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# Attitude to regulations and motivation to comply: Empirical analysis of survey data from the coastal cod fishery

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# CONTENT

# 1 INTRODUCTION AND RESEARCH QUESTION

The fisheries depart from standard management procedures in several ways. The regulations are detailed and aimed directly at vessel size and type, gear category, species, region, and time period. The authorities depend on the fishermen's reporting and, to some extent, self control. The fisheries represent huge values for each fisherman as well as the society at large. Non-compliance is a severe problem for at least five reasons; firstly, cheating disrupts the fisheries as a competitive arena and thus undermines the efficiency of the industry; secondly, cheating distorts the quality of the information used to determine stock size and total quotas; thirdly, the survival of the stock may be in danger in an uncontrolled fishery; fourthly, considerable public costs are related to control and surveillance. For the Norwegian fisheries, these costs are estimated to NOK 500 million annually (Wallis and Flåten 2000); and fifthly, considerable values are kept away from the national economy; NOK 1 billion annually are reported (Rapp 2000), which is about 10 % of the catch value. There are thus obvious arguments in favour of increased overlap between regulations and de facto fishermen behaviour. Due to increasing costs per extra controlled unit, increased policing may not be the right path to go. So when this overlap does not occur satisfactorily, what can we do to remedy it?

The objective of this paper is to analyze the fishermen's attitude to regulations of the Norwegian coastal cod fisheries, and whether this attitude is conditioned by the fisherman's age, regional location, and size of the vessel. Based on the fact that the coastal cod fishery is strictly regulated, we expect that fishermen have a distinct opinion on whether the system is "good" or "bad", whether it is "fair" or "unfair", whether it is perceived as "rational" or "irrational". The assumption is that the fishermen's inclination to abide the law is conditioned by their acceptance or rejection of the system, or whether they perceive the system as fair or rational. In the following we analyze statistically the degree of compliance as a function of quota size, fairness, design of the regulation, complexity and comprehension of the regulations, income alternatives, and reciprocity between fishermen. Furthermore, the paper tests statistically whether the motivation for compliance is conditioned by the size of the vessel, age or regional location along the coast of Norway.

The analysis is based on a survey among coastal cod fishermen conducted in the fall 2003. The universe was defined as the 2332 "group I" fishermen with rights in the coastal cod fishery. Our aim was to receive responses from 300 fishermen, and in order to reach this goal, 1543 fishermen were contacted. The fishermen were contacted by telephone, and each

interview, following a structured form, lasted approximately 30 minutes. The feedback from the large vessels was enhanced in order to ensure that their experiences did not disappear in the material. The main variables are vessel length, fisherman age, and home region[1].

The data investigated in this paper is presented in full in Aarset (2006). Here we have made a thematic selection for more detailed analysis.

Below, the main trends in the literature on fisheries crime are presented. Secondly, we investigate in more detail the fishermen's opinions on regulations and justice, the assumption being that justice is an absolute precondition for legitimacy of regulations. In order to study the motivation to comply further, we analyse, thirdly, responses to propositions about motivations to comply (or not) to regulations. Fourthly, we analyse the control regime and effects of this regime on legitimacy, and at last we conduct a summary and a brief discussion.

[1] F = Finnmark; T = Troms; N = Nordland; NT/ST = Nord-Trøndelag and Sør-Trøndelag; MoR = Møre og Romsdal; SoF/H/R/VA = Sogn og Fjordane, Hordaland, Rogaland, and Vest-Agder.

# 2 THEORETICAL APPROACH

Becker (1968) is the basic reference on crime in the economic literature. Here rule compliance is explained as a matter of control and punishment, in other words, increased force provides increased compliance to the regulations. This perspective is repeated in the earlier studies on fisheries crime (Sutinen and Gauvin 1988;Sutinen et al. 1990;Furlong 1991). An interesting divide has occurred over the last 15 years with a development of more sociologically oriented explanations that includes norms and moral (Hønneland 1999a;Hønneland 1999b;Jentoft 2000;Nielsen 1998;Gezelius 2001).

Hardin (1968) launched a controversial contribution to the approach of the studies of natural resource management, including fisheries management, that still is present in contemporary analyses. His analysis concluded that free and unprotected access to the resources, such as the global fisheries resources at the time, inevitably would be fished down. This analysis fits hand-in-glove with the paradigm of state management, that the globes natural resources can be mapped and regulated in line with the needs of the present and future human generations. Within academia, Hardin's philosophy found fruitful soil among rational positivists, first and foremost the economists. After a while, other branches of the social sciences introduced shades of grey in Hardin's black and white picture. A broad selection of studies has demonstrated that there are a series of advanced systems for allocation and management of resources established and maintained by defined users. The oceans are no open and rule-less arena, but submit to complex arrangements for allocation and use, systems that has evolved in balance with the surrounding nation's dependence on these resources.

