2000) the main problem with the Icelandic ITQ system is that quotas were not sold initially, but were given away for free. The Icelandic government neither sold the fishing rights nor taxed directly the rent. This arrangement entailed gross inequities and led to substantial waste. The stipulation in the *Fisheries Management Act* that the fishing rights are handed out for free rather than sold to vessel owners based on their fishing experience in 1981-1983 is viewed as an obstacle to keep Iceland outside the EU indefinitely, as giving quotas to foreigners out of charge is not acceptable, and trading them on barter basis, as has been done on a limited scale within framework of intergovernmental agreements like between Iceland and Russia, is inefficient. Selling quotas for foreigners while continuing to give them to Icelandic vessel owners for free would involve discrimination by nationality and, would thus, constitute a violation of the Treaty of Rome.

But most important is that unrequited quota allocations to vessel owners have reduced the transparency of fiscal and monetary operations by hiding substantial de-facto government subsidies to the fishing industry. The main relevant to the topic of the thesis argument is that free quotas enabled fragile fishing firms to use their quota allocations to service their debts rather than declare bankruptcy.

Gylfason also argued that these concealed subsidies in a form of valuable fishing rights to vessel owners promoted and perpetuated inefficiency as well as a lack of financial self-responsibility in the fishing industry. The vessel owners allegedly used the money to buy more and bigger vessels. This argument however didn’t stand the reality of data provided in Figure 6. depicting decreasing number of decked vessels and stable number of trawlers from 1991, right after full scale introduction of the ITQ system in Iceland.

According to Gylfason (Gylfason, 2000) the ongoing rationalization of the Icelandic fishing industry would entail less waste and be more rapid if the fishing permits were sold initially (e.g. auctioned off, taxed, or allocated to all Icelanders alike in the form of shares or vouchers), and would then remain fully and freely transferable and thus not subject to any restrictions. This is the most efficient, fair, and equitable way of regulating the access to the fisheries and of distributing the associated fishing rent, which is roughly estimated at around 5 per cent of the Iceland's GNP in the long run, year after year.

It is unlikely a coincidence that the first Icelandic fishing company was listed in the Icelandic Stock Exchange in the summer of 1992, right after adoption of the *Fisheries Management Act.* In the years to follow there was a growing momentum in which it peaked in 1999 when 20 fishing companies listed there. But from the year 2002 there was a decrease of companies and in 2005 there was only one fishing company left on the Icelandic Stock Exchange. This was mostly due to mergers and acquisitions of fishing companies which led to the privatization of the companies' involved (Erla Kristjánsdóttir, 2009, pp. 46-47). So in a last couple of years there has been a concentration of fish quota to a few big companies in the fishing industry. Many experts did believe that this was a positive sign because with bigger companies in the fishing industry, the industry would achieve greater economies of scale both in fishing and processing the fishing products (Landsbanki Íslands, 2006). Others believe that it is unavoidable because the implicit and the explicit price of the ITQs in the markets for fishing-rights and for public stocks do not match, that is the expectation formed by stock traders and fishery managers with respect to the future development of the fishing firms are not in line (Ólafur Klemensson & Þórólfur Matthíasson, 2004, p. 9). According to data the 10 major fisheries in Iceland had about 27% of the total quotas in 1995 (Landsbanki Íslands, 2006), but in 2009 the ten major fisheries had about 50% of the quotas (Fiskistofa, 2009). There are limitations about how much quota any individual company can own. According to article 13 of *Fisheries Management Act* for example the maximum ownership of cod is 12% per company and 20% of haddock. This limitation of the quota system is called "quota roof" and means that fishing companies cannot internally grow or externally through merger and acquisition any further than the law permits.

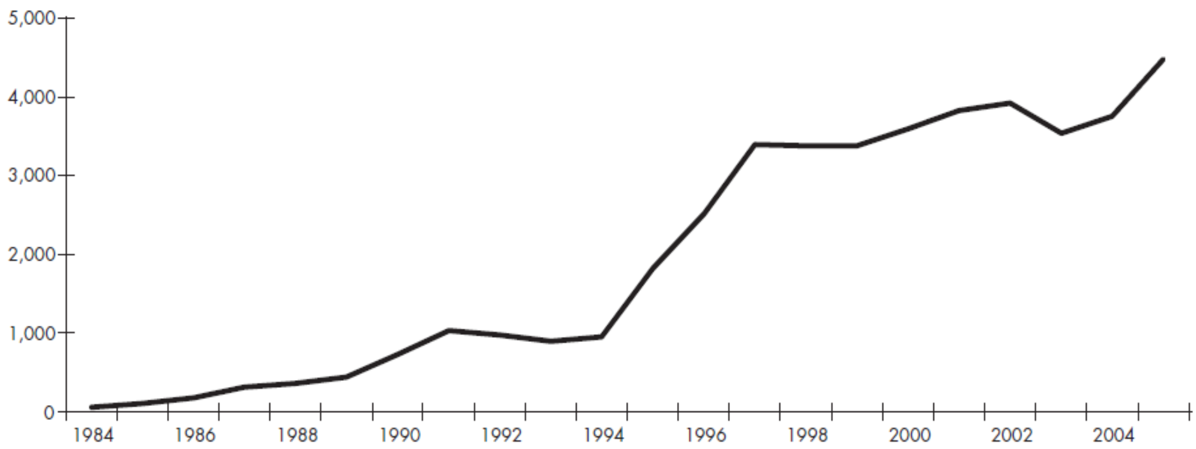
2.3. Resource rent, ITQ system and quota value

According to estimates made in 90-s Iceland's fish stocks were capable of yielding economic rents amounting to at least US$ 400 m annually. This amount was almost twice that of projected personal income taxes in Iceland in 1994 (Arnason R., 1996). This means that provided the fisheries were operated in the optimal manner they would generate economic rents more than sufficient to completely replace income taxation in Iceland. In this sense

Iceland's marine resources are capable of generating annual rents on pair with the oil revenues of some other states. The difference, however, is that Iceland's marine resources, being renewable, are presumable capable of yielding these rents in perpetuity.

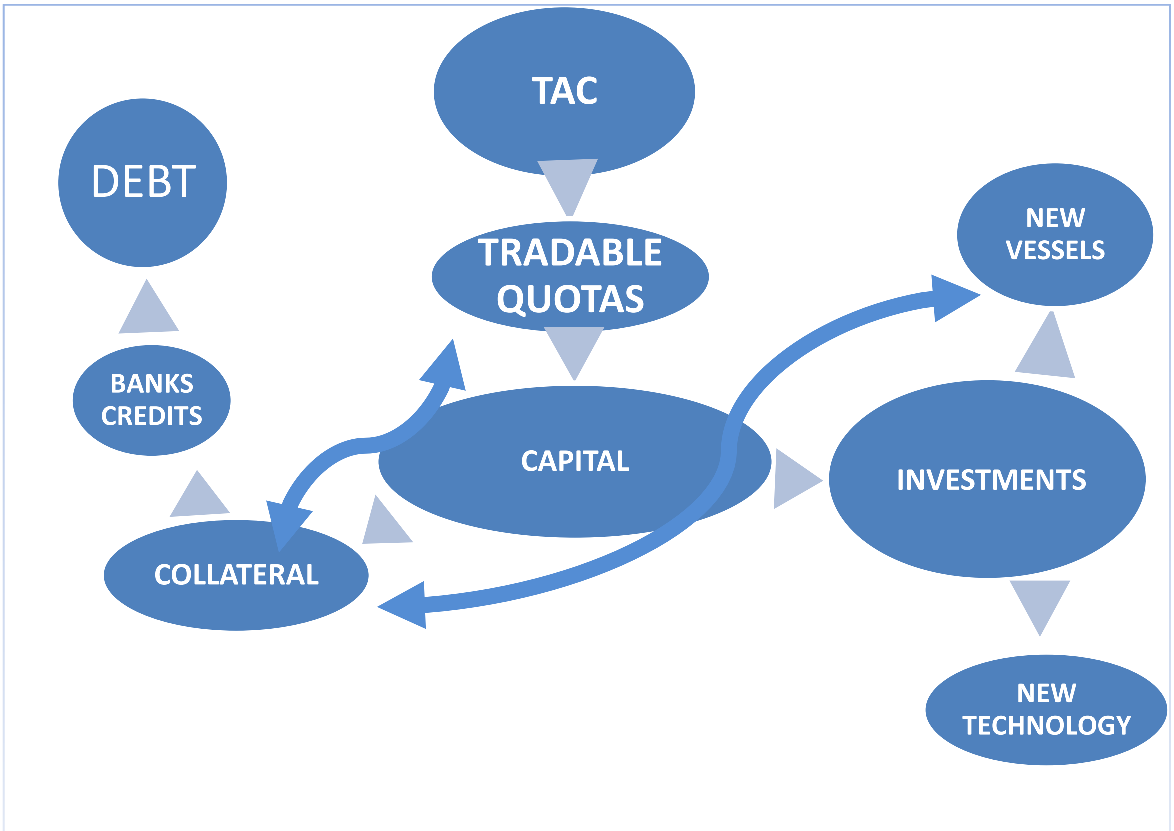
The standard economic theory and assumption that the quota market is reasonably effective lays a foundation for estimating the rents generated in the fisheries. As quotas are transferable with some regional and periodical limitations and tradable, a market for quotas has developed. In this market, quotas are exchanged for other valuables such as money. Arnason's estimation of value of quotas on demersal fisheries (constituting 75% of total value of Icelandic fisheries) was that it exceeded a quarter of total earnings in this type of fisheries. In 1990 the whole value of this type of fisheries generated from USD 222 mln. to 267 mln. value of rent (Arnason, 1995, p. 130), thus becoming a substantial financial asset for the economy of GDP worth of USD 6.5 bln. in 1991 (Arnason, 1995, p. 18).

Figure 10. Permanent quota values in Iceland: estimates, mln. USD (Arnason, 2008, p. 37).



In the context of macro-economic policy this rent was partly 1) distributed among the whole population through taxation and especially exchange rate unfavorable for fishermen, 2) used as investments in the fishery sector itself and 3) came to the free capital market. The capital created by the ITQ system was mainly distributed in the fishing industry according to the following scheme.

Figure 11. Scheme of capitalisation of fishing industry through ITQ trade.

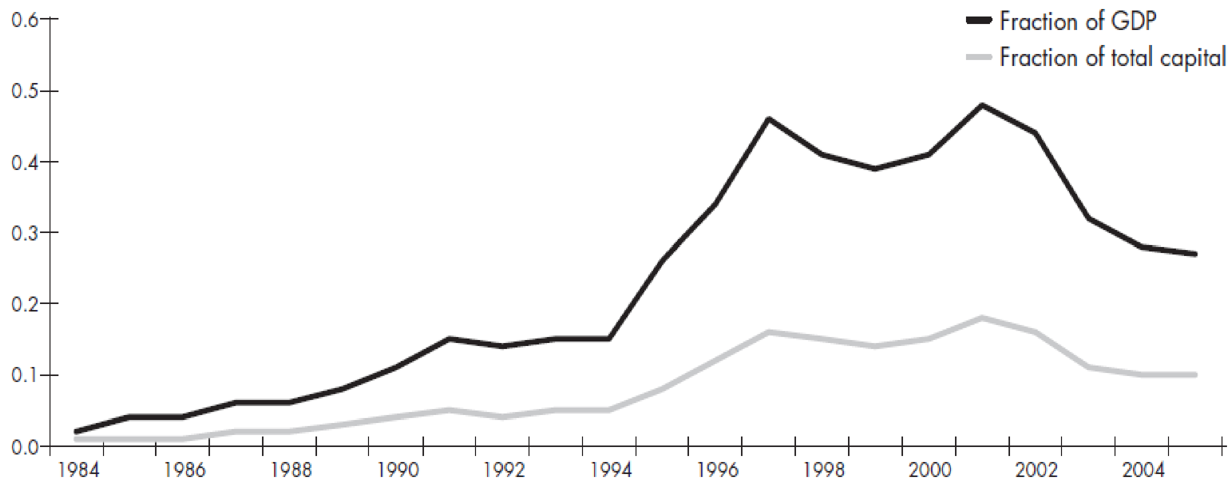


Fishing companies used their fishing quotas as part of collateral along with the fishing vessels to get loans from banks. This led to significant capitalization of the industry but because of restricted access and limitations for new fishing vessels investments were tunneled into increasing efficient technologies in catches and processing.

Besides restoration and two decades long sustainable utilization of fish stocks Icelandic ITQ system brought significant economic gains. An enhanced effectiveness of the fishing industry through administratively adjusted harvest levels maximized the value of quota price (Patterson, 2008, p. 269). The tradability of quotas gave birth to a quota market and proved to be an efficient mechanism to evaluate the whole fishing industry and effectively relocate investments.

According to Arnason (Arnason, Iceland's ITQ System Creates New Wealth, 2008, p. 39) rent generated in the fisheries was not lost due to the effective ITQ system like in most of the cases of common property (or common pool) arrangement. Accumulated rent boosted capitalization of the fishing industry, created a considerable capital. The introduction of the ITQ system was followed by a substantial spurt in economic growth that primarily occurred in sectors of the economy other than the fisheries sector, most importantly the financial sector. Legally secured fishing quotas became measurable financial assets of particular importance for a small economy like Icelandic. Generated capital boosted stock exchange activity and banking development. Permanent, secure and appropriately enforced ITQ system constituted high quality property rights in harvesting, and thus certain, albeit limited, form of property rights in the fish stocks. Tradable and divisible fishing quotas for indefinite period became a factor of stability for the industry.

