TO INVEST OR NOT - RENEWAL OF THE NORWEGIAN BOTTOM TRAWLER FLEET

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ABSTRACT

In order to survive and prosper fishing companies have to balance the need for continuity and change. Investment strategy is a good indicator on the direction companies are headed in terms of capacity, onboard production, and the financial risks they are willing to take. However, the success of an investment does not only depend on company decision and timing, but also how companies tackle unpredicted changes in the competitive environment. Cash flow rise and fall with the quota. Accordingly, successful investment strategies in such settings are often linked to timing and capacity decisions. In this paper we propose a framework that explains the investment strategy behind fishing vessel renewal. The hypothesis that cash flow and profitability impact the decision on when to replace an old vessel with a new is tested by studying the pattern of renewal of Norwegian bottom trawlers in a closed fishery. Results suggest that the decision of renewal is taken on rising quota, just before it peaks. Due to long planning and construction time new vessels are operational under conditions very different than predicted. Declining quota and revenues provides challenging conditions, especially for companies building new vessels. However, companies building new vessels have better economic performance than companies not renewing. And vessels being renewed have more fishing licenses than other vessels. An important observation is that the ITQ system has prolonged renewal, as companies buy licenses rather than new vessels. On rising quotas, owners of fully licensed vessels renew 25% of the Norwegian fleet in 2012-2014.

INTRODUCTION

Production of food is based on harvesting from nature. Some food production concepts are more exposed to unpredictable environments than others. One of the most risky concepts is harvesting from wild fish stocks. The wild fish stocks fluctuate as a result of environmental variations on many unpredictable factors like sea water temperature, feeding conditions and development in predating stocks. In addition accessibility for fishing depends on stock migration pattern and climate conditions as well as fishing effort. Based on these variations fishermen skills and technology are developed to reduce uncertainty and improve efficiency in harvesting from wild fish resources. Public authorities also contribute to the struggle by improving knowledge on how commercial stocks develop and thus try to modify the management regime in order to create stable and predictable conditions for fishing companies to invest and prosper.

However, looking at variation in quota, landing, cash flow and fleet structure, fluctuation seems to be a more proper notion than stability. One key challenge in such business environment is how to invest, in particular when to invest, what technology to select and capacity to choose. The way companies face these challenges is multiple. The most obvious way is to defer (Hart, 1940) renewal of vessels and rather put financial resources in maintenance. Often the result is an outdated fleet. In 2010 for instance, one of the most important vessel groups in Norway – bottom trawlers, the newest vessel was ten years, the average vessel was 19 years, and the oldest vessel was 38 years (Larsen and Dreyer, 2012).

Observations reported indicate that the renewal of fishing vessels is not a continuous one, but rather that the introduction of new vessels is concentrated in short periods of time. From theory this is well known in fisheries where a new species is discovered and opened for commercial fishing. This indicates that first

mover advantages (Lieberman and Montgomery, 1988, 1998) or changes in management regimes trigger a wave of new vessels introduced to fisheries (Foley et al 2011). Another trigger might be technology improvements allowing value adding under fixed quota (Bendiksen et al 1999).

However, independent of changes in accessibility related to new species and technology improvement, old vessels need to be replaced by new ones. One strategy, to reduce the cost of replacement, known from other industries and markets, is to make use of the second hand market. In a closed fishery there will be no well-functioning second hand market when no new vessels are built or vessels from other fisheries are for sale. In line with this there has been reported a wave of renewal in a fishing fleet when relatively new second hand vessels have been introduced from one closed fishery to another. For instance, the fall of the Soviet Union formed a global second hand market as Russian fishing companies replaced old and outdated vessels with second hand vessels from other countries (Nilssen, 2003). Norway was an important supplier of such vessels which strongly contributed to the renewal wave occurring in Norway around 1990. This implies that a functioning second hand market can be an important factor in explaining renewal strategies.