The fisheries crime literature as well is oriented after this divide, where some studies, predominantly the older, view increased control as the only way to discipline the fisheries. Implicit in this perspective is the position that fishermen are economic actors only out there to maximise the profits. Profitability is important to fishermen as to everyone else, but they are also social beings that participate in several capacities. This is more pronounced in later studies that have more emphasis on normative aspects. The branch of the fish-crime literature that holds this perspective belongs to the part of the resource management literature that is critical to Hardin's simple mathematics. Research on the violations of regulations has, in the search for explanations of irregular fisheries praxis, left the strong defence of economic sanctions (Sutinen and Gauvin 1988;Sutinen et al. 1990) in favour of more normative perspectives (Nielsen 1998;Hønneland 1998;Hønneland 1999b;Jentoft 2000;Gezelius 2001;Gezelius 2002). Even though normative analyses are asked for by several economists

(Sutinen et al. 1990;Kuperan and Sutinen 1998), the normative perspective is moved to the centre stage in a few studies only (Gezelius 2001;Hønneland 1998;Hønneland 1999a). It is a paradox that while fish-crime research increasingly demand normative explanations to non-compliance (also research conducted by economists) in order to find answers to observations that falls outside their models, the authorised fisheries management has moved towards a more instrumental view with emphasis on economic rationality where economic sanctions are used as the major solution to resource crimes.

# 3 REGULATION AND FAIRNESS

Why is the perception of fairness of any interest in this study? If we can identify large variation in the perception of fairness, this will be a factor in the understanding of compliance to the regulations. A hypothesis is that the fishermen that perceive the regulations as less legitimate may use this to justify non-compliance. In order to be perceived as legitimate, a regulation must be perceived as fair. In this paper we investigate the fishermen's perception of fairness in relation to regulations. We ask the respondents for their opinion on the share of the fishermen that will agree that the regulations are fair. Six categories are available, either "none" (0 %), "up to one third" (1-33 %), "plus minus half" (34-66 %), "more than two thirds" (67-99 %), "all" (100 %), or "no opinion" (NO)". The five answer categories (0 %, 1-33 %, 34-66 %, 67-99 % and 100 %) are ranked from 1 to 5 where 5 are 100 %. We exclude the answer alternative "no opinion" in the statistical calculations, because it is not possible to rank “no opinion” in relation to the other alternatives.

The fishermen comprise a group with assumed good internal communication and strong social ties and culture based identity. It is reasonable to conclude that an internal adjustment of their perception of the industrial environment takes place via internal communication. Along these lines there will also be developed common perceptions of regulations that can be investigated. When a fisherman from one type of vessel is asked about the perception of "other fishermen" we may consider this as opinions that will be shared by other fishermen with the same background as the respondent. Several fishermen consider the regulations as unfair (Table 1), which may have an impact on the legitimacy of the regulations. The information may be significant in an attempt to correct the regulations so they are perceived as legitimate.

*Table 1: In your opinion, what will be the share of all fishermen that agrees that the regulations are fair?*

| | **None** | **Up to one third** | **Plus minus half** | **More than two thirds** | **All** | **No opinion** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 5,5 | 25,5 | 32,5 | 18,5 | 3,5 | 14,5 | 200 |
| 15 - 19,99 meter | 3,9 | 33,3 | 25,5 | 5,9 | 2,0 | 29,4 | 51 |
| 20 - 27,99 meter | 14,3 | 38,8 | 20,4 | 8,2 | 0,0 | 18,4 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 16,4 | 40,0 | 14,5 | 10,9 | 0,0 | 18,2 | 55 |
| 41 - 50 year | 5,4 | 31,1 | 32,4 | 13,5 | 2,7 | 14,9 | 74 |
| 51 - 55 year | 5,4 | 32,1 | 32,1 | 10,7 | 3,6 | 16,1 | 56 |
| 56 - 60 year | 1,7 | 25,0 | 38,3 | 20,0 | 1,7 | 13,3 | 60 |
| 61 year or older | 5,5 | 16,4 | 27,3 | 18,2 | 5,5 | 27,3 | 55 |
| *Location* | | | | | | | |
| F | 12,5 | 22,9 | 35,4 | 10,4 | 4,2 | 14,6 | 48 |
| T | 4,6 | 21,5 | 32,3 | 24,6 | 3,1 | 13,8 | 65 |
| N | 4,7 | 30,7 | 29,9 | 9,4 | 2,4 | 22,8 | 127 |
| NT/ST | 0,0 | 50,0 | 0,0 | 33,3 | 8,3 | 8,3 | 12 |
| MoR | 6,7 | 26,7 | 30,0 | 16,7 | 0,0 | 20,0 | 30 |
| SoF/H/R/VA | 16,7 | 50,0 | 16,7 | 11,1 | 0,0 | 5,6 | 18 |
| ***Sum*** | ***6,7*** | ***29,0*** | ***29,3*** | ***14,7*** | ***2,7*** | ***17,7*** | ***300*** |