Figure 12. Permanent quota values in Iceland as fractions of GDP and total capital: estimates (Arnason, 2008, p. 38).



As found by Arnason (Arnason, 2008) quota values have risen quite dramatically since 1984. A dramatic jump occurred in 1990-1991 and 1995-1997 due to stronger guarantees introduced for the property rights on the quotas. It 1984 judging from the quota prices the total value of these property rights was about USD 25 mln. whereas in 1998 it was estimated between USD 3.5 and 4.5 bln. These ITQ values constituted a very substantial fraction of Iceland's GDP and its total capital base. Between 1997 and 2002 ITQ values amounted to over 40% of annual GDP and up to 20% of national capital. Since 2002 the percentage declined mostly due to the rapid growth of capitalization of Icelandic banking sector.

Besides secondary capital generation the ITQ system improved profits and reduced excessive fishing fleet. At the same time the level of indebtedness in the fishing industry doubled between 1997 and 2007. Fishing companies became hostages of their newly created wealth, having much of their assets on bail. Property rights for fishing quotas have been put under significant risk as the economy being affected by increased external volatility. Thus ITQ values represent new wealth that didn't exist before, but its value is subject to number of objective and subjective factors.

Conclusions

- the ITQ system enhanced capitalization of the fishing industry allowing renovation of the fleet and fishing technologies;
- tradable quotas were used as additional collateral to credit the fishing industry;
- due to restricted access and limitations for new fishing vessels to enter into fishing, investments were tunneled into new technologies.

3. FISHING QUOTAS AS FINANCIAL ASSET

The above case study of the situation in Iceland puts different questions as regards fishing quotas as assets in front of authorities regulating fish stocks usage, the general public as a sovereign holder of rights of national resources, that includes fish as well as in front of fishing companies and vessel owners with financial institutions that credit the industry

Individual fishing quotas are a promising market-based system for avoiding the common pool problem in fisheries, particularly when trade of quotas between fishers is permitted. When there are competitive quota markets, rational asset pricing theory suggests that the price of quotas should reflect the expected present value of future profits in the fishery. Thus, for ITQs to deliver an efficient solution to the common pool problem, quota markets must convey appropriate price signals.

Newell *et al*. (2005) found that asset prices are higher when interest rates are low and for stocks that experience less biological fluctuation. Furthermore, stocks with higher growth rates of fish output prices tend to have higher quota asset prices. Stocks that are thought to have experienced reductions in costs since the introduction of the ITQ market are also found to have higher asset prices and these effects were not found to have decreased over time. The New Zealand quota system is functioning also reasonably well and the prices at which quotas are sold appear to reflect expectations about future returns on specific fish stocks (Newell, 2005, p. 20).

Fishing firms, to the extent that their chief assets are fish stocks, representing rights to catch, land and market fish, is not ordinary enterprises. Fish stocks are the property of people at large, not of fishers. This stipulated in many national laws. Russia's Federal Law on Fisheries and Preservation of Aquatic Biological Resources 2004 in particular states in article 10 that "water biological resources belong to the federal property". In this sense the fish stocks are similar to potential offshore oil and gas deposits, to be explored, developed and extracted by private sector firms. Ultimate ownership of fish stocks as vested in the state, which may claim the resource rent. As with oil and gas, fish stocks pose vexatious problems of taxation. In resource taxation system investments in the stock of fish reserves are carried forward as offsets against royalties levied on future rents generated by extraction. As discussed by Neher et al. (1989, p. 189) taxation should not distort the natural (economical) level of investment in the resource stock.

3.1. Fishing quota markets

As it was stated by Newell (Newell, 2005, p. 9) trades of the perpetual right to fish will occur as high-cost fishers find it profitable to sell their quota rather than fish it. Markets exist for perpetual right to a share of a stock's TAC, as well as for leases of that right to catch a given tonnage in a particular year. They constitute the asset and lease markets. Thus the current quota asset price should be equal to the present discounted value of all future expected earnings, where the lease prices represent the annual flow of profits from holding quotas.

The price of the quota asset, therefore, will vary across fish stocks and over time based on changes in expected future lease prices or changes in the expected discount rate over time. Under the simplifying assumption that expected lease prices and discount rates remain constant in the future, the price of the asset would simply equal the lease price divided by the discount rate, or $p=\Pi/r$, where Π is lease price and r is a discount rate. "The level of the average asset price is also approximately 10 times the lease price over the sample period, roughly equal to the present value of a perpetuity discounted at 10 percent" (Newell, 2005, p. 2).

According to Newell et al. (Newell, 2005, p. 3) there is considerable cross-sectional variation in the dividend-price ratio across fish stocks markets, where the upper and lower plus signs represent the 25th and 75th percentiles around the median. One reason could be that if fishers are risk averse, they might prefer fish stocks with lower variance, other things equal. This effect is consistent with a higher discount rate, or higher required rate of return for riskier stocks. Such volatility could be associated with natural variation in stock abundance and economic variability in costs and fish prices. Another explanation could be differences in the expected growth rate of profits over time, possibly due to differences in output price growth, changes in fish populations, or other factors affecting costs such as cost rationalization due to quota trading. Stocks with a higher degree of biological volatility tend to have lower asset prices, and stocks that have rising returns or falling costs from fishing are found to have higher asset prices.

The price of fish is an excellent instrument as it is a significant determinant of profits from fishing, it is highly correlated with quota lease prices (ρ = 0.77), and it is exogenous (Newell, 2005, p. 16).

Factors that influence quota prices are of natural (ecological), political and economic origin:

Natural (ecological): **a)** fluctuation of fish stocks and subsequent scientifically justified total allowable catch (TAC) forecast **b)** weather conditions **c)** ecological regulations of fishing gear, seasons and fishing efforts.

Economic factors: **a)** general economic situation in Iceland (in particular interest rate) **b)** global prices on fish (and exchange rate of Icelandic krona) **c)** demand on quotas from expanding fishing industry d) prices of fuel and labor.

Political factors: **a)** political stability guaranteeing status quo **b)** public consensus on the problem of public assets versus private use.

3.2. Quota market in Iceland

Constant and foreseeable growth of prices for fish products plays a positive role in increased value of quotas. At the same time a dramatic turn in economy in Iceland put at risk value of quotas because of high interest rate stimulating a delay for further investments in vessels, fishing and processing equipment to explore natural resources. Growing prices on fish partly compensate the shrinking resource base of Icelandic fisheries. It was reduced on cod from 186.000 in 1996/97 to 130.000 tons last fishing year, but increased on haddock some other species. This tendency inevitably bears risk of jeopardizing ITQ value in quantity. The fact that the total catch in the Icelandic waters went down from 1.383 thousand tons in 1997/1998 to 781 thousand tons mostly because of depleted stocks of less valuable species like capelin and herring (Fiskistofa, 2010) makes this picture less gloomy.

It should be noted that evaluation of fishing quota as collateral takes into account these factors; however creditability of a company is determined by its expected future cash flow. There is a significant dichotomy in case of fishing quota as fishing quota only in combination with a proper fishing vessel provides a basement for the future cash flow. This double faceted nature of the fishing quota as a collateral and a right to access to raw material for production make quota holders even more vulnerable to the fluctuation of the above mentioned factors.

The current economic crisis in Iceland has brought the permanent quota market to a deadlock. Almost no trade has been taking place. It could be explained by either the already achieved concentration of quotas from one side, which means they are now anchored to their final effective users, or expected changes in the fishery management system, or quotas are on bail, that means that they guarantee fishing companies' liabilities,. The last argument can be proved by the price situation of a lease quota market. The volume of fishing quotas leased decreased along with slight decrease of their value, which will be more dramatic if the value is not calculated in Icelandic currency but furthermore in US dollars.

Table 4. Value of fishing quotas leased annually (Fiskistofa, 2010).

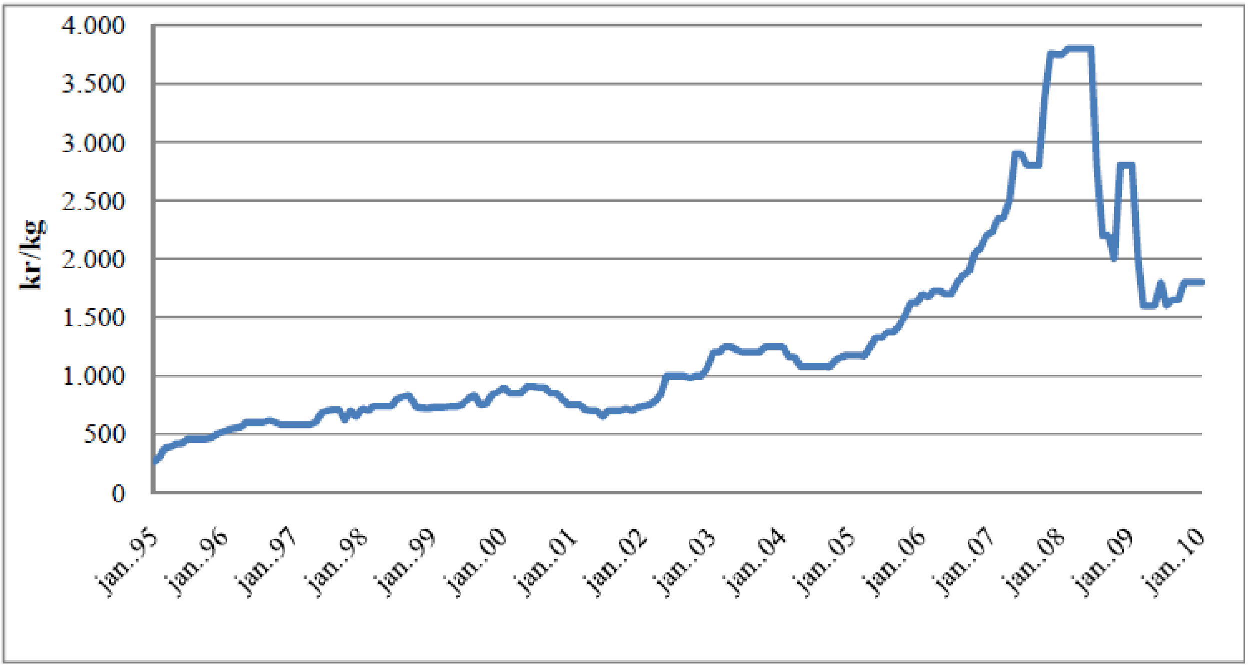
	Volume (kg)	**Value (ISK)**	ISK/kg	USD/kg
2007	161 649 458	54 422 601 879	337	5.35
2008	124 501 727	41 364 985 712	332	2.69
2009	117 316 220	31 610 418 596	270	2.12

In the middle of 2010 quota leasing rights for major species (haddock, catfish, Pollock) were offered in the range of 105-150 ISK (Icelandic Association of Fishing Vessel Owners, 2010) per kg that means a drop of an average quota leasing price. These data display the significant devaluation of fishing quotas as financial assets. It could be concluded that currently liabilities of fishing companies are not fully collateralized. The loss is 60% of their value. But the reduction in price could partly be attributed to an increasing uncertainty about future of ITQ system compromised with allegation of quota cuts if they are leased.

Agnarson (2010) showed that in Iceland a number of companies transferring quotas was decreasing significantly from the first years of allocation due to a natural process of concentration of the quotas in hands of more efficient companies that usually are big companies. The number companies that made cod quota transfers dropped from 908 in 1991/1992 to 156 last year (Agnarsson, 2010, p. 26). Similar tendency took shape in New Zealand where Newell *et al*. (2005) found that from 1986 to 2000 the quota markets are active with about 140,000 leases and 23,000 quota asset sales occurring between economically distinct private entities—an annual average of about 9,300 leases and 1,500 asset sales. The annual number of leases has risen 10-fold during this period, and the median percentage of quotas leased in these markets has risen consistently, from 9 percent in 1987 to 44 percent in 2000. At the same time, the total number of quota asset sales declined from a high of about 3,200 sales in 1986 (when initial quota allocations for most species took place), leveling off to around 1,000 sales in the late 1990s. Data analysis (Newell, 2005, p. 6) showed a similar decline, with the percentage sold being as high as 23 percent at the start of the program, gradually decreasing in subsequent years to around 5 percent of total outstanding quotas per year in the late 1990s. This pattern of asset sales is consistent with a period of rationalization and reallocation proximate to the initial allocation of quotas, with sales activity decreasing after the less profitable producers have exited.

The report by Stefán B. Gunnlaugsson et al. (2010) is based on Icelandic data but recalculated in SDR to allow comparability not distorted by ISK exchange rate. The report proved that a quota price (fixed quota) had a major impact on the economic status of Icelandic fisheries and the data show dramatic price fluctuations of the cod quota.

Figure 13. Development of the cod quota share price 1995-2010 (Gunnlaugsson, S., Knútsson, O., Heiðarsson, J., 2010)



The price was rising almost continuously from the beginning of 1995 when it was 260 ISK/kg to June 2008 when prices peaked to 3800 ISK / kg. Since then the price dropped a lot and according to Gunnlaugsson et al. (2010) was in 2010 about 1800 ISK / kg, i.e. it reached the bottom. The reasons for increases in the price of quota shares of 1995-2001 were the improved performance of fishing companies and changes in the total allocation. The increase in 2002-2007 was due to improved access to credit and cheaper capital. Expectation of a higher inflation was seemingly another reason for the increase in 2008. That is why the quota share price reached its peak in mid-2008 and plummeted after the banking collapse. In addition, it is likely that uncertainty about the future of the existing quota system has led to reductions in the price of quota shares since 2008 in Iceland.