The starting point of this paper is the observation that in a closed fishery the renewal of vessel is concentrated in short periods of time. Our intention is to improve our understanding of this phenomenon. In doing so, we explore the dynamics in renewal of fishing vessels in a closed fishery. In the period studied the renewal of vessels is concentrated in at least two significant "waves". To explain this phenomenon we include the variation in quota of the main target species for this fleet. We also look at the number of new vessels and licenses on each active vessel during the period studied. Cash flow is used as a measure on economic performance in the proposed framework. The collective aim is to gather sufficient information to predict the renewal dynamics in the fleet.

The paper continues as follows. In the next section we introduce three propositions based on observable perspectives like variation in cash flow and quota, the number of licenses per vessel and the number of new vessels. In the third section we describe the data, introduce the methodology and formulate testable hypothesis based on the propositions proposed. The fourth section contains the results from the empirical testing. The final section contains a short conclusion with possible implications derived from findings.

PERSPECTIVE

Our port of departure is fishing and renewal of fishing vessels. In choosing factors important for cash flow in such an activity and asset, accessibility to a commercial interesting biomass and allowance to harvest from it is crucial. As over-fishing has been an important issue in most large-scale fisheries, public authorities have often implemented restrictions both related to total allowable catch (TAC) and number of fishing licenses. Thus, the most crucial factor when it comes to future cash flow is how the biomass develops in years to come. Obviously, the condition of the biomass depends on uncertain physiological, biological and ecological factors. But also human action, i.e. the way fisheries are managed and operated in terms of quota and fishing rights, are important for both short and long term cash flow at vessel level.

As we focus on the decision of renewal of fishing vessels, catch capacity and capacity utilization are important. These are not fixed factors but factors that continuously change as technology develops. Renewal often represents a significant increase in capacity. Capacity might also change as a result of maintenance or reconstruction of old vessels. However, capacity utilization in a closed fishery at large depends on quota, number of vessels and number of fishing licenses per vessel. Accordingly, variations in biomass and management regime are crucial for the capacity utilization.

Based on these arguments, and empirical findings reported, we predict that a renewal wave of vessels in a closed fishery will follow the quota variation and catch per unit effort. However, the timing of renewal

among different vessel owners will depend on company level factors (Barney, 2002) like knowledge, financial position and slack in capacity. The investment decision studied, i.e. to renew or not, depends on the risk attitude among vessel owners and investors.

The climate for renewal will improve as the quota increase, indicating that renewal are more likely to occur after a period of continuous growth in vessel quotas than in periods with stable or even decrease in vessel quota. First movers (Lieberman and Montgomery, 1988, 1998), i.e. those vessel owners that renew their vessel first in a period of quota growth, are more likely characterized by higher cash flow than late movers, deferring to order new vessels.

Accordingly, we propose;

Proposition 1: In a closed fishery the renewal of vessels will follow the fluctuation of the quota
Proposition 2: The first movers are characterized by higher cash flow than late movers.

In order to increase the pace of renewal and to improve cash flow, the public authorities can intervene by adjusting the rules of the game and e.g. allow an increased number of licenses on each vessel (Hermansen and Dreyer, 2010; Hermansen et al, 2012). However, there will be a short term tradeoff between investing in new licenses and the return on invested capital. In a period after introducing this possibility, vessel owners will adapt differently to the new management regime dependent of their strategic position.

Some vessel owners are in a position where they are able to add more licenses to their vessel, others not. This position varies along dimensions like slack in capacity and financial strength. The market for fishing licenses is also important. Some vessels are in a position where they can avoid the market for licenses if they are a part of a multi vessel company. If a company owns several vessels, they can use the second hand market to sell a redundant vessel at a fair price, and move licenses over to newer and more efficient vessels. Multi-vessel companies are also in a position, if sufficiently solvent, to sell and order new vessels at different point in time and thus exploit first mover advantages.

Other vessel owners, however, might be in a strategic position where they are unable to exploit the possibilities opened. Insufficient financial resources, slack in capacity or great demand for fishing licenses make both adding more licenses and vessel renewal too risky. Being in such position it is likely that the new option rather represent an attractive exit strategy from the industry, i.e. both license and a vessel are offered for sale.