We want to test whether the exogenous, structural variables $x_1$: size of owner's fishing vessel (categories less than 15 meters, between 15 and 19,99 meters and between 20 and 27,99 meters), $x_2$: age of the fisherman (categories; younger than 40 years, 41-50 years, 51-55 years, 56-60 years and 61 and older), or $x_3$: regional location of the vessel (and fisherman), respectively, have any influence on the fisherman's answer. The value of the regional variable increases the farther south the vessel is registered. We treat the ranked answer as the endogenous *y*-variable. The variables $y$, $x_1$, $x_2$ and $x_3$ are ranked and measured on ordinal level.

The following theoretical model is estimated by using ordinary least squares (OLS) as estimator.

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon$$

where the $\alpha$ and $\beta_i$ ($i$ = 1, 2 and 3) are parameters to be estimated. $\varepsilon$ is the stochastic residual which absorbed the white noise, i.e. unexplained variation in the model with zero

expectation and constant variance. The result of the regression is as follows (student *t*-values are in brackets):

$$\hat{y} = \underset{(13.176)}{2.752} - \underset{(-3.154)}{0.250}x_1 + \underset{(3.625)}{0.156}x_2 - \underset{(-0.904)}{0.039}x_3$$

Statistically evaluated the model is fairly good: $\overline{R}^2 = 0.10$ and $F_{(3,243)} = 9.729$ which indicate that the null hypothesis $H_0 : \alpha = \beta_1 = \beta_2 = \beta_3 = 0$ can be rejected. The residuals are not autocorrelated at first order, i.e. Durbin-Watson (DW) statistics equal 2.01. Spearman's ρ shows that there is some dependency between vessel size and age and vessel size and geographical location respectively. The correlation between the said variables could give multicollinearity and affect the statistical tests based on the OLS-regression. Elements of multicollinearity cause high coefficient variance and therefore result in unstable estimates, and inflates R-square and the F-statistics. The collinearity statistics, tolerance and the variance inflation factor (VIF), respectively, on the other hand, show no indication of too high correlation between the exogenous variables measured on ordinal level. The regression shows that it is only variable $x_3$: regional location that is not significant on 5 % level numerical (*t*-value < 2), which means that regional location has no influence on the answer. However, the sign of the coefficient is negative and indicates that the farther south the fishermen is located, the more inclined he is to answer that only a small share of the fishermen consider the regulations as fair. The variable $x_1$: size of the vessel is significant, and the negative value of the coefficient shows that the longer the vessel is, the more inclined the respondent is to answer that a small share of the fishermen consider the regulations as fair. The statistical result also shows that the older the fisherman is ($x_2$), the more inclined he is to answer that a bigger share of the fishermen consider the regulations as fair. The statistical findings predicts that; the older the fisherman is, the shorter the vessel he owns is, and the farther north he is located – the more loyal he is to the official regulations. The share of the respondents that have answered "no opinion" on the question is quite large.

# 4 MOTIVATION FOR COMPLIANCE (AND NON-COMPLIANCE)

The motivation for compliance varies, based in the experience and the position of each fisherman. In order to investigate this motivation and how they evaluate different situations, we have formulated different propositions and asked for responses on the validity of them. The aim is to produce more nuanced information about the argument in favour or opposition to breaching of the regulations, and check the attitude towards core issues on regulations and the decisions fishermen make in practical fisheries. What kind of evaluation is conducted when fishermen decide what to do in practical fishing? The respondents are fishermen with a specific age, vessel type, and regional location that influence their position on these responses.

## 4.1 Quota size and rule compliance

First, our aim is to investigate the effect of the quota size on compliance, and we propose that "the typical fisherman will always comply to the regulations when the quota size allows a profitable result". Younger fishermen and fishermen from smaller boats seem to have a higher tendency not to respect the regulations that limit the quotas, even if the variations are modest (Table 2). When it comes to the small vessels, this can be explained by vulnerability to weather conditions; under good weather conditions the fishermen want to fish, because they know they will be forced ashore when the weather turns bad. Younger fishermen will be more exposed to financing costs and thus also have an economic incentive not to comply with rules.