Now the market for quota shares is frozen with no official sales taking place. At the same time leasing market shrunken significantly but still active at a smaller scale. According to data from Federation of Icelandic Vessel Owners the recent prices for annual cod quota was in April 2011 in the range of 320-330 ISK per kg. Using the ration of the price of quota share to leasing price at 10 to 1 the current price could be assumed equal to 3200-3300 ISK/kg.

Political uncertainty about quota system as well as poor financial performance of Icelandic fishing companies in 2008 were main reasons for the quota markets collapse. Losses were in

1997, 2000 and 2001, in 2000-2001 primarily due to long-term foreign currency moves under the inflation adjustment and interest. Significant loss in 2006 was due to exchange rate adjustment that weakened Icelandic krona by 15%. A tremendous loss of 2008 was caused by banking collapse and 45% depreciation of Icelandic krona that deprived fishing companies of funds to acquire quota shares.

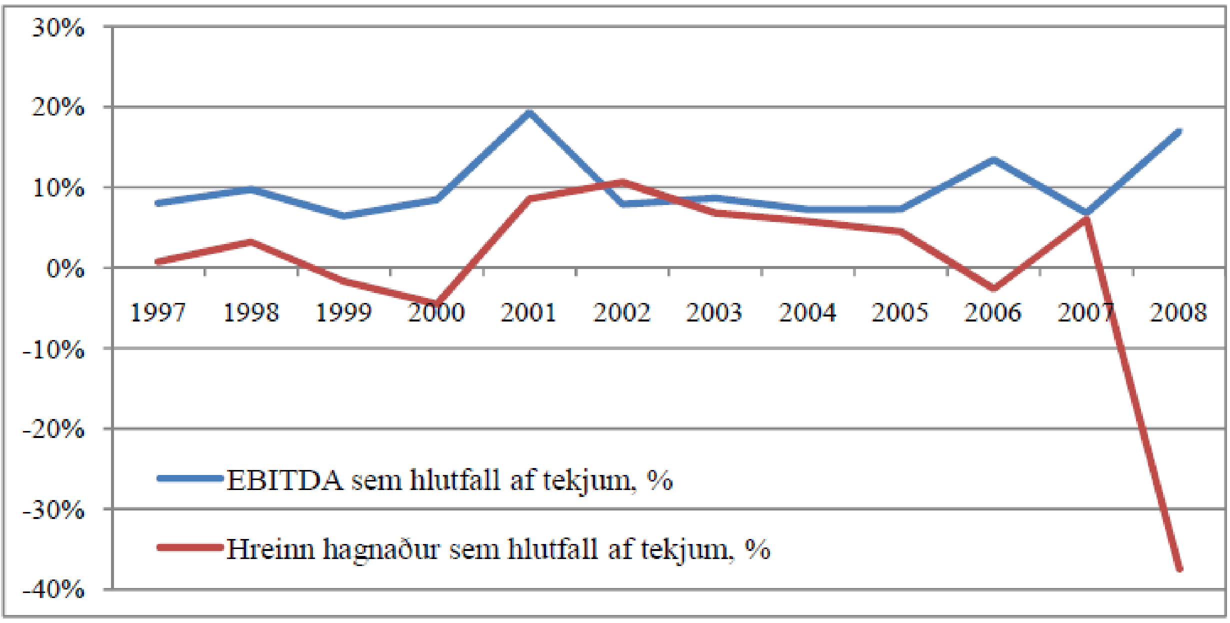
Table 5. Development of the main variables in the profit and loss of fishing 1997-2008 million. SDR on the weighted year (Agnarsson, 2010)

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Total revenue	611	651	647	602	611	699	656	688	804	793	872	746
Total expenditure	-508	-522	-527	-485	-462	-535	-516	-570	-647	-601	-685	-56
Margin (EBITDA)	104	128	120	117	149	164	140	118	157	193	187	187
Depreciation	-82	-100	-99	-87	-70	-100	-115	-113	-97	-81	-74	-56
Inflation adjustment and interest	32	-36	-20	-76	-92	46	-1	21	34	-211	15	-917
Net profit (EBT)	-11	7	1	-46	-13	110	23	26	93	-100	128	-785

Despite the fluctuation of profits due to depreciation of the Icelandic krona EBITDA ratio makes it evident that fisheries are stable. Agnarsson (2010) shows that In 1997 EBITDA was 17% while in 2008 it was 25%. This ratio measures how high proportion of income is left to cover depreciation, interest and tax payments. Interestingly, the Icelandic fisheries have managed to increase this rate despite the skyrocketing prices on oil at this period (in 1997 the average price of oil was 19 USD per barrel, while in 2008 it was 91 USD). This huge increase of 378% had no significant impact of oil cost ratio in revenues that in 1997 was 8.1% of revenues, but only 12.3% in 2008. Labor costs of fishing operations were very stable, since wages of seafarers constitute a fixed percentage of the value of catch. Yet wage rates, i.e. labor costs in percentage of operating revenue, decreased somewhat. This ratio was 39.7% in 1997 but was come down to 35.4% in 2008. The fishing companies have managed to reduce other costs such as catch the moving costs, maintenance costs, etc. fairly continuously since 1997. The enormous losses of 2008 were due to the krona depreciation by 45% that caused huge foreign exchange losses. The financial expenses of operations grew by 123%. Profit that year was very poor as a loss in fisheries reached 105% of revenue in 2008, as shown in Figure 14. However, EBITDA was high in 2008 reaching 25%. Post crisis operations of Icelandic fishing industry has been doing pretty well since 2008.

The Figure 14. shows the development of EBITDA and profit rate data. Smaller fluctuations took place in the performance production and profitability of fishing operations. Examined in more detail one can find that the standard deviation profit rate of fishing operations during this period is 32%, which is extremely high, but standard profit rate is 13%. The most likely explanation is that fishing industry had high rate of debt and the exchange rate made relatively higher profits and depreciation.

Figure 14. Development of EBITDA and profit rate in 1997-2008 in Icelandic fisheries (Gunnlaugsson, S., Knútsson, O., Heiðarsson, J., 2010, p. 16)



Due to the overwhelming share of revenues in the fishing industry is in foreign currencies (about 90-93%) and the enormous fluctuations of the Icelandic krona affect its rate that is why the balance sheet is calculated in SDR. The table shows the balance sheet of the Icelandic fishing industry has grown, assets have increased and debt has increased. The increase in debt has exceeded assets and therefore the equity sector erased. Overall, the financial account of the Icelandic fisheries increased by 55% in 1997-2008 if measured in SDR. However, the size of the balance sheet increased by 201% which is more than tripled its size if measured in ISK. The increase in other assets was up by 507% during this period (1997-2008) if measured in the SDR and by about 1075% if measured in ISK. “Other assets” account comprises quotas so increase was mainly due to investments in quota. Interestingly, there was no increase in fixed assets (fishing vessels and equipment) during this period. If measured in SDR this account dropped by 46% but if measured in ISK increased by only 4%. Therefore the expansion of assets and increased leverage of the Icelandic fishing industry took place not because of investment in fixed assets.

Table 6. Development of the main balance sheet aggregates the Icelandic fishing industry (million of SDR in 1997-2008) (Gunnlaugsson, S., Knútsson, O., Heiðarsson, J., 2010, p. 23)

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
1.Current	*379*	*370*	*520*	*374*	*424*	*441*	*537*	*693*	*672*	*635*	*795*	*524*
1.1 Cash	*59*	*65*	*63*	*51*	*55*	*58*	*112*	*188*	*182*	*191*	*271*	*150*
1.2 Trade and bills	*156*	*161*	*216*	*123*	*208*	*206*	*257*	*345*	*269*	*242*	*247*	*194*
1.3 Inventories	*141*	*122*	*133*	*162*	*140*	*143*	*148*	*154*	*162*	*141*	*163*	*140*
1.4 Other current assets	*24*	*22*	*109*	*37*	*21*	*34*	*20*	*7*	*60*	*61*	*114*	*40*
2. Fixed assets	*1.346*	*1.501*	*1.687*	*1.573*	*1.440*	*1.652*	*1.843*	*2.401*	*3.221*	*3.066*	*3.633*	*2.155*
2.1 Financial Risk. and Long-term	*201*	*197*	*290*	*272*	*264*	*365*	*439*	*453*	*740*	*764*	*1.02*	*661*
2.2 Property Equipment	*986*	*1.07*	*1.12*	*948*	*846*	*872*	*863*	*1.02*	*1.105*	*875*	*911*	*530*
2.3 Other assets	*159*	*234*	*280*	*353*	*329*	*415*	*541*	*925*	*1.376*	*1.43*	*1.702*	*963*
3. Assets = Liabilities + Equity	*1.725*	*1.871*	*2.207*	*1.947*	*1.864*	*2.093*	*2.380*	*3.094*	*3.893*	*3.701*	*4.429*	*2.679*
4. Debt	*1.271*	*1.430*	*1.611*	*1.481*	*1.411*	*1.439*	*1.671*	*2.162*	*2.748*	*2.778*	*3.308*	*2.997*
4.1 Current	*405*	*426*	*492*	*455*	*443*	*474*	*549*	*561*	*735*	*583*	*803*	*671*

4.2 Long-term	*866*	*1.004*	*1.119*	*1.026*	*968*	*966*	*1.122*	*1.601*	*2.013*	*2.195*	*2.506*	*2.326*
5. Equity	*454*	*441*	*596*	*466*	*453*	*654*	*709*	*931*	*1.145*	*923*	*1.120*	*-318*

The data depict a huge increase in debts. If the debt is to be examined by net debt (total debt less current assets) than according to Gunnlaugsson et al. (2010) at the end of 1997 net debt of the Icelandic fishing companies was 892 million SDR (87 bln. ISK), at the end of 2008 net debt became 2,473 million SDR (465 bln. ISK). This 437% increase in debt signals about large deterioration of economic situation in the fishing industry. Year of 2003 was a turning point when with privatization of a large portion of the Icelandic banking system availability of funds to credit increased and consequently increased leverage ratio in fishing companies. As found by Gunnlaugsson et al. (2010) 60% of the debt was due to purchase of quotas, 30% investments in fixed capital, 5% investments in unrelated activities and 5% was a loss on foreign exchange and stock trading. Another bank estimated a share of quotas constituting 54% of total debts of fishing companies, 31% was investment in an unrelated business and 15% for loss of foreign exchange and derivatives trading. The authors concluded that the rise in debt since 2003 took place not because of exchange rate collapse in 2008 but due to purchase of quotas. Fixed assets didn't increase in SDR, and authors concluded these investments have not raised debt of Icelandic fisheries since 2003. This conclusion of the report is indirectly supported by Figure 5 showing the aging of the fishing fleet. Comparison of the debt of the fishing industry with debts of companies in other industries showed that the latter performed much poorer. Most of twenty of biggest fishing companies in Iceland with 44.6% of total quota are debt free with their current assets higher than total debt. They are in very good financial position. Only three of these twenty companies with about 5.3% of Icelandic fisheries output and the total quota of 7.9% need to undergo substantial restructuring of assets and reduce debts.

Table 7. All and twenty largest Icelandic fishing companies and ability to serve their debts (Gunnlaugsson, S., Knútsson, O., Heiðarsson, J., 2010, p. 28)

	All fishing companies	*Major 20 fishing companies*
Debt-free	*10%*	*8.8%*
Good situation	*30%*	*35.8%*

Difficult situation	*45%*	*47.5%*
Enforced bankruptcy	*15%*	*7.9%*
Total	*100%*	*100%*

According to (Gunnlaugsson, S., Knútsson, O., Heiðarsson, J., 2010) the banks also evaluated the position of Icelandic fishing companies and discovered that out of the 50 largest companies about 24% had unmanageable financial situation and were heading for bankruptcy. These companies have only about 10% of the total quota. About 34% of these 50 with about 54% of the total quota are in good position.

EBITDA in 2008 in fishing industry was 47.5 billion ISK. This EBITDA is the highest that has been in recent years. It is expected that industry will reach the same EBITDA (in amount) for the next few years. It is therefore natural to assume that fish prices will remains as of 2008. It is likely that the catch of important fish stocks such as catch of cod is now in minimum and therefore there is no ground to assume extension of quotas. However there could be strengthened Icelandic krona that leads to a reduction in EBITDA but no one can predict the development rate and this is not expected to be stronger. Real credit in the economy is now about 2%. It is assumed that real interest rates will come up to 7% in the following years. Annual re-investment required is estimated at 13 billion ISK and could be done through depreciation as a measure of the reinvestment. Since 2005 quotas generally have not been written off in the accounts balance and the fisheries have depreciation of those assets for the time being. On average depreciation was 10.8 billion ISK in 2005-2008. The reinvestment needs are some higher than depreciation. Reasons for this are that devaluation of the rate causes the current depreciation being not consistent with the cost of replacement of vessels, equipment and appliances.

Because over 90% of debts in foreign currencies is almost certain that industry debt was in 2010 close to 465 bln. ISK. Of the 20 largest companies 30% of companies in good position having about 35.8% of the quota are expected to pay off their debts on average in 4.4 years based on the aforementioned assumptions. The companies classified in a difficult position are to pay off debts on average in 18.8 years. In this category are 9 of the 20 largest companies, i.e.