Based on these arguments we propose the following to occur when introducing an individual transferable quota (ITQ) system in a closed fishery;

Proposition 3: Only after the vessels have reached the maximum number of licenses allowed the owners will start renewal.

In a closed fishery with an ITQ system, owners will prioritize to accumulate fishing licenses over vessel renewal.

DATA
The issues addressed in this paper require good quality panel data. For example, we need to study a cross sectional sample of vessels representing the entire fleet over some time to get sufficient variation to conduct empirical analysis. Structural shifts are important too as management regime changes will affect vessel owners choice of strategy and performance. Fish stock condition and quota are perhaps the strongest drivers to economic performance for the vessels. Hence, the stock and quotas need to fluctuate sufficiently in the period studied.

The data used in this study is collected by the Norwegian Directorate of Fisheries and organized by the authors. It consists of annual financial statements for each vessel submitted by vessels owners. Accounting reports are available for the years 2000 to 2010.

Data on quota and vessel renewal are available for the years 1980 to 2014. For 2013 and 2014 we use the quota predictions from the Institute of Marine Research (www.imr.no/en). Vessels owners are eager to announce when they have signed a contract for a new vessel. Since the construction period takes two to three years, we know with good certainty today which vessels that will be renewed the next two years. Table 1 contains descriptive statistics on the variables used in this study.

Table 1. Descriptive statistics from 2000 to 2010.

Variable	Obs.	Mean	Std. Dev.	Min	Max
New vessels	364	0.16	0.37	0.00	1.00
Quota (in tonnes)	364	211861	23597	192500	271000
EBITDA (in million NOK)	364	4.33	6.41	-26.86	23.69
Number of licenses per vessel	364	1.52	0.73	0.23	3.00

The variable "New vessels" is a dummy variable represents vessels being replaced by new vessels from 2012 to 2014. These vessels are also referred to as first movers. In 2010 the entire fleet consisted of 41 vessels[i]. 11 vessels are scheduled to be renewed in 2012 to 2014, more than one quarter of the entire fleet. In the 2003 to 2010 period, and especially after 2005 when the ITQ system was made more attractive, major restructuring took place. The consequence was that not a single new vessel was built. Cash flow is measured as EBITDA, which reflects earnings before interest, taxes, depreciation and amortization.

Norwegian bottom trawlers
The setting chosen for this study is the Norwegian bottom trawlers. This fishery has been closed since the late 1970s. Accordingly, there is a fixed number of fishing licenses. The main target species are cod, haddock and saithe. The target species have been regulated with TAC where the bottom trawlers share a more or less fixed part of the Norwegian part of TAC, annually set by Norway and Russia together. Some of the vessels are also allowed to fish prawns in the north Atlantic.

Poor profitability and slack in capacity led to an old and outdated fleet. From 1990 owners where allowed to transfer two time-limited (13-18 years) licenses[ii] to an existing vessel resulting in a maximum of three licenses per vessel. From 2005 added licenses where made perpetual, adding attractiveness to the scheme. The scheme's objective was to help the fleet to adapt capacity, improve efficiency and financial performance.
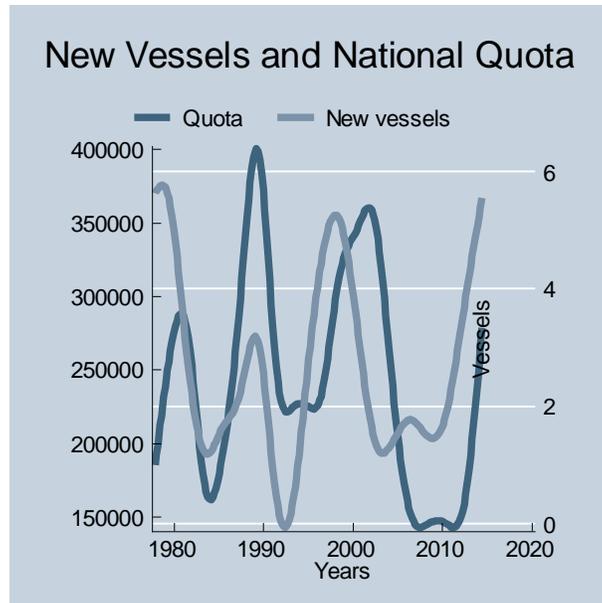
Figure 1. The Norwegian quota of North East Atlantic cod from 1990-2014 and number of new bottom trawlers (3 yrs. moving average).