*Table 2: The typical fisherman will always comply with the regulations when the quota size allows a profitable result.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 49,5 | 27,0 | 10,5 | 8,0 | 1,0 | 4,0 | 200 |
| 15 - 19,99 meter | 64,7 | 9,8 | 17,6 | 2,0 | 3,9 | 2,0 | 51 |
| 20 - 27,99 meter | 57,1 | 24,5 | 8,2 | 6,1 | 2,0 | 2,0 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 52,7 | 21,8 | 12,7 | 5,5 | 7,3 | 0,0 | 55 |
| 41 - 50 year | 48,6 | 21,6 | 18,9 | 8,1 | 0,0 | 2,7 | 74 |
| 51 - 55 year | 55,4 | 23,2 | 7,1 | 8,9 | 0,0 | 5,4 | 56 |
| 56 - 60 year | 58,3 | 28,3 | 6,7 | 3,3 | 1,7 | 1,7 | 60 |
| 61 year or older | 52,7 | 23,6 | 9,1 | 7,3 | 0,0 | 7,3 | 55 |
| *Location* | | | | | | | |
| F | 64,6 | 18,8 | 10,4 | 6,3 | 0,0 | 0,0 | 48 |
| T | 50,8 | 30,8 | 10,8 | 4,6 | 0,0 | 3,1 | 65 |
| N | 52,0 | 20,5 | 12,6 | 7,9 | 1,6 | 5,5 | 127 |
| NT/ST | 50,0 | 33,3 | 16,7 | 0,0 | 0,0 | 0,0 | 12 |
| MoR | 56,7 | 26,7 | 6,7 | 6,7 | 0,0 | 3,3 | 30 |
| SoF/H/R/VA | 38,9 | 22,2 | 11,1 | 11,1 | 16,7 | 0,0 | 18 |
| ***Sum*** | ***53,3*** | ***23,7*** | ***11,3*** | ***6,7*** | ***1,7*** | ***3,3*** | ***300*** |

The proposition represents the independent *y*-variable. Here we will test whether the age of the fisherman, size of the fisherman's vessel or the regional location influence the fisherman's answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(8.677)}{1.905} - \underset{(-1.614)}{0.131}x_1 - \underset{(-2.058)}{0.090}x_2 + \underset{(2.406)}{0.107}x_3$$

The model has explanatory power. $F_{(3,286)} = 3.44$ (p = 0.017) and $\overline{R}^2 = 0.025$. The hypothesis $H_0 : \alpha = \beta_1 = \beta_2 = \beta_3 = 0$ is rejected. Durbin-Watson equal 1.98 which indicates no autocorrelated residuals. Tolerance and VIF tests indicate there is no multicollinearity in the model. The estimated coefficients are significant (5 % level). Note that the estimated coefficient for the vessel size ($x_1$) is significant at 10 % significance level. The value on the location variable ($x_3$) indicates that the further south the respondent is located the more inclined he is to respond that the proposition is wrong. It means that a larger portion of the fishermen in the north seems to agree more on the proposition compared to fishermen located in the south. The model also shows that the larger the owners vessel is ($x_1$) the more inclined is the respondent to agree on the proposition. The small-boat owners seem to have the

opinion that fishermen will not under any economic condition follow the regulations. The age-variable ($x_2$) shows that the older the fisherman is, the more inclined he is to agree on the proposition. The result indicates that the younger fishermen are more inclined not to follow the regulations. The result can also indicate that the young fishermen have higher debt than the older ones, and therefore have a different attitude and economic incentive to draw income from fishing.

## 4.2 Fairness and rule compliance

A general proposition in the compliance debate has been that the fishermen do not perceive the regulations as fair, and that the legitimacy of the regulations is deflated and the fishermen's respect for them is decreased. We propose specifically here that "when the fishermen see the regulations as fair, the typical fisherman will comply with the regulations". The responses are similar to those of the former question; 78 % claimed that this was "completely right" or "fairly right" (Table 3). In other words, fishermen seem to agree that when regulations are perceived as fair they influence the fishermen's motivation to comply. The category "vessel size" indicates that the fishermen with the largest vessels have a somewhat higher tendency to give this proposition "completely right" or "fairly right" (86 %).