45% with 47.5% quota. Companies with unsustainable debt account for 15% of the number of the 20 largest companies, i.e. three companies with 7.9% of total quota. The Icelandic fishing industry as a whole is expected to pay debts in 25.9 years. So smaller companies are in worse situation than 20 largest companies with 67.2% quotas. The statistic data reveal that the majority of Icelandic fishing companies are now in negative equity. However, real equity of companies generally positive but the reasons for this are that fish quota trade is low and the prices are low that is why value is low in the companies' books. Therefore, Cunnlaugsson et al. (2010) estimate that most Icelandic fishing companies have positive earnings, i.e. properties which include in particular quotas are higher than the amount of debt if assets are valued at market value. Assessment of the value of the quota is made by cod equivalents quota. Assumption that the price of quota of cod equivalents is15% lower than the estimated price cod quota should take into account that prices cod quota are higher than other species. Cod equivalent unit was estimated at 1,530 ISK/ kg. In Iceland there were 468 thousand. tones of cod equivalents in 2008.

As of the mid-1990s, the species managed under the new Zealand ITQ system accounted for more than 85 percent of the total commercial catch taken from New Zealand’s EEZ and from Newell’s calculations an estimated market capitalization amounted to about NZ$3 billion (Newell, 2005, p. 4).

The asset price is dependent on the expected future stream of earnings, so that information available at time *t* along with type of expectation process is important in modeling the relationship between asset prices and dividends.Newell (2005, p. 7) suggested the following formula for evaluation taking account of the determinants of asset prices, which is a function of inflation, taxes, credit market imperfections, transaction costs, and risk aversion

$$p_{ij,t} = \frac{\pi_{ij,t}}{(\tilde{r}_t + \theta_{ij} - g_{ij})}.$$

To investigate different risk premium, Newell follows the methods employed in Alston and Cochrane by decomposing the discount rate into a real market interest rate (r) and an asset-specific risk premium (θ*ij*) where future profits (lease prices) grow at a constant rate *g* for certain limit of time t, and on certain asset (quota units) ij.

4. CAPITALIZATION OF FISHING INDUSTRY VIA FLEET RENOVATION AND FISHING QUOTAS

Anderson (Neher, 1989, pp. 185-186)computes average and marginal costs of a fishing firm in terms of production of fishing effort, not its production of caught fish. He suggests that the fishing firm's cost of producing effort is not affected by fish abundance or the kind of management system in force.

Caught fish= catch per unit effort (CRUE) x *e* (effort)

Fleet wide effort reduction in connection with the introduction of ITQs reduces the number of vessels with effort per vessel remaining unaffected. His unit per effort (e) has many components: characteristics of vessel architecture, equipment, propulsion and gear, boat-days of fishing trips per months, fisher-days, and fuels. An ITQ system featuring a longer fishing season as well as more abundant fish stocks might favor a smaller, more labor-intensive, and less fuel - intensive fishing enterprise, producing least-cost effort as a lower value of *e.*

An ITQ tax or royalty should not bear on economic collective investments that fisheries might make. The investments should be made and should drive up the value of quotas (the value of wild fish). But according to Neher et al. (Neher, 1989, p. 186)the increased quota value should not be taxed as they may anticipate no collective tax benefit because of offsetting taxation and stop protecting their fish from "poachers" or start fishing "over quota".

Improvements in fishing technology can increase quota values as the new technology will lower fishers' cost of efforts. The least cost level of effort for each fishing firm may change as well. The market price of outstanding quota allocations will bid up by the difference between the old and the new minimum average cost of effort, multiplied by (1/CPUE).

4.1. Fishing vessel – fishing quota dualism

According to Stopford (Stopford, 2010)the shipbuilding prices were at their height in 2007-2008 and it is expected that the supply side of the shipping market is drawing ahead of demand and with shipyard output growing fast the surplus is likely to get bigger over the next couple of years.

Table 8. Cost of construction of a new bulker in mln USD (Stopford, 2010)

1996	1998	2000	2002	2004	2006	2007	2008	2009	
19	18	23	18	43	80	126	82	18	

Stopford (Stopford, 2010)drew few conclusions from his analysis of shipbuilding market that could be applied to shipbuilding of fishing vessels as well:

- prudent ship owners are now tempted to re-invest significant funds but they have problems finding well priced assets;
- new ships now look very expensive and with prices well down from the peak, their collateral value is insufficient to support the required loans;
- the investment boom went on so long that shipbuilders were able to drive up prices and had time to plan and build new capacity. As result today's capacity has drawn well ahead of the requirement indicated by long-term trends;
- second-hand prices increased very rapidly and seductive arguments about "new paradigms" persuaded bankers to build portfolios which were often based on collateral valued at levels well above long-term trends.

Ship owners are at the heart of the equation and they face a wide range of different problems over finance and investment. Bankers are still struggling with the credit crisis generally but shipping portfolios have their own problems. The shipbuilders who are expanding fast are juggling the problems of cash flow; funding new facilities and managing accounts which cannot meet their commitments. Finally where things are not going smoothly governments are being drawn into the frame, generally reluctantly. The governmental policy is Russia, for example, is encouraging renovation of the fishing fleet by fishing companies through subsidies on paid interest if a vessel is build on a Russian shipbuilding yard. Currently the Russian Government is finalizing Strategy of Development of Fishing Shipbuilding in the Russian federation for the period up to 2020. The Strategy estimates a future demand for new fishing vessels amounting to 160 vessels to allow Russian fishing companies to fully exploit available fish resources (2011, p. 11).

A fishing vessel constitutes not only a dichotomy of capital cost and linked fishing quota, it bears a triple faceted character nowadays with capital cost, more divided into capital investments into the vessel or its purchase price and operational costs. Operational costs include technical maintenance of the vessel and her equipment including fish factory on board, as well as comparative parameters of her exploitation such as fuel consumption, energy and fishing efficiency, autonomy of operations and partly crew and factory workers conditions.

There are many options that may confront a ship owner contemplating an investment decision. For the many practical reasons it is not easy to evaluate these options in financial or economic terms and there is a temptation to suggest that ship design is a matter for commercial flair or "gut feeling" rather than rigorous economic analysis. However, in all but a very few cases, the commercial world demands that decisions of this type should be supported by economic analysis.

There is substantial literature on the evaluation of alternative ship designs. For practical purposes, the analysis needs to be carried out at two levels, which are market research and operational analysis.

Market research is concerned with analyzing the economic performance of the ship within the company's overall shipping activities. For a charter market operator this analysis might involve an examination of the type of vessel that will be easy to charter and its potential resale value. A liner operator might study the type of ship required to handle changes in the pattern of trade or competition on major routes. A fishing vessel owner has to base his analysis on availability of the abundant fish resources to fish as many days a year as possible. Through market research the owner can develop a specification for the type of fishing operation in which the vessel is to be used and the performance parameters that the vessel much satisfy. But as in many national fisheries access to fishing is restricted t national players only few fishing zones can be taken into consideration such as Western African zone, South- Pacific zone and a few others. Thus for the purposes of this thesis national players will be used as basic examples, in particular in Iceland and Russia.

Operational analysis is the next step is to identify the ship design that meets the performance requirements most effectively, using some form of economic measure of merit. For example, the designer may be told that the owner requires a trawler with the following features:

- Freezing factory on board
- Length of about 50 meters
- Ability to accommodate 22 men crew

Economic Criteria for Evaluation Ship Design:

- Fish hold to be about 900m3
- Fuel tanks for 300-400 m3 that are cheap to clean
- Main engine power 2000 kW
- Generator up to 400 kW. An operating speed of 14 knots

The task of the ship owner is to evaluate the various options in economic terms to see which gives the best overall result, recognizing both cost and operational performance. Stopford (Stopford, Maritime Economics, 1988, p. 287)suggests NPV way of doing this depending on the circumstances.

Net present value (NPV).This involves setting up a projected cash flow for optimal operational circumstances. Revenues and costs are projected on an annual basis over the life of the ship (for fishing vessels it is assumed to be 30 years) and the net cash flow in each year is calculated, taking account of capital payments, trading income and expenditure, and the final resale value of the vessel (for 50% resale value it is assumed to be in 10 years taking into account technological renovation cycle). These annual cash flows are then discounted back to the present (using the current interest rate) and summed, giving the net present value of each of the options. The option giving the highest NPV is generally preferred.

The advantage is that it takes account of both the cost and revenue flows, and produces a single figure, which makes the comparison of options a simple matter. On the negative side, the revenue flow may in some cases be extremely difficult to project and arbitrary assumptions about the potential earning power of the vessel may give a distorted result. This technique however should also take into account opportunity costs to compare profitability of investments into a new fishing vessel.

There is a variation on this methods, notably the yield in internal rate of return (Statistic Iceland takes 6% as rate of return for 1993-2009 years), which is closely related to the NPV method (being the interest rate that produces an NPV of zero), and the permissible prices, which can be derived from it as well (Stopford, Maritime Economics, 1988, p. 289).

4.2. Quota system and fleet renovation

The society is interested to fish its “privatized” resources the most efficient way as this increases a tax base, reduces risks associated with fishing and makes national fish products more competitive. Thus national level management of fisheries is to target establishment of a linkage between fishing quotas and incentives to introduce innovations (new production methods). Although some innovations can be protected by patents and hence there is an incentive to do research and development, R&D costs take a small share of expenses in fisheries. Innovations take place as exploratory fishing, or adaptations in gear and vessels. The former cannot be protected by patents, and it is usually quite easy to copy the new gear, but it is more costly and risky to start new shipbuilding. That is why economic reasons for a new vessel will be under analysis in this chapter.

According to R.Neher from a social point of view it makes economic sense to start new shipbuilding, if the present net value of the returns from using the new vessel over its normal expected lifetime, that is assumed for this thesis being 30 years, is greater than the present net value of returns from using the old vessel for the remainder of its lifetime. When measuring the net value of the new vessel, it is necessary to take capital construction costs into consideration, that should include at least 1 year extra interest repayment during the construction period.

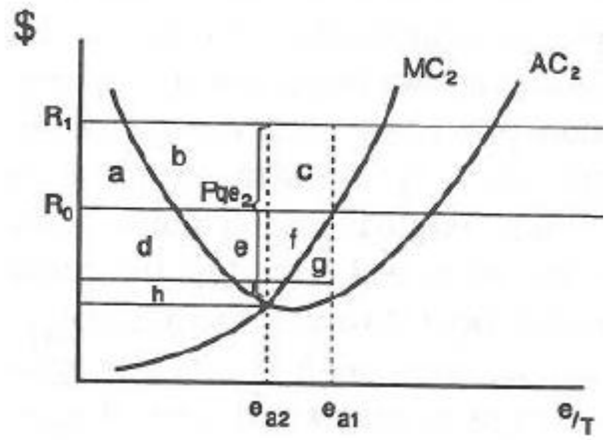
However, when measuring the net returns from the old vessel, it is only necessary to consider variable opportunity costs. If she has no other use but to go to scrap, her operation and required maintenance costs plus her scrap price (usually equal to price of her metal) should be taken into account. If the old vessel could be working in another fishery or country, or in other industry, then net earnings in the other use should be counted as a cost (further referred as resale value).

Regardless of net social productivity, investment decisions are made by private individuals, who pursuing profits do not build boats unless there are net financial or other gains to them. Additional to Neher’s analysis a further representation of the proper “fixed” costs for the current and the proposed vessel will be made in financial terms, and an attempt to provide a comparison of the gains and losses.

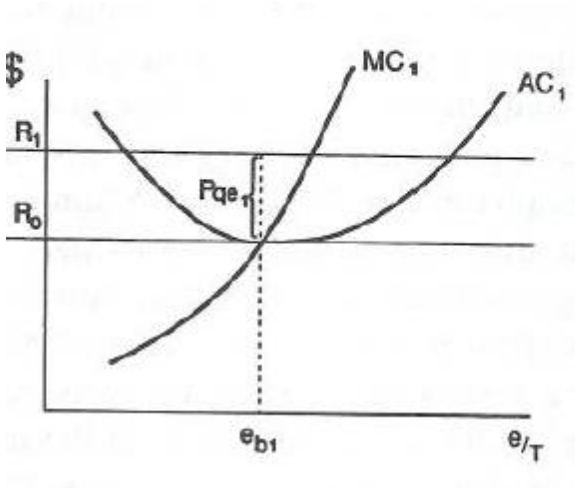
Graphically these incentives deliberately depicted by Neher in the following graphs in Figure 15. They show that an owner will be motivated to build the new vessel if the present value of the increased net returns represented by areas (d+e+f+g) over the normal operating life of the new vessel are high enough. The bottom line is that the proposed vessel will be profitable if the present value of net earnings of the owner is expected to increase if it is build.

Figure 15. Graphics of net returns from old and new fishing vessels

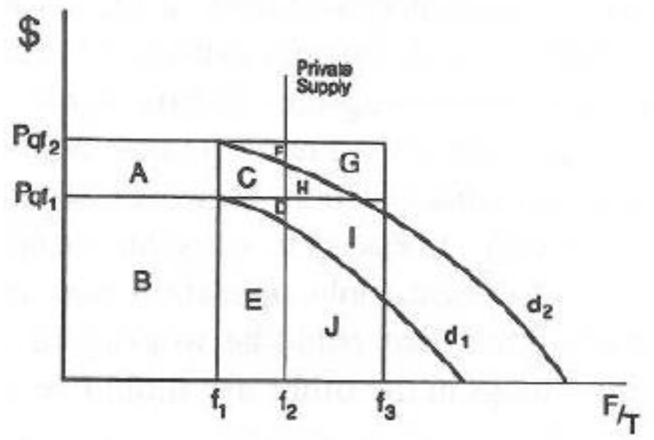
A.



B.



C.



It is assumed that the net gains represented by areas (d+e+f+g) are large enough to encourage private investment, and that it is also socially advantageous to do so. If the owner believes the operation procedure can be kept secret from other competing companies, such that there will be no changes in the market that will affect the level of these returns, the vessel will be built. But this is rarely found in the world of real business where fishing companies are competing in search of opportunities to enhance effectiveness, including through replacement of old vessels with new ones.