In figure 1 we have plotted the annual variation in the quota (in tonnes) from 1990 till 2014[iii] and the number of new vessels entering the fishery. Cod is the single most important specie for this fleet. As illustrated in the figure the vessel owners are exposed to a biological resource that fluctuates strongly and makes investments decision related to capacity and renewal both complicated and risky.

METHODOLOGY
Based on our data and the propositions proposed above we have generated three empirical hypotheses that we will test.

The first hypothesis (proposition 1) states that the correlation between quota and new vessels is zero. A rejection implies some kind of relationship. We expect quota to be positive correlated with new vessels. Due to time lag between company decision to build new vessel and vessel entering fishery we expect the correlation to be stronger with a lagged quota variable, possible with 2-3 year time span. We use data from 1980 to 2014 (see figure 1).

The second hypothesis (proposition 2) states that first movers and late movers have equal accumulated cash flow in the years prior to renewal. We use a simple linear regression model to test whether new vessels as a binary independent variable significantly impact cash flow as the continuous dependent variable. We expect cash flow to be significantly higher for first movers than late movers, thus rejecting the hypothesis. We use data from 2003 to 2010, which is a period where no new vessels were built.

The third hypothesis (proposition 3) states that first movers and late movers have an equal number of licenses per vessel. This hypothesis is tested using a simple linear regression model with the number of fishing licenses as the dependent variable and first movers as a binary independent variable. We expect that the number of fishing licenses to be significantly higher among first movers than late movers, thus rejecting the hypothesis.

RESULTS
All empirical analysis was conducted using the STATA software. Hypothesis 1 was empirically tested by correlation analysis. Results in table 1 suggest that the covariation between new vessels and quota is largest with a lagged quota. In other words, a peak in new vessels occurs 1-3 years after a peak in the quota. This is in line with the practice of building new vessels which is known to take 2-3 years from company decision is taken until the vessel operate. We reject hypothesis 1 and conclude that the fluctuation in quota is a significant input to the company's renewal strategy. The decision to build new vessels seems to be taken a year before or the same year as the quota peak.

Table 1. Correlation Analysis of Quota and New Vessels.

	Correlation Analysis	
	New vessel	p-value
Quota	0.254	0.124
Quota (1 lag)	0.466	0.004
Quota (2 lags)	0.503	0.002
Quota (3 lags)	0.407	0.015
Quota (4 lags)	0.203	0.249
Quota (5 lags)	-0.014	0.937

Hypothesis 2 was empirically tested using a linear regression model. Results in table 2 suggest that first movers have almost 5.3 million kroner higher accumulated cash flow than late movers over the 2003 to 2010 period.

Table 2. Linear regression model testing hypothesis 2.

	Accumulated cash flow	
	Coefficient	t-value
Constant (A_1)	10.493	10.42*
New vessels (A_2)	5.271	2.11*
F-value	4.44	
N	364	
R-squared	0.013	

* indicate p < 0.05

Hypothesis 3 was empirically tested using a linear regression model. Results in table 3 suggest that first movers have accumulated 0.57 more fishing licenses than late movers.

Table 3. Linear regression model testing hypothesis 3.

	Number of fishing licenses	
	Coefficient	t-value
Constant (B_1)	1.432	35.71*
New vessels (B_2)	0.566	5.68*
F-value	38.28	
N	364	
R-squared	0.082	

* indicate p < 0.05

Results suggest that hypothesis 1, 2 and 3 are rejected. This implies that the propositions seem to describe the industry fairly accurate. By statistical tests we infer that vessels renewing in 2012-2014 have higher cash flow than vessels not renewing. We also find that the renewing vessels have more fishing licenses than vessels not renewing. We therefore, indirectly, suggest that there is a link between higher cash flow and more fishing licenses, and that the former comes as a result of the latter. We do, however, not establish any causality by statistical testing, nor do we try to explain further why first movers have higher cash flow than late movers. There are surely other factors not taken into account in this study that affects cash flow and a company's ability and willingness to accumulate fishing licenses and operate efficiently.