*Table 3: When the fishermen see the regulations as fair, the typical fisherman will comply with the regulations.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 53,0 | 24,0 | 15,5 | 3,5 | 2,0 | 2,0 | 200 |
| 15 - 19,99 meter | 58,8 | 15,7 | 17,6 | 0,0 | 3,9 | 3,9 | 51 |
| 20 - 27,99 meter | 51,0 | 34,7 | 8,2 | 4,1 | 0,0 | 2,0 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 49,1 | 27,3 | 12,7 | 7,3 | 1,8 | 1,8 | 55 |
| 41 - 50 year | 45,9 | 27,0 | 23,0 | 0,0 | 1,4 | 2,7 | 74 |
| 51 - 55 year | 55,4 | 26,8 | 10,7 | 1,8 | 3,6 | 1,8 | 56 |
| 56 - 60 year | 70,0 | 15,0 | 13,3 | 1,7 | 0,0 | 0,0 | 60 |
| 61 year or older | 49,1 | 25,5 | 10,9 | 5,5 | 3,6 | 5,5 | 55 |
| *Location* | | | | | | | |
| F | 58,3 | 25,0 | 16,7 | 0,0 | 0,0 | 0,0 | 48 |
| T | 55,4 | 26,2 | 12,3 | 1,5 | 3,1 | 1,5 | 65 |
| N | 52,8 | 21,3 | 15,7 | 4,7 | 1,6 | 3,9 | 127 |
| NT/ST | 50,0 | 25,0 | 16,7 | 0,0 | 8,3 | 0,0 | 12 |
| MoR | 56,7 | 26,7 | 13,3 | 0,0 | 0,0 | 3,3 | 30 |
| SoF/H/R/VA | 38,9 | 33,3 | 11,1 | 11,1 | 5,6 | 0,0 | 18 |
| ***Sum*** | ***53,7*** | ***24,3*** | ***14,7*** | ***3,0*** | ***2,0*** | ***2,3*** | ***300*** |

The proposition represents the independent *y*-variable. Here we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence the fisherman's answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(8.681)}{1.820} - \underset{(-1.210)}{0.093}x_1 - \underset{(-1.177)}{0.049}x_2 + \underset{(1.528)}{0.065}x_3$$

The model has no predictive power: $F_{(3,289)} = 1.368$ (p = 0.253) and $\overline{R}^2 = 0.004$. The residuals are not autocorrelated (DW = 2.0) and there are no multicollinarity. The estimated coefficients are not significant given 5% significant level, except the constant term. The regional variable is significant given 10% significant level. In a qualitative analysis where the sign of the coefficients are interpreted, the interpretation would be similar to the analysis of the proposition in Table 2, i.e. the further south $(x_3)$ the vessel is registered, the more the respondent disagrees on the proposition. Further, the respondent agrees more the larger the vessels $(x_1)$ and the older the respondents $(x_2)$ are. A closer look at Table 3 demonstrate that the majority of the respondents agree on the proposition, but the model shows that there

is no statistical evidence for saying that the structural variables such as age, vessel length and regional location have any significant influence on the attitude to the proposition.

## 4.3 Design and rule compliance

Participation in regulation design is part of the co-management "legacy", and the logic of the proposition is that the legitimacy of the regulations is enhanced when the actors participate in the design of the regulations. They thus develop an "ownership" to the regulations and a participatory responsibility to the management system (i.e. Jentoft (2000) and Jentoft and Mikalsen (2004) for more on this issue). We propose here that "when the fisherman has been active in the construction of the regulations, the typical fisherman will comply with the regulations". In total 63 % of the fishermen answered "completely right" or "fairly right" on this proposition (Table 4). There is a tendency that this proposition receives more support and less direct opposition from fishermen from the smaller vessels than from the bigger ones.

*Table 4: When the fisherman has been active in the construction of the regulations, the typical fisherman will comply with the regulations.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 31,5 | 33,5 | 17,5 | 10,5 | 2,0 | 5,0 | 200 |
| 15 - 19,99 meter | 37,3 | 17,6 | 29,4 | 5,9 | 7,8 | 2,0 | 51 |
| 20 - 27,99 meter | 32,7 | 28,6 | 18,4 | 14,3 | 2,0 | 4,1 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 29,1 | 34,5 | 20,0 | 10,9 | 3,6 | 1,8 | 55 |
| 41 - 50 year | 28,4 | 28,4 | 27,0 | 9,5 | 2,7 | 4,1 | 74 |
| 51 - 55 year | 42,9 | 21,4 | 14,3 | 17,9 | 1,8 | 1,8 | 56 |
| 56 - 60 year | 41,7 | 25,0 | 16,7 | 10,0 | 3,3 | 3,3 | 60 |
| 61 year or older | 21,8 | 41,8 | 18,2 | 3,6 | 3,6 | 10,9 | 55 |
| *Location* | | | | | | | |
| F | 37,5 | 33,3 | 18,8 | 8,3 | 0,0 | 2,1 | 48 |
| T | 30,8 | 30,8 | 18,5 | 10,8 | 3,1 | 6,2 | 65 |
| N | 33,9 | 22,0 | 23,6 | 13,4 | 3,1 | 3,9 | 127 |
| NT/ST | 25,0 | 50,0 | 16,7 | 0,0 | 0,0 | 8,3 | 12 |
| MoR | 30,0 | 43,3 | 13,3 | 6,7 | 3,3 | 3,3 | 30 |
| SoF/H/R/VA | 27,8 | 38,9 | 11,1 | 5,6 | 11,1 | 5,6 | 18 |
| ***Sum*** | ***32,7*** | ***30,0*** | ***19,7*** | ***10,3*** | ***3,0*** | ***4,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence the

fisherman's answer. The independent variable $y$ is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(8.767)}{2.167} + \underset{(0.375)}{0.034}x_1 - \underset{(-0.764)}{0.037}x_2 + \underset{(0.453)}{0.023}x_3$$