The situation when other companies started new shipbuilding (adopt the new technology) can be described by switch to the demand curve in terms of annual fish ITQs. Let d1 in Figure 4c represent the demand curve for fish ITQ's for the company with the old cost curves. This hypothetical company is assumed to be the marginal company (as the first likely to start new building), and so the fish ITQ price, Pqf1, is analogous to the effort ITQ price, Pqe1. The company originally operates at f1. Additionally it is assumed that the firm owns f2 units of fish ITQs. Therefore f2 – f1 units will be annually rented out at the going market rate. Without making the investment, the company will earn profits equal to area B on its vessel operations and an additional amount equal to areas (D+E) from the rental of its excess fish ITQs (Area B is equivalent to the profits earned by operating at eb1 in Figure 4b). Total annual profits will equal areas B+D+E, and there is no way to increase its total earnings by changing the amount it fishes itself and the amount it rents out.

Let d2 represent the demand curve for fish ITQs that follows from the new cost curves. It is assumed that others do not have access to the new shipbuilding. So that there are no other changes in the market, most importantly that the price of annual fish ITQs do not change. In that case, the company will wish to operate at a level of catch equal to f3. To do so, it will have to purchase or rent annual fish ITQs such that its private supply increases from f2 to f3. At the new level of output it will be earning gross regulated highliner rents equal to areas A+B+C+D+E+H+I+J, which is an amount equivalent to areas a+b+c+d+e+f+g in Figure 3a. Of this amount, areas I+J represents the annual payment for the new ITQ.s, which must be subtracted out to measure net gains. The net annual returns are equal to areas A+B+C+D+E+H, which is an increase of A+C+H. In the simple case where no other companies with new vessels, these extra rents will be earned for the life of the boat. In essence, the operation of the new vessel has increased the returns the company can earn from the fish ITQ's. It earns higher profits on the ITQs it owns (areas A+C) and it also earns a rent equal to area H on the new fish ITQs that became profitable for it to acquire.

What happens if other vessel owners start operating newly built vessels? If it is assumed that all companies in the industry do so, then the restructured industry will be a constant cost fishery, with all companies operating on the cost curves in Figure 4a. A new equilibrium will be reached at a price of annual effort ITQs equal to Pqe2. With annual fish ITQ price Pqf2 in Figure 4c being analogous to effort ITQ price Pqe2 all companies, including the original innovator, will operate at a level of fishing equal to f1 (It has been assumed that the minimum critical level of output remains the same with the new vessels to be shown on the graphics). Out of Neher's analysis it is possible to make important conclusion that the extra profits of the first company with a new vessel are not lost in a situation with a total renovation of the fishing fleet. The increase in returns becomes capitalized in the quotas. Their value is to be increased due to the fact that the fish can be harvested cheaper but fish prices tend to be constantly increasing. Thus the gains from that new vessel will fall to the owner of the ITQs, and quota holders but not quota leasers will benefit.

Depending upon how long it takes the renovation of fishing vessels to be spread through the industry the innovator can capture more gains by having advance knowledge to buy or acquire long-term leases on quota. For instance, at the new price of fish ITQ's the company will be making higher overall annual profits than it did before the price of ITQ went up due to the usage of a more efficient vessel with the new technology. As a result of the change in price, the company will find it profitable to change the combination of fishing and renting out ITQs. Due to the higher price, it will reduce fishing to f1 and it will earn a profit equal to areas A+B on vessel operation. This will be equal to areas a+b+d+e+h+i in Figure 4a. It will also become profitable to lease out annual fish ITQs equal to the difference between f3 and f1, at the new price. For this, it will earn an amount equal to F+C+D+E+G+h+I+J. The company's total profit will therefore increase by an amount to areas F+G over that amount which was earned at the lower price of fish ITQs.

A different effect will happen to the incentives of the company if it operates in a fishery where there is a resource rental equal to management rent. Figures 5a and 5b assume that originally the resource rental is equal to Pqe1. After it pays the rentals, the company will be only making normal profits by operation at effort level eb1. The value of the ITQ, either in terms of fish or effort, will be zero, because all gains will be taxed away. In the short-run, if it were to build a new vessel, it would earn a return over and above the resource rentals, equal to areas d+e+f+g. If the other companies cannot buy new vessels, then these extra profits will not be touched by rentals, because the marginal cost conditions of the industry will not have changed. Because the company will capture the gains from the investment, it will have the incentive to proceed with renovation of its fleet.

If all the companies in this basin or species fishery obtain new vessels, then the profits to the innovating company will cease the year the resource rentals are increased, because of the new marginal cost conditions in the fishery. For example, with a new resource rental equal to Pqe2, the company will earn normal profits by operating at ea2 in figure 4a. Since the rentals pick up all the extra profit from the new vessels, the value of the ITQs will remain zero. The company makes normal profits before and after the investments. Its ITQs have zero value before and after the investment. Therefore, unless the profits it can earn in the short-run (after it invests in a new shipbuilding but before others do and the resource rental rates go up), are high enough to make the investment worthwhile, it will not be undertaken.

But additional to this analysis of Philip Neher (page 205) it should be pointed that it lacks one significant dimension as it describes the situation in term of oligopoly both in fishing quotas and fish sales. But while a fishing quota holders club is de-facto a national oligopoly, this oligopoly group operates in a wider international environment in which fleet renovation may last for decades and never achieve an even level due to accelerating speed of new technology spread as well as competition on the fish market that is becoming more and more internationalized.

To summarize, with a resource rental policy that collects all management rents, none of the gains from innovation can be retained by the innovator either by higher returns or higher value of ITQ's. Such a policy will therefore be a disincentive to optimal investment in the fishery. (Philip A. Neher, 1989, pp. 201-202)

4.3. Calculation of operating budgets of existing and new fishing vessels

The aim of this comparison is to show behavior quotas of needs to profitably operate the current vessel and new one. Assumption figures are based on figure of the project assumption provided by Alasund ehf, Icelandic official sources, including Statistics Iceland and Islenska Sjomann Almanahid and numerous interviews with vessels owners in Iceland.

Hypothetical calculation of financial terms for new vessels built on the basis of recent designs made by Skipasyn company in Iceland is based on OECD's Understanding on Export Credits for Ships that was concluded between EU states, Norway, Australia and some others. Its provisions for export credits and tied aid set 12 years after delivery as the maximum repayment term. The Participants shall require a minimum cash payment of 20% of the contract price by delivery. And *"a)* The principal sum of an export credit shall be repaid in equal installments at regular intervals of normally six months and a maximum of 12 months, *b)* Interest shall be paid no less frequently than every six months and the first payment of interest shall be made no later than six months after the starting point of credit". (Trade and Agriculture Directorate, 2007, p. 3).
So for the purposes of this thesis it is assumed that loan term is 10 years with credit repaid in equal installments on yearly basis and the full sum is paid for a newly built vessel before delivery. Depreciation is taken equal to 20% which is a maximum annual percentage of depreciation for ships in Iceland according to PWC Iceland (PWC Iceland). Estimated cost of construction is USD 7,7 mln. and total cost of equipped vessel estimated at USD 8 mln with 20% of the owner's equity and 80% loan. Prices on fish products (h/g cod and haddock) are based on real market information on ex cold store Kirkenes of Norway with minor adjustments.

Variable operational expenses take into account the following statistical data provided by Statistics Iceland for trawlers with some adjustment to wet fish trawler of 29m trawler project vessel where is applicable.

Table 9. Expenses of trawlers in Iceland in 2006 and 2009 in mln. ISK (Statistics Iceland, 2011)

	2006	Share	2009	Share
Operating expenses	20800	100%	31806	100%
Fishermens´ shares	8508	40%	13430	42,22
Other wages	1548	7,40%	1373	4,32
Labour related costs	890	4,30%	1975	6,21
Oil	4137	19,80%	5199	16,35
Fishing gear	657	3,20%	1546	4,86
Maintenance and repair	1375	6,60%	2458	7,73
Packaging and freezing ost	431	2%	1303	4,10
Transportation cost	194	0,90%	1169	3,68
Salaries	15	0,07%	52	0,16
Overhead cost, excl. salaries	508	2,40%	608	1,91
Insurance	607	2,90%	746,3	2,35
Sales cost abroad	28	0,13%	65	0,20
Disembarkation cost	328	1,60%	829	2,61
Renting of catch quotas	.		0	
Other expenses	1575	7,60%	1052,8	3,31

The above mentioned figures provided basis for assumption figures for calculation of the profitability of an old and similar but new 29 m trawler. However it should be noted that they are significantly adjusted to the real estimations made upon interviews with fishing companies in Iceland.

Based on these adjusted figures the following table shows significant variables highlighted with bold fonts to allow easier comparison with real operational expenses of a new vessel of similar size to fish on the same quota. The quota basis is taken from Islenska Sjomanna Almahakið (2009, p.249) based on quota allocation of a real vessel, m/t Steinunn, to make real life comparison between old and new vessels. With the same fish quota the variables for an of existing 29m trawler (based on quotas of m/v Steinunn) and Alasund ehf’s estimations of the performance of a new one. To compare investment in a newly built trawler to replace existing operating vessel and to fish on the same quota data provided by Statistics Iceland about operating expenses of Icelandic trawlers in 2009 was taken into account. Most of the parameters like fishermen wages, labor related costs, expenses on oil, insurance, packaging and maintenance and repair have been calculated based on these data. It is assumed however that for a newly built trawler the following parameters will differ from these data due to better efficiency of the newly built vessel in particular as regards oil and lubricants consumption, cheaper insurance and minimal maintenance and repair costs that are assumed to be equal to 50 thousand USD per year.

Thus based on these parameters the budget for an old average trawler will look like in the following table provided below. It should be pointed out that the main difference in variable costs to operate an old average trawler in Iceland will lay in more expensive maintenance costs, higher insurance due to higher risks and of course because of higher fuel consumption.

Table 10. Operational budget of an average trawler in Iceland. Based on quota allocation for 29m trawler like m/t Steinunn in Iceland

FISH to CATCH:				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Cod	Ton			650	650	650	650	650	650	650	650
Haddock	Ton			700	700	700	700	700	700	700	700
Saithe	Ton			300	300	300	300	300	300	300	300
Sole	Ton			160	160	160	160	160	160	160	160
FISH TOTAL:	Ton			**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**
Average Catches per Day		**6**	**Ton**								
VALUE OF PRODUCTS:	%	Ton	Yield:	Year 1	Year 2	Year 3	Year 3	Year 3	Year 3	Year 3	Year 3
Cod Gutted	100	650	90%	585	585	585	585	585	585	585	585
Haddock Gutted	100	700	90%	630	630	630	630	630	630	630	630
Saithe - Gutted	100	300	90%	270	270	270	270	270	270	270	270
Sole - Gutted	100	160	95%	152	152	152	152	152	152	152	152
TOTAL WEIGHT:	Ton			1 637	1 637	1 637	1 637	1 637	1 637	1 637	1 637
SALES PRICES:	exW			Assumed growth is 2% per year equal to growth of variable operating expenses							

Cod Gutted	USD/Ton			3 000	3 060	3 121	3 184	3 247	3 312	3 378	3 446
Haddock Gutted	USD/Ton			2 000	2 040	2 081	2 122	2 165	2 208	2 252	2 297
Saithe Gutted	USD/Ton			2 000	2 040	2 081	2 122	2 165	2 208	2 252	2 297
Sole Gutted	USD/Ton			1 500	1 530	1 561	1 592	1 624	1 656	1 689	1 723
Average price per ton of quota	USD/Ton			2 310,93	2 357,15	2 404,30	2 452,38	2 501,43	2 551,46	2 602,49	2 654,54
GROSS REVENUE:											
Cod Gutted	USD			1 755 000	1 790 100	1 825 902	1 862 420	1 899 668	1 937 662	1 976 415	2 015 943
Haddock Gutted	USD			1 260 000	1 285 200	1 310 904	1 337 122	1 363 865	1 391 142	1 418 965	1 447 344
Saithe Gutted	USD			540 000	550 800	561 816	573 052	584 513	596 204	608 128	620 290
Sole Gutted	USD			228 000	232 560	237 211	241 955	246 795	251 730	256 765	261 900
TOTAL GROSS REVENUE	USD			3783000	3858660	3935833	4014550	4094841	4176738	4260272	4345478
QUOTA PAYMENTS/FEES:											
Leased quota	USD/ton			0	0	0	0	0	0	0	0
Own Quota	USD/ton			0	0	0	0	0	0	0	0
TOTAL QUOTA PAYMENTS/FEES:	USD			0	0	0	0	0	0	0	0
ADDITIONAL EXPENSES											
450 liter Containers	USD										

Other Packaging Material Costs	USD/ton										
NET REVENUE:	USD			3783000	3858660	3935833	4014550	4094841	4176738	4260272	4345478
TOTAL VALUE OF VESSEL			1000000								
Crew Members	men	13									
Fishing Days/Steaming				300	300	300	300	300	300	300	300
Discharging Days				25	25	25	25	25	25	25	25
Maintenance/Laid up Days				45	45	45	45	45	45	45	45
VARIABLE OPERATING EXPENSES											
Crew Wages (of Gross revenue)	USD	40%	of Gr.Revenue	1 513 200	1 543 464	1 574 333	1 605 820	1 637 936	1 670 695	1 704 109	1 738 191
Labour related costs	USD	6,20%	of Oper. Expen	221 898	230 000	240 000	250 000	260 000	270 000	280 000	290 000
Insurances	USD	2,35%	of Oper. Expen	84 106	85 000	86 000	87 000	88 000	89 000	90 000	91 000
Maintenance & Repair	USD	7,70%	of Oper. Expen	275 583	276 004	282 000	287 630	293 729	299 882	306 090	312 354
FUEL OIL CONSUMPTION TOTAL	USD	16,35%	of Oper. Expen	585 166	600 000	615 000	630 000	645 000	660 000	675 000	690 000