CONCLUSION

In this paper we examine the dynamics of renewal of the fleet in a closed fishery. The TAC of the target species, i.e. Northeast Arctic cod, fluctuates strongly in the period studied. To help the fleet in improving its profitability and adapting the capacity the public authorities introduced an ITQ system, allowing vessel owners to increase quota and catch per vessel.

Our findings are as follows. In the closed fishery studied the renewal of vessels follow the fluctuation of the quota. However, the new vessels ordered operate for the first time 1-3 years after the TAC has peaked. This can be explained by the time lag between the order was placed and the vessel operate. This result indicates that a renewal wave tends to peak shortly after TAC and cash flow starts to decrease.

First movers, i.e. owners replacing old vessels by new vessels, are characterized by higher accumulated cash flow than late movers. First movers also have accumulated more licenses than late movers, which strongly contribute to higher accumulated cash flow. Improved financial strength creates favorable conditions for investments. The timing of vessel replacements is not optimal as the new vessel will operate on declining quota. The selling price will most likely decline as the supply of used vessels increase. At the same time the price of the new vessel might be higher as shipyards face increased demand. Going counter-wave, i.e. ordering new vessel when shipyard activity is low and second hand market is good seems to be a more optimal strategy. Such strategy demands that companies are in a good financial state, and that the authority govern the business in a predictable manner.

The last decade this fishery has faced major restructuring as the number of vessel was reduced from around 100 to 40. Early in the decade vessel owners chose to buy fishing licenses rather than ordering new vessels. Toward the end of the decade, however, the more aggressive owners reached the maximum number of licenses allowed on a single vessel (figure 2). A healthy fish stock led to an increase in quota. Economic performance was good and the climate for renewal deemed very favorable. The result is seen today, the total number of vessels seems to stabilize and more than one quarter of the fleet is renewing. This is a good example that the authorities indirectly decide when fleet renewal occurs.
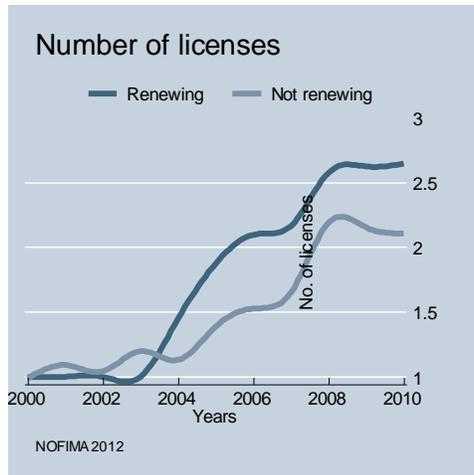
Figure 2. Number of licenses amongst first movers (renewing) and late movers (not renewing).

Allowing owners to add more licenses per vessel seems to have been a successful way of adapting capacity and improving cash flow to the Norwegian bottom trawlers. If this cure is transferable to other fisheries is to be seen. Larsen and Dreyer (2012) indicate that the fleet is close to capacity limit if one judge by the number of days at sea. The present annual growth of 25% of the TAC for Northeast Arctic cod, will further stress the fleet capacity. However, according to history the renewal wave we now experience will be followed by a significant fall in TAC. If (or perhaps more correctly when) that happens, the cash flow will fall and owners will once more argue for rising the maximum number of licenses allowed per vessel to protect yesterday's investment, and ensure future renewal.

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[i] Our data contains 34 of the 41 vessels in 2010.

[ii] Authorities set the maximum allowable catch per license annually, but can be adjusted more frequently when redistribution across groups occurs.

[iii] Years 2013-2014 are based on Institute of Marine Research (www.imr.no/en) quota advice.