The model has no predictive power: $F_{(3,286)} = 0.386$ (p = 0.763) and $\overline{R}^2 = 0.006$. There is no first order autocorrelation in the model (DW = 1.88), or multicollinearity. The estimated coefficients are not significant, except the constant term. The exogenous variables can not explain the variation in the dependent variable. There is no correlation between the structural variables age, length of the vessel and regional location and the way of responding to the proposition. A closer look at Table 4 shows that the majority of the sample agrees on the proposition, but the inclination to agree on the proposition is independent of the structural variables $x_1$, $x_2$ and $x_3$. The structural variables do not predetermine the responses to the proposition.

## 4.4 Comprehension and rule compliance

A long-lasting argument in the Norwegian fisheries has been that the regulations are complex and difficult to understands, and that the fishermen can become criminals without being aware of it. This is a perspective not necessarily shared by the authorities. They, on the other hand, claim that even if the total scope of regulations in the Norwegian fisheries are extensive, the regulations of concern for the individual fisherman are not that many and relatively easy to understand. Our proposition is "when the fisherman understand the regulations, the typical fisherman will comply with the regulations", which about 66 % of the fishermen answered "completely right" or "fairly right" on this proposition (Table 5). Except a general agreement on the proposition, it is difficult to find other patterns here. It is reasonable to perceive that fishermen that have planned their fishing activities based on several species or in other ways participated in activities that are regulated by different regulations, will find this proposition as "more true" than fishermen that only participates in one fishery.

*Table 5: When the fisherman understands the regulations, the typical fisherman will comply with the regulations.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 39,0 | 28,5 | 16,5 | 8,0 | 2,0 | 6,0 | 200 |
| 15 - 19,99 meter | 35,3 | 19,6 | 25,5 | 7,8 | 7,8 | 3,9 | 51 |
| 20 - 27,99 meter | 42,9 | 26,5 | 16,3 | 8,2 | 2,0 | 4,1 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 41,8 | 27,3 | 16,4 | 7,3 | 3,6 | 3,6 | 55 |
| 41 - 50 year | 35,1 | 31,1 | 23,0 | 4,1 | 2,7 | 4,1 | 74 |
| 51 - 55 year | 33,9 | 23,2 | 17,9 | 19,6 | 1,8 | 3,6 | 56 |
| 56 - 60 year | 56,7 | 15,0 | 16,7 | 5,0 | 0,0 | 6,7 | 60 |
| 61 year or older | 27,3 | 36,4 | 14,5 | 5,5 | 7,3 | 9,1 | 55 |
| *Location* | | | | | | | |
| F | 47,9 | 18,8 | 20,8 | 8,3 | 0,0 | 4,2 | 48 |
| T | 43,1 | 27,7 | 10,8 | 4,6 | 6,2 | 7,7 | 65 |
| N | 37,0 | 22,8 | 22,0 | 9,4 | 3,1 | 5,5 | 127 |
| NT/ST | 16,7 | 75,0 | 8,3 | 0,0 | 0,0 | 0,0 | 12 |
| MoR | 26,7 | 36,7 | 20,0 | 10,0 | 0,0 | 6,7 | 30 |
| SoF/H/R/VA | 50,0 | 22,2 | 11,1 | 11,1 | 5,6 | 0,0 | 18 |
| ***Sum*** | ***39,0*** | ***26,7*** | ***18,0*** | ***8,0*** | ***3,0*** | ***5,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence the fisherman's answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(7.576)}{1.887} + \underset{(0.196)}{0.018}x_1 + \underset{(0.126)}{0.006}x_2 + \underset{(0.775)}{0.038}x_3$$

The model has no predictive power: $F_{(3,280)} = 0.247$ (p = 0.864) and $\overline{R}^2 = 0.03$. There is no first order autocorrelation in the model (DW = 2.0) or multicollinearity. The estimated coefficients are not significant, except the constant term. The exogenous variables can not explain the variation in the dependent variable. There is no correlation between the structural variables age, length of the vessel and regional location and the way of responding on the proposition. Table 5 shows that about 70 % of the respondents support the proposition. The statistical analysis shows that there is no correlation between respectively age-, vessel-category and regional location and the attitude to the proposition. By looking at the signs to the coefficients, we can argue as a hypothesis that; the larger vessel, the older the respondent is and the farther south he is located, the more inclined he is to disagree with the proposition.