Fishing Gear	USD	4,86%	of Oper. Expen	173 939	180 000	185 000	190 000	195 000	200 000	205 000	210 000
Packaging Costs	USD	4,10%	of Oper. Expen	146 739	150 000	155 000	155 000	160 000	165 000	170 000	175 000
Harbour/Discharging Fees	USD	2,61%	of Oper. Expen	93 412	95 000	100 000	105 000	110 000	115 000	120 000	125 000
VARIABLE COSTS TOTAL	USD			3 094 043	3 159 468	3 237 333	3 310 450	3 389 666	3 469 578	3 550 199	3 631 545
FIXED COSTS		13,55%	of Oper. Expen	484 954	425 000	425 000	425 000	425 000	425 000	425 000	425 000
OPERATING EXPENSES TOTAL	USD			3 578 997	3 584 468	3 662 333	3 735 450	3 814 666	3 894 578	3 975 199	4 056 545

Table 11. Estimation of profits and losses from operation of an old average trawler in Iceland for 8 years

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Total Sales Revenue	3 783 000	3 858 660	3 935 833	4 014 550	4 094 841	4 176 738	4 260 272	4 345 478
Total Quota Fees/Payments	0	0	0	0	0	0	0	0
Net Revenue	3 783 000	3 858 660	3 935 833	4 014 550	4 094 841	4 176 738	4 260 272	4 345 478
Variable Costs Total	-2 947 304	-2 994 634	-3 052 499	-3 110 616	-3 169 832	-3 229 744	-3 290 365	-3 351 711
Fixed Costs Total	-484 954	-425 000	-425 000	-425 000	-425 000	-425 000	-425 000	-425 000
Result before Financial Costs	350 742	439 026	458 334	478 934	500 009	521 994	544 907	568 767
Interest Mortgage Loans	0	0	0	0	0	0	0	0
Depreciation	0	0	0	0	0	0	0	0
Result before Taxes	350 742	439 026	458 334	478 934	500 009	521 994	544 907	568 767
Taxes	-50 148	-69 805	-75 467	-81 207	-86 880	-92 589	-98 353	-104 187
Result	300 593	369 221	382 867	397 727	413 129	429 405	446 554	464 579

As it is shown in the above tables fishing of already existing trawler based on average parameters in the fishing industry in Iceland in 2009 is profitable if 2 % growth of sales prices of produced fish products is assumed to match them with increase of costs of operational expenses. To make this table comparable with performance of a newly built similar vessel the growth of the fish sales prices has been equaled to the growth rate of the operating expenses which approximately is supperted by data from 2006 and 2009. To allow the comparability wages of the crew currently equaling to 40% of the value to the catch are taken as a fixed basic point of calculation instead of linking them to operational expenses as is the case in the data provided by Statistics Iceland.

The profits of this old trawler indicate that it is unlikely that a vessel owner will plan to replace his old vessel by a new one unless it is required either by governmental or technical regulations. Moreover the current indebtness of the Icelandic fishing companies discourages huge renovation of the fishing fleet. But conditions in other national fisheries, for example in Russia may favor a wide scale fleet renovation, especially if supported by governmental programs. Comparing budgets of old and new vessels based on Icelandic statistics a special significance of quota allocation for each vessel is to be highlighted as the main incentive parameter to any vessel owner or fishing company both in Iceland, Russia and elsewhere.

The budgets show operational expenses, profits and losses in current prices without adjustment to inflation, which will be in both cases the same. The comparison of investment into a new vessel don't take into account opportunity cost as this goes beyond the scope of the thesis focusing on issues related to fishing quotas.

For computing of operational budget of a newly built vessel the following assumption are made:

1. fuel consumption is reduced from 16% to 13% of operational expenses or by about 20% due to increased efficiency of more flexible power plant;
2. maintenance costs are assumed to be not more than 50 000 USD per year because of the decreased demand;
3. insurance cost is expected to be slightly less due to less risk of vessel operation.

All other parameters are the same as for the old, already operating vessel.

Table 12. Estimation of operational budget of a newly built 29 m trawler based on quota allocation for 29m trawler like m/t Steinunn in Iceland

FISH to CATCH				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Cod	Ton			650	650	650	650	650	650	650	650
Haddock	Ton			700	700	700	700	700	700	700	700
Saithe	Ton			300	300	300	300	300	300	300	300
Sole	Ton			160	160	160	160	160	160	160	160
FISH TOTAL:	Ton			**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**	**1 810**
Average Catches per Day		6	Ton								
VALUE OF PRODUCTS:	%	Ton	Yield:	Year 1	Year 2	Year 3	Year 3	Year 3	Year 3	Year 3	Year 3
Cod Gutted	100	650	90%	585	585	585	585	585	585	585	585
Haddock Gutted	100	700	90%	630	630	630	630	630	630	630	630
Saithe - Gutted	100	300	90%	270	270	270	270	270	270	270	270
Sole - Gutted	100	160	95%	152	152	152	152	152	152	152	152
TOTAL WEIGHT:	Ton			1 637	1 637	1 637	1 637	1 637	1 637	1 637	1 637
SALES PRICES:	exW			Assumed growth is 2% per year equal to growth of variable operating expenses							

Cod Gutted	USD/Ton			3 000	3 060	3 121	3 184	3 247	3 312	3 378	3 446
Haddock Gutted	USD/Ton			2 000	2 040	2 081	2 122	2 165	2 208	2 252	2 297
Saithe Gutted	USD/Ton			2 000	2 040	2 081	2 122	2 165	2 208	2 252	2 297
Sole Gutted	USD/Ton			1 500	1 530	1 561	1 592	1 624	1 656	1 689	1 723
Average price per ton of quota	USD/Ton			2 310,93	2 357,15	2 404,30	2 452,38	2 501,43	2 551,46	2 602,49	2 654,54
GROSS REVENUE:											
Cod Gutted	USD			1 755 000	1790100	1825 902	1 862 420	1899668	1937 662	1 976 415	2 015 943
Haddock Gutted	USD			1 260 000	1285200	1310 904	1337122	1363865	1391142	1418965	1447344
Saithe Gutted	USD			540 000	550 800	561 816	573 052	584 513	596 204	608 128	620 290
Sole Gutted	USD			228 000	232 560	237 211	241 955	246 795	251 730	256 765	261 900
TOTAL GROSS REVENUE	USD			3 783 000	3858660	3935 833	4 014 550	4094841	4176 738	4 260 272	4 345 478
QUOTA PAYMENTS/FEES:											
Leased quota	USD/ton	0		0	0	0	0	0	0	0	0
Own Quota	USD/ton	0		0	0	0	0	0	0	0	0
TOTAL QUOTA PAYMENTS/FEES:	USD			0	0	0	0	0	0	0	0
ADDITIONAL EXPENSES											
NET REVENUE:	USD			3 783 000	3 858 660	3 935 833	4 014 550	4 094 841	4 176 738	4 260 272	4 345 478

Value of Vessel	USD					8000 000					
Own Equity		25%				2000 000					
Loan		75%				6000 000					
TOTAL VALUE OF VESSEL						8000 000	0	0	0	0	0
Crew Members	man	13									
Fishing Days/Steaming				300	300	300	300	300	300	300	300
Discharging Days				25	25	25	25	25	25	25	25
Maintenance/Laid up Days				45	45	45	45	45	45	45	45
VARIABLE OPERATING EXPENSES											
Crew Wages (of Gross revenue)	USD	40,00%	of GR. REVENUE	1 513 200	1543464	1574 333	1 605 820	1637936	1670 695	1 704 109	1 738 191
Labour related costs	USD	6,20%	of Oper. Expen	180 548	184 044	187 609	191 246	194 955	198 739	202 598	206 535
Insurances	USD	2,00%	of Oper. Expen	58 241	59 369	60 519	61 692	62 889	64 109	65 354	66 624
Maintenance & Repair	USD			50 000	50 000	50 000	50 000	50 000	50 000	50 000	50 000
OIL TOTAL	USD	13,00%	of Oper. Expen	378 569	385 899	393 374	401 000	408 777	416 711	424 803	433 057
Fishing Gear	USD	4,86%	of Oper. Expen	141 527	144 267	147 061	149 912	152 820	155 786	158 811	161 897
Packaging Costs	USD	4,10%	of Oper. Expen	119 395	121 706	124 064	126 469	128 922	131 424	133 976	136 579

Harbour/Discharging Fees	USD	2,61%	of Oper. Expen	76 005	77 477	78 977	80 508	82 070	83 663	85 287	86 944
VARIABLE COSTS TOTAL	USD			2 517 486	2 566 225	2 615 939	2 666 647	2 718 370	2 771 127	2 824 939	2 879 827
FIXED COSTS		13,55%	of Oper. Expen	394 586	402 225	410 017	417 965	426 072	434 341	442 775	451 378
OPERATING EXPENSES TOTAL	USD			2 912 072	2 968 450	3 025 956	3 084 612	3 144 442	3 205 468	3 267 714	3 331 206
CALCULATION OF COST OF LOAN											
		Loan	*Interest LIBOR+2.5%*	*Years*	*Payment/Month*						
		6 000 000	7,00%	8		81 900					
Depreciation 10.4% -		years	8	Of 90% value USD	7200000						

Table 13. Estimation of profit and loss for 8 years of operation of a newly built 29 m trawler in Iceland.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8

Total Sales Revenue	3 783 000	3 858 660	3 935 833	4 014 550	4 094 841	4 176 738	4 260 272	4 345 478
Total Quota Fees/Payments	0	0	0	0	0	0	0	0
Net Revenue	3 783 000	3 858 660	3 935 833	4 014 550	4 094 841	4 176 738	4 260 272	4 345 478
Variable Costs Total	-2 398 091	-2 437 189	-2 477 070	-2 517 748	-2 559240	-2 601 561	-2644729	-2 688 760
Fixed Costs Total	-394 586	-402 225	-410 017	-417 965	-426 072	-434 341	-442 775	-451 378
Result before Financial Costs	990 323	1 019 246	1 048 746	1 078 837	1 109 529	1 140 836	1 172 768	1 205 339
Interest Mortgage Loans	-420 000	-379 064	-335 262	-288 393	-238 244	-184 585	-127 170	-65 735
Depreciation	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000
Result before Taxes	-179 677	-109 818	-36 515	40 443	121 285	206 251	295 598	389 604
Taxes	0	0	-6 907	-35 878	-64 267	-92 259	-120 028	-147 738
Result	-179 677	-109 818	-43 422	4 566	57 018	113 991	175 571	241 866

As it is shown in the table above with only economy on oil consumption and on costs on maintenance and repair of a newly built vessel profits received from the operations of such a vessel are in 3 years out of 8 in minus with only two last years being profitable. Thus is could be concluded that the replacement of the old vessel with a new one if fishing on the same fish quota is out of the agenda for a vessel owner if he is not forced by technical requirements due to the age of the vessel. That is actually the case in Russia where the Russian Maritime Register of Shipping is tightening its requirements to old fishing vessels trying to bring vessel over 30 years old under more frequent technical surveys, thus increasing significantly repair related operating expenses.

Taking into account conclusions made in the chapters above it should be clear that with no perspectives of an increase of fishing quotas a construction of new fishing vessels is unrealistic. An increase in quota allocation by 330 tons of cod may yield attractive profits for the vessel owner to encourage a new shipbuilding. With all other parameters being the same profits brought by such a new vessel fishing on an increased quota will be as follows. In Tables 14 and 15 the new vessel works on an extended quota provided for free. However it should be understood that a new free of charge quota allocation is hardly expectable in most of the fisheries worldwide and Iceland as well. The only perspective to increase fishing quotas could be anticipated in the Far Eastern basin of Russia due to still existing under exploration of the fish stocks in comparison with Soviet times.

If it is assumed that the annual quotas for cod are bought on the existing prices at about 320 ISK/kg or 2.8 USD/kg than the operational expenses will be as in Table16 and the company that build a new vessel will encounter severe losses in order to use full fishing capacity of its new vessel as indicated in the Table 17.

The situation with the purchase of quota shares, the price of each is 10 times higher than the price of annual quota, will even make the performance of operations of the new vessel worse if calculated on a 8 year basis (as it is supposed to be the case in the fishery in Russia with quotas allocated till 2018).

With a new vessel capable to catch more efficiently it is assumed that the new vessel is capable to catch by 15-20% more than the old one and her average catch could be assumed to be equal to not 6 but 7 tons per fishing day.

One more advantage of the new vessel is that she has less maintenance and repair days than the old one, thus extra 330 tons of cod quota is quite feasible to catch.

Table 14. Fish quota allocation for a newly built 29 m trawler like m/t Steinunn in Iceland with extra 330 t of cod quota

FISH to CATCH:				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Cod	Ton			1 080	1 080	1 080	1 080	1 080	1 080	1 080	1 080
Haddock	Ton			700	700	700	700	700	700	700	700
Saithe	Ton			300	300	300	300	300	300	300	300
Sole	Ton			160	160	160	160	160	160	160	160
FISH TOTAL:	Ton			**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**
Average Catches per Day		7	Ton								

Table 15. Estimation of profits and losses for 8 Years of operation of a newly built 29 m trawler on increased quotas

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Total Sales Revenue	4 944 000	5 042 880	5 143 738	5 246 612	5 351 545	5 458 575	5 567 747	5 679 102
Total Quota Fees/Payments	0	0	0	0	0	0	0	0
Net Revenue	4 944 000	5 042 880	5 143 738	5 246 612	5 351 545	5 458 575	5 567 747	5 679 102
Variable Costs Total	-3 110 523	-3 161 621	-3 213 740	-3 266 903	-3 321 128	-3 376 438	-3 432 854	-3 490 398
Fixed Costs Total	-511 810	-521 794	-531 978	-542 365	-552 960	-563 766	-574 789	-586 033
Result before Financial Costs	1 321 667	1 359 465	1 398 020	1 437 345	1 477 457	1 518 371	1 560 104	1 602 671
Interest Mortgage Loans	-420 000	-379 064	-335 262	-288 393	-238 244	-184 585	-127 170	-65 735
Depreciation	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000
Result before Taxes	151 667	230 402	312 758	398 952	489 213	583 786	682 934	786 936
Taxes	-20 333	-52 080	-82 952	-113 150	-142 867	-172 279	-201 556	-230 860
Result	131 334	178 321	229 807	285 801	346 346	411 507	481 378	556 076

Table 16. Fishing quotas with extra quota rented for the new vessel

FISH to CATCH:				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Cod	Ton			1 080	1 080	1 080	1 080	1 080	1 080	1 080	1 080
Haddock	Ton			700	700	700	700	700	700	700	700
Saithe	Ton			300	300	300	300	300	300	300	300
Sole	Ton			160	160	160	160	160	160	160	160
FISH TOTAL:	Ton			**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**	**2 240**
Average Catches per Day		7	Ton								
TOTAL WEIGHT:	Ton			2 024	2 024	2 024	2 024	2 024	2 024	2 024	2 024
TOTAL GROSS REVENUE	USD			4 944 000	5 042 880	5 143 738	5 246 612	5 351 545	5 458 575	5 567 747	5 679 102
QUOTA PAYMENTS/FEES:											
Leased quota	USD/ton	0		924 000	924 000	924 000	924 000	924 000	924 000	924 000	924 000
Own Quota	USD/ton	0		0	0	0	0	0	0	0	0
TOTAL QUOTA PAYMENTS/FEES:	USD			924 000	924 000	924 000	924 000	924 000	924 000	924 000	924 000

Table 17. Estimation of profits and losses of operation of the new vessel with extra quota rented

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Total Sales Revenue	4 944 000	5 042 880	5 143 738	5 246 612	5 351 545	5 458 575	5567 747	5 679 102
Net Revenue	4 020 000	4 118 880	4 219 738	4 322 612	4 427 545	4 534 575	4643 747	4 755 102
Variable Costs Total	-3 604 023	-3 371 958	-3 433 301	-3 495 451	-3 558 424	-3 622 236	-3686905	-3 752 447
Fixed Costs Total	-745 048	-425 000	-425 000	-425 000	-425 000	-425 000	-425 000	-425 000
Result before Financial Costs	-329 071	321 922	361 436	402 161	444 121	487 339	531 842	577 655
Interest Mortgage Loans	-420 000	-379 064	-335 262	-288 393	-238 244	-184 585	-127 170	-65 735
Depreciation	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000	-750 000
Result before Taxes	-1 499 071	-807 142	-723 825	-636 232	-544 124	-447 246	-345 328	-238 080
Taxes	0	0	0	0	0	0	0	0
Result	-1 499 071	-807 142	-723 825	-636 232	-544 124	-447 246	-345 328	-238 080

Thus it could be concluded that under existing conditions like in Iceland the development of the quota market can't facilitate new shipbuilding.

If NPV of profits of the old vessel and new vessel with existing and extra quotas is calculated results may be discouraging again until a resale value of the vessel is taken into the account. In this case the value is discounted by 7% similar to the cost of credit.

Table 18. NPV of profits of old and new vessels in 8 years

NPV for 8 years	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
NPV of profits of old vessel	280 928	322 492	312 534	303424	294 556	286 131	278 092	270389	2348546
NPV of profits of new vessel	-167922	-95919	-35446	3483	40 653	75 957	109337	140768	70 911
NPV of profits of new vessel with increased quota	122 742	155 753	187 591	218037	246 940	274 205	299 778	323641	1828686

Table 19. NPV of profits and vessels value

	Total NPV 8 years (USD)	Present value of the vessel in 8 years (USD)	Total NPV value for 8 years (USD)
Old vessel	2348546	582009	2 930 555
New vessel	70 911	4656073	4 726 984
New vessel with free increased quota	1828686	4656073	6 484 759
New vessel with bought quotas	Losses for 8 years -5241048	4 656 073	Losses after resale of vessel -584 975

In the case of the purchased 330 tons of extra quotas on the currently existing prices the losses during 8 years will amount to 5.2 mln USD, thus the company will not be able to compensate them with the vessel resold at 4.6 mln USD in 8 years.

Obviously for any government steps aimed at development of the market for quota in order to encourage capitalization of fishing companies and through this to have available funds to build new vessels is counterproductive.

Conclusion

But as the ITQ system is about first of all the preservation of fish stocks, it is unlikely that renovation of the fishing fleet in current circumstances in Iceland could be expected through the increase of the fish quota for valuable species.

It should be noted that in other fisheries for example in Far East Russia and in Moroccan-Mauritanian zone annual TAC quotas could be increased for some species. This may go in line with the strategic goals of the Russian Fishery Agency that announcing than Russian Far Eastern basin could sustain catch by 2 mln. tons more by 2020.

Of course this allocation of extra quotas could be for free. If extra quotas are sold on the currently existing prices on the quota markets in Iceland. These extra expenses will undermine economic outcomes of the usage of the new vessel.

5. FACTORS THAT INFLUENCE CAPITALIZATION OF FISHING INDUSTRY

Factors that influence quota prices are of natural (ecological), political and economic origin:

Natural: a) fluctuation of fish stocks and subsequent scientifically justified total allowable catch (TAC) forecast b) weather conditions c) ecological regulations of fishing gear, seasons and fishing efforts.

Economic: a) general economic situation in Iceland (in particular interest rate) b) global prices on fish (and exchange rate of Icelandic krona) c) demand on quotas from expanding fishing industry d) prices of fuel and labour.

Political: a) political stability guaranteeing status quo b) public consensus on the problem of public assets versus private use.

5.1. Political and public consensus about fish quota system

In terms of volatility in the market the price of quotas drops when the government talks about the quota being allocated under the new pricing approach as the price determination of quota is based on quotas permanence of the current quota system and formation of assets in quota companies.

The Icelandic catch quota system has been controversial since it was launched in early 1984 but discussions about the need had been going on for quite some time before the system was fixed in law. Little discussion took place regarding this legislation, both in parliament and in the society. However, it was clear to everyone at that time that something would have to be done to save the fish stocks around the country. Ichthyologist warnings had become more intense regarding overfishing and so called "black reports" were published, which showed the horrible conditions of the cod stock.

The current system allows time unlimited use of national resources by private companies. Therefore people have different attitudes towards quotas as intangible assets with regard to the permanence of these property rights. Many vessel owners and followers of particular political view look at the quota as permanently properties since the quota system will not be abolished unless by authority of the Parliament.

Another view is that it is not possible to look at quota as intangible assets while the quota is allocated to individual fisheries according to the catch quota system. It has to be considered that the quota is only allocated for one year at a time by the Minister and only in the species that the Minister considers, in consultation of the Marine Research Institute to protect fish stocks.

Once the quota has been allocated for one year to the fisheries, it is indeed intangible asset as a right of use of fishery resources of the nation, nota bene while the quota system is maintained under the Act of Parliament and therefore quotas can be looked at as intangible assets in the form of rights from the state in the long term, but it is in the decision and the responsibility of those who do so since there are no guarantee that the quota will be allocated in the same manner as has been customary in past years.

As the case today in Iceland, it is responsibility and risk of the fisheries that have pledged the quotas and of the lending institutions that took mortgage in the quota that consider quota permanent property. Responding to recently launched discussion about future of ITQ system in Iceland the Confederation of Employers suggested to allocate quotas “at least for 35 years with a unilateral right to extend these rights to harvest fish” („Vilja kvota til minnst 35 ara“, 2011).

Suppose that the quota will be allocated for 10 years at a time as it took place in Russia in 2008. Then the landscape should change significantly because then quota is certainly intangible assets of individuals and legal entities in this 10 year period, but thereafter subject to the will of the legislator. A public consensus on the issue thus can support and public disagreement can undermine value of fishing quotas. But approaching the deadline quotas as financial asset will inevitably lead to their diminishing value and the sooner a decision about extension is taken before the end of allocation period the better it will be for capitalization of the fishing companies.

5.2. Social and regional impact of fishing quota system

An ITQ system with high quality title rights can create significant wealth and the latter are taxed or channeled through other mechanisms into the economy and public welfare, as was persuasively proved by Arnason (2008). At the same time in an open economy, highly exposed to external financial risks like Iceland’s, quotas playing the role of financial instruments bear risks to fall under control of the alien forces standing far beyond national interests, like creditors of bankrupted financial institutions. These two situations represent advantages and disadvantages of making fishing quotas unlimited financial assets and show possible social consequences in the nationwide framework.

There are also regional implications of an ITQ system as it allows transfers of vessel quotas and TAC shares between harvesting firms. From the point of view of its regional impact the system may accordingly facilitate a regional redistribution of the fishing activity. According to Arnason (Arnason, 1995) this has been one of the most persistent arguments forwarded against the transferability of the vessel quotas. Looking at the period 1984-91 as a whole, the demersal ITQ system does not appear to have had an adverse regional impact. In spite of very substantial transfers of temporary and permanent quotas, their regional allocation remained remarkably invariant. But redistribution of labor takes place with a tendency of smaller fishing villages losing their quotas not only in Iceland but elsewhere. In Iceland this trend is softened by voluntary redistribution of quotas from the subsequent fund by the Ministry of Fisheries. In other countries and in Russia in particular, without emigration from remote fishing villages are reaching a threatening scale and free trade of quotas would have definitely facilitated the process.

All these arguments fired up debates in Iceland about the future of the ITQ system. A stance of the vessel owner represented by the Confederation of Employers advocating long period of allocation of quotas for 35 years with a right for further extension is clearly indicating that longevity of harvesting rights is a prerequisite to a progressive capitalization of the Icelandic fisheries.

5.3. Fluctuation of external markets

The ITQ system created to manage depleting fishing stocks proved to be very efficient economic instrument of wealth creation. Its economic effect brought primary and secondary benefits to the industry and national economy as a whole. However considering fishing quotas being financial assets is both beneficial in stable economic situation and extremely risky in a volatile one. Collateralization of fishing quotas put at risks both banks and fishing companies when the value of these assets dramatically dropped. These bad debts may result in legal collision between a national legislation on fisheries securing quota ownership only to Icelandic nationals and bank´s exposure to foreign lenders. Volatility of such a stable asset as fishing quota guaranteed by the world wide growing demand for protein became explicitly obvious in case of Iceland. It proves unreliability of this asset in the volatile economic and political situation. Such a negative turn may undermine existing mechanisms of wealth creation through ITQ systems throughout the world.

However a sound global fish market leaves hopes that the Icelandic quota system will gain back its value and the fishing industry will manage to repay current debts. If the situation on this market becomes affected by dramatic shocks this volatility will threaten the last sector of stability on which a small export oriented economy can rely on.

6. CONCLUSION

A problem of financial incentives to renew a country's fishing fleet as a part of the process of capitalization of the fishing industry has a distinct solution through a proper tailoring of its fishery management system. For a fishing company there is only one way of financing its investments: through sales of fish, i.e. crediting under future sales with mortgaging of a fishing vessel with quotas if they have a market value. By enhancing the market value of its fishing quota system through longer and securer property rights to harvest fish resources a state not only encourages effective allocation of efforts by fishing companies and thus creates effective and competitive fishing industry, it can as well motivate fishing companies and fishing vessel owners to replace their fishing vessels with more efficient having advanced technological solutions. For this purposes "quota under keel" policy as being now advocated by many in Russia displays its shortcomings as it leads to redistribution of the fishing quotas and undermines security of fishing quota rights. It could be concluded that such a scheme of financing of new shipbuilding is not able to create conditions in the fishing industry that allow long term investments to be made by fishing companies.

To make fishing companies built new fishing vessels the state can use its fish resources to make companies to efficiently use these resources through taxes, rent and other levers related to the nation owned fish stocks. But these instruments are to be created as purely financial ones.

6.1. Recommendations

On the basis of the discoveries made in the thesis it could be recommended for Russian fishery policy that capitalization of the fishing industry should be achieved by strengthening the quality of fishing quota rights through their extension for longer period as well as exclusivity to the current quota holders with extension of the quota rights made or announced as soon as possible before the end of the 10 year period of quota allocation in 2018. Extra allocation of fishing quotas for fleet renovation on Russian shipbuilding yards is advisable only for existing players through the extension their property rights to harvest fish to a longer period. A free quota market is recommended as a effectivel instrument to "tailor" quotas to existing capability of available vessels with quotas being allocated to a vessel not to a company.