## 4.5 Group compliance and individual compliance

Our proposition "as long as other fishermen are complying, the typical fisherman will comply with the regulation" relies on a perception that the fishermen's acceptance of a regulation itself is a driver for increased acceptance. Perhaps the situation is that the fisherman has not reflected so much about the content of the regulation, but observes that others comply and thus do the same himself. If this is the case, it is reasonable to perceive that the three categories will bring varying information. Acceptance and rejection, among other things, will be expressed differently. Other fishermen's relation to regulations is part of a recruit's socialisation process and embedded in the understanding for how you are supposed to act as a fisherman. If other fishermen comply, you most likely comply yourself. This proposition was seen as "completely right" or "fairly right" by 63 % of the fishermen, with a higher score among the fishermen from the smaller vessels (67 %) (Table 6). A possible explanation is that the smaller vessels to a higher extent see their activity as a part of a larger system. The larger vessels are more independent actors in an economic system, perhaps a shareholding company with owners that claim the fulfilment of certain specified economic goals. With the exception of the oldest fishermen there is a tendency to increasing agreement ("completely right" or "fairly right") with the proposition with increasing age. Fishermen compliance depends on the compliance of other fishermen. It is difficult to comply if you perceive it as an extra cost and individual economic loss not to do as your peers. This is linked to the argument for why non-compliance is unwanted (except from the moral sides of the issue); it destroys the competition of the fishery and the market as an effective distributor of input factors.

*Table 6: As long as other fishermen are complying, the typical fisher will comply with the regulations.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 35,5 | 31,0 | 17,5 | 7,5 | 3,0 | 5,5 | 200 |
| 15 - 19,99 meter | 41,2 | 17,6 | 23,5 | 3,9 | 7,8 | 5,9 | 51 |
| 20 - 27,99 meter | 36,7 | 18,4 | 22,4 | 10,2 | 8,2 | 4,1 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 32,7 | 27,3 | 20,0 | 10,9 | 7,3 | 1,8 | 55 |
| 41 - 50 year | 36,5 | 25,7 | 20,3 | 5,4 | 5,4 | 6,8 | 74 |
| 51 - 55 year | 37,5 | 32,1 | 12,5 | 8,9 | 3,6 | 5,4 | 56 |
| 56 - 60 year | 48,3 | 23,3 | 21,7 | 1,7 | 0,0 | 5,0 | 60 |
| 61 year or older | 27,3 | 25,5 | 21,8 | 10,9 | 7,3 | 7,3 | 55 |
| *Location* | | | | | | | |
| F | 39,6 | 29,2 | 16,7 | 6,3 | 2,1 | 6,3 | 48 |
| T | 36,9 | 27,7 | 16,9 | 7,7 | 4,6 | 6,2 | 65 |
| N | 38,6 | 22,8 | 19,7 | 7,9 | 6,3 | 4,7 | 127 |
| NT/ST | 33,3 | 50,0 | 8,3 | 0,0 | 0,0 | 8,3 | 12 |
| MoR | 23,3 | 36,7 | 23,3 | 6,7 | 6,7 | 3,3 | 30 |
| SoF/H/R/VA | 38,9 | 11,1 | 33,3 | 11,1 | 0,0 | 5,6 | 18 |
| ***Sum*** | ***36,7*** | ***26,7*** | ***19,3*** | ***7,3*** | ***4,7*** | ***5,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence what the fisherman answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(7.353)}{1.882} + \underset{(1.095)}{0.102}x_1 - \underset{(-0.243)}{0.012}x_2 + \underset{(0.799)}{0.042}x_3$$

The model has no predictive power: $F_{(3,280)} = 0.832$ (p = 0.477) and $R^2 = 0.09$. There is no first order autocorrelation in the model (DW = 2.1) or multicollinearity. The estimated coefficients are not significant, except the constant term. The exogenous variables can not explain the variation in the dependent variable. There is no correlation between the structural variables age, length of the vessel and regional location and the attitude to the proposition. Table 6 shows that more than 60 % of the respondents support the proposition. The statistical analysis shows that there is no correlation between respectively age-, vessel-category and regional location and the attitude to the proposition. By looking at the signs of the coefficients, we can formulate the following hypothesis; the larger the vessel, the younger the fishermen and the farther south the fisherman is located, the more the fisherman disagrees with the proposition.

## 4.6 Alternative species and rule compliance

The background for the proposition "as long as there are alternative species, the typical fisher will comply with the regulations" is that there is an anticipation that when the fisherman has the opportunity to fish for other species, he will rather do that than breaking the regulations. This investigation is focused on fishermen fishing for cod, and cod will for most of them be the economically most important species, even if they fish for other species. However, it is possible to anticipate that fishermen that is used to combine a fishery on multiple species will achieve compensation by fishing (more of) other species when the access to cod declines. In total 67 % of the fishermen answered "completely right" or "fairly right" on this proposition (Table 7).