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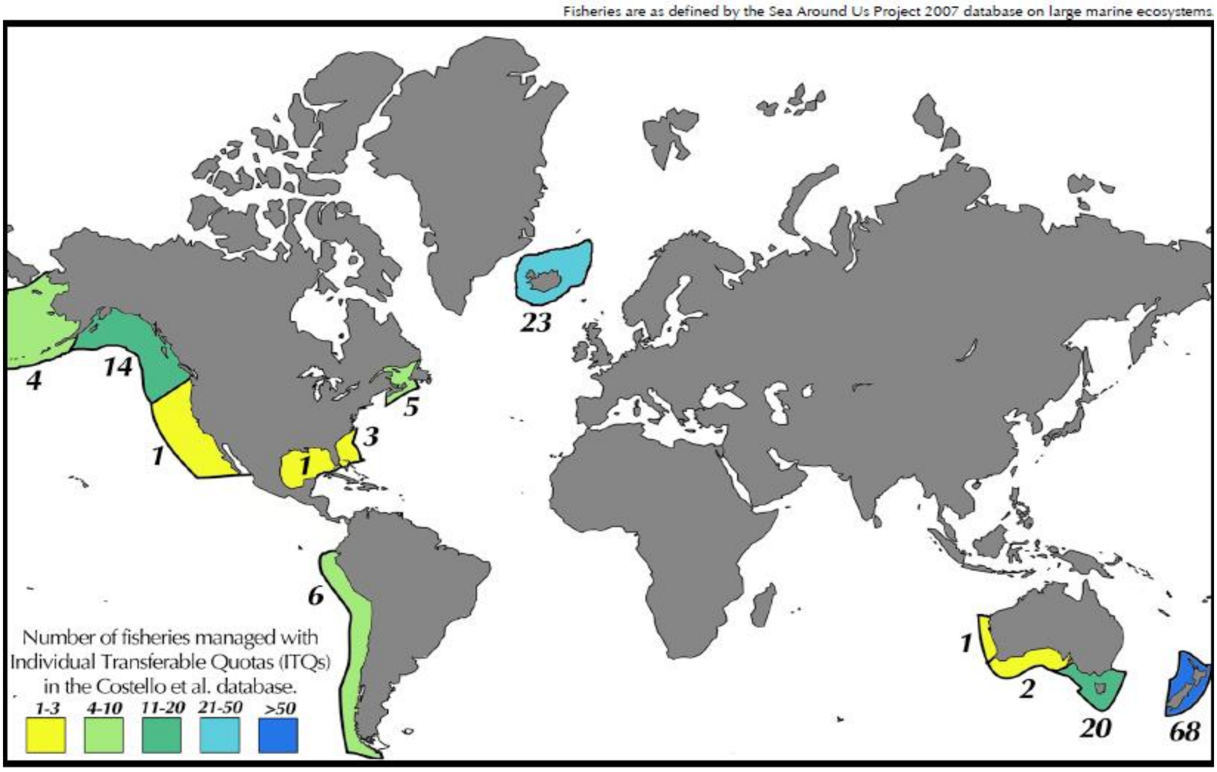
8. APPENDIX

1. Map of world ITQ areas
2. Unstructured Interviews
3. Questionnaire for fishing companies
4. Descriptive statistics for determinants of fishing quota asset prices
5. Average quota asset price versus average quota lease price
6. Main particularities of the project of 29m trawler and of the project of 50m trawler

Appendix 1. Map of world ITQ areas (sourced from Sea Around Us Project 2007)



Appendix 2: Unstructured Interviews with Russian and Icelandic companies

Number	Interviewer	Company	Name	Region
1.	Yu. Korolev		Victor Soborov	Kamchatka, Russia
2.	Yury Korolev		Valery Nikiforov	Murmansk, Russia
3.	Yury Korolev		Dmitry Zakharov	Sakhalin, Russia
4.	Yury Korolev	Owner of Brettingur vessel	Magnus Jonsson	Iceland
5.	Yury Korolev	Murman Seafood	Andrey Roman	Murmansk, Russia
6.	Yury Korolev	Hydrostroy	Valery Rebrov	Kuril Islands, Russia
7.	Yury Korolev	VNIRO Fishery Research Institute	Victor Sirenko	Moscow, Russia
8.	Yury Korolev	SZRK	Alexey Yakushin	St Petersburg, Russia
9.	Yury Korolev	Alasund ehf	Thorarinn Gudbergsson	Iceland

Appendix 3. Questionnaire for Russian fishing companies

Basic parameters for estimation of efficiency of the vessel if different please specify (in the Russian language).

Некоторые показатели для оценки эффективности судна, имеющего следующие параметры, если иные просьба указать какие.
LOA 50 м
M/E ‘/Главный двигатель: примерно 2000 kВт
Generator /Генераторы: два комплекта на 400 kВт
Fuel tank /Топливный бункер 360 000 литров
Fish hold (freezing) /Рыбный трюм (заморозка) 900 м3
Crew /Экипаж 22 чел

	Цены в долл. США или рублях Prices in USD or Russian rubles	Указывается примерная динамика по годам (например, ремонт)/If any dynamics to specify in years	Год/ Year 1	Год/ Year 2	Год/ Year 3
Усредненная основная квота (минтай) / Average fish quota	т				
Иные виды/ Other species	т				
Средний вылов, всего/ Total catch	тонн/сут/t/24h				
Доля произведенной рыбопродукции из улова (цельная, тушка, б/г, филе, икра?) Yield (whole, h/g, fillets, roe):	% выхода: например, 100% или 55%				
Тушка (например, минтай)/Whole	%				
Б/г/H/g	%				
Филе/Fillets	%				
Другие виды/other products	%				
Тушка/ whole	%				
Б/г/h/g	%				
Филе/Fillets	%				
Цена продажи (например, минтай) (в 2011?) Sales price in 2011 (for example of Alaska Pollack	USD/Ton				

Тушка/ Whole					
Б/г/H/g					
Филе/Fillets					
Другие виды (то же)/ Other species (same)					
Налог на добычу ВБР (Собственная квота)/Tax of fish quota	% или USD,Руб/т				
Аренда чужой квоты/ Leasing of others' quota	USD/т				
Иные платежи за квоту/Other payments for quotas	USD/т				
Упаковочные материалы (на тонну рыбы/или рыбопродукции/Packaging materials per ton of fish of fish products	USD				
Стоимость разгрузки (за тонну) Discharging costs (per ton)	USD/т				
Дни на промысле (в среднем в году)/Average fishing days per year	Сут/24h				
Дни на переходе/Steaming days	Сут/24h				
Дни на разгрузку/Discharging days	Сут/24h				
Дни простоя (ремонт и т.п.)/Laid up days (maintenance etc)	Сут/24h				
Зарплата экипажу (усредненно на человека)/Crew wages, average	USD/мес/per month				
Офицеры/Officers	USD/мес/per month				
Матросы/fishermen	USD/мес/per month				
Средняя численность экипажа (если иная, чем 22 чел)/Average crew number (if different than 22)	Чел/man				
Провизия/Provision	USD на чел/день/per man per 24h				
Страховые платежи за судно (в %					

от цены парохода)/Insurance payments (in % of vessel value)					
Затраты на ремонт и обслуживание судна/ Maintenance and services costs	USD в год/year				
Потребление на промысле/переходе (при ГД в 2000 kВт)/ Fuel consumption, fishing/steaming (ME is 2000 kW)	т/сут/t/24h				
- Цена дизеля /HFO price	USD/Ton				
Потребление в порту (ДГ на 350 кВт)/consumption in port (generator of 350 kW):	т/сут/t/24h				
-Цена MDO /MDO price USD/Ton					
Усредненное потребление масел/ Lubricant oil consumption	т/год/t/year				
- Цена масел/ Lubricants oil price	USD/Ton				
Промысловое оборудование/fishing gear Трал/ trawl траловые доски/trawl doors ваера/wires ремкомплект/ spares	USD				
Портовые сборы/Harbor fees	USD/год/year				
Административные расходы (расходы компании/количество судов)/Administrative costs (or overhead costs of company divided by number of owned vessels	USD/год/year				
Бухгалтерские и юридические расходы (если не включены в административные)/Audit, accounting, legal services	USD/год/year				
Затраты на услуги связи (если не включены в административные)/ Communication costs (if not included into administrative costs)	USD/год/year				
Непредвиденные расходы/unexpected expenses	USD/год/year				

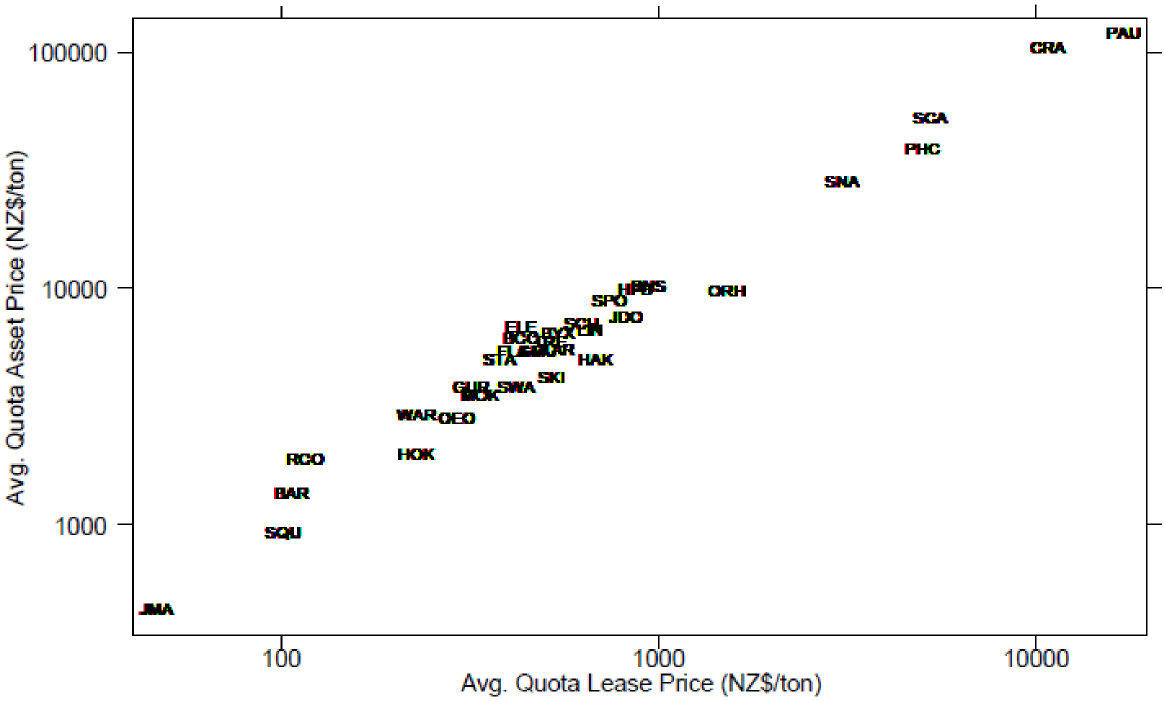
Амортизация судна/depreciation	% в год/year				
Применяется ли ускоренная амортизация для судов?/Is speeded up depreciation used?	Да/нет, какой %./Yes, no, % rate				
Иные параметры, важные для оценки эффективности судна/ other parameters deemed necessary					
Показатели при кредитовании постройки новых судов/Parameters related to the crediting of new shipbuilding					
Процентная ставка при кредитовании новостроя в России под залог судна/ Rate of credit for new shipbuilding in Russia					
Процентная ставка при кредитовании новостроя зарубежными партнерами/Rate of crediting by a foreign bank					
Собственные средства для новостроя/Own planned equity for new shipbuilding financing					
Заемные средства для новостроя/Planned loan for new shipbuilding					
Иные параметры, важные для новостроя/other parameters relevant to shipbuilding financing					

Appendix 4. Descriptive statistics for determinants of fishing quota asset prices (Newell, 2005, p. 27)

Variable	*Mean*	*Std. dev.*	*Min.*	*Max.*
Lease price ($/ton)	1,795	4,289	1	43,663
Asset price ($/ton)	20,266	46,870	22	358,586
Export price ($/ton)	8,319	12,096	630	61,009
Export price growth rate	0.013	0.023	-0.027	0.071
Interest rate	0.064	0.022	0.027	0.110
Normalized percentage of quotas sold	1.000	0.952	0.000	11.892
Natural mortality rate	0.222	0.174	0.045	1.000
Reduced TAC (dummy indicating fishery had initial reductions)	0.273	0.446	0	1
Shellfish (dummy indicating shellfish quota market)	0.116	0.320	0	1
Number of leases per quarter	17	20	1	194
Number of asset sales per quarter	4	4	1	75

Note: Statistics are based on the 4,120 observation sample from the estimation of quota asset price determinants. Monetary figures are year 2000 New Zealand dollars, which are typically worth about half a U.S. dollar. Tons are metric tons.

Appendix 5: Average quota asset price versus average quota lease price (Newell, 2005, p. 30)



Note: Logarithmic scale. Averages by species. Year 2000 NZ$. Data symbols are species abbreviations (see Table 1). Note that the asset price and lease price are approximately linearly related with a slope of 1. The level of the asset price is also approximately 10 times the lease price, roughly equal to the present value of a perpetuity discounted at 10 percent.

Appendix 6. Main particularities of the project of 29m trawler and of the project of 50m trawler

Main particularities of the project of 29m trawler.

LOA - 29 m

Beam - 14 m

Fuel oil tank – 50 500 liters

Fish hold – for 196 pieces of 440 liter tub containers

Accommodation – for 13 men

Main engine (M/E): 600 hp

Generator: 350 kW

Main particularities of the project of 50m trawler

LOA - 50 m

Beam - 14 m

Fuel oil tank - 360 000 liters

Fish hold – 910m3

Accommodation – for 22 men

Main engine (M/E): 2000 kW

Generator: 350 kW.