*Table 7: As long as there are alternative species, the typical fisher will comply with the regulations.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 41,0 | 27,0 | 18,5 | 7,5 | 2,0 | 4,0 | 200 |
| 15 - 19,99 meter | 47,1 | 13,7 | 23,5 | 5,9 | 5,9 | 3,9 | 51 |
| 20 - 27,99 meter | 32,7 | 38,8 | 14,3 | 6,1 | 0,0 | 8,2 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 34,5 | 30,9 | 18,2 | 10,9 | 5,5 | 0,0 | 55 |
| 41 - 50 year | 39,2 | 28,4 | 16,2 | 5,4 | 1,4 | 9,5 | 74 |
| 51 - 55 year | 37,5 | 33,9 | 17,9 | 8,9 | 0,0 | 1,8 | 56 |
| 56 - 60 year | 55,0 | 18,3 | 18,3 | 5,0 | 0,0 | 3,3 | 60 |
| 61 year or older | 36,4 | 21,8 | 23,6 | 5,5 | 5,5 | 7,3 | 55 |
| *Location* | | | | | | | |
| F | 56,3 | 20,8 | 16,7 | 2,1 | 4,2 | 0,0 | 48 |
| T | 43,1 | 32,3 | 16,9 | 4,6 | 0,0 | 3,1 | 65 |
| N | 37,0 | 23,6 | 22,8 | 8,7 | 3,1 | 4,7 | 127 |
| NT/ST | 41,7 | 25,0 | 16,7 | 8,3 | 0,0 | 8,3 | 12 |
| MoR | 33,3 | 33,3 | 16,7 | 6,7 | 3,3 | 6,7 | 30 |
| SoF/H/R/VA | 27,8 | 33,3 | 5,6 | 16,7 | 0,0 | 16,7 | 18 |
| ***Sum*** | ***40,7*** | ***26,7*** | ***18,7*** | ***7,0*** | ***2,3*** | ***4,7*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence what the fisherman answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(8.144)}{1.928} - \underset{(-0.583)}{0.051}x_1 - \underset{(-0.816)}{0.038}x_2 + \underset{(1.810)}{0.087}x_3$$

The estimated coefficient for the localization variable ($x_3$) is significant given 10% significance level. There is no first order autocorrelation in the model (DW = 1.99) or multicollinearity. The model predicts that the farther south the boat is registered, the more negative is the attitude to the proposition. Table 7 demonstrate that about 70 % of the respondents are positive to the proposition. By looking at the signs of the coefficients, we can formulate the following hypothesis; the larger vessel, the older fishermen and farther north the fisherman is located, the more he agrees with the proposition.

## 4.7 Availability and rule compliance

A maximum quota regulated fishery with "overregulation" as practised in the 1990s, have different effect for different vessel sizes, and also perceived as unfair for some, but perhaps not for others. Within the maximum quota regulation with overregulation, the vessels were allocated a vessel quota based on length meter vessel. The sum of these vessel quotas were larger than the group TAC, hence overregulation. The biology of the fish is still of a character that makes it available in large amounts for parts of the fleet, dependent on when and how the stock comes in to shore. Some vessels thus experience large amounts of fish in the fjord without quota to catch the fish. The overregulation was designed to ensure sufficient available quotas wherever the fish approached “fishable” grounds for the coastal vessels. In periods with low TAC and thus low quotas, but good availability on the coast, no one was allowed to fish. With higher TAC, but with a stock that kept further out to sea, there where higher quotas, but less availability and thus difficult access to the fish for the smallest vessels. The larger vessels are more able to find the fish wherever it is, while the smaller vessels cannot fill their quota because of lack of access to the fish. For the smallest vessels a seemingly free fishery in an empty ocean may change to a very limited fishery (small quotas) in an ocean filled with fish. We propose that "it is difficult to respect the quotas when much fish is accessible" to identify the opinions on this issue. Only 55 % answered "completely right" or "fairly right" on this proposition (Table 8). In addition there is a clear decrease in the "completely right" or "fairly right" response with increasing vessel size.

*Table 8: It is difficult to respect the quotas when much fish is accessible.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 31,0 | 27,5 | 14,5 | 8,0 | 16,5 | 2,5 | 200 |
| 15 - 19,99 meter | 29,4 | 23,5 | 21,6 | 9,8 | 13,7 | 2,0 | 51 |
| 20 - 27,99 meter | 18,4 | 22,4 | 12,2 | 20,4 | 24,5 | 2,0 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 38,2 | 23,6 | 10,9 | 7,3 | 20,0 | 0,0 | 55 |
| 41 - 50 year | 24,3 | 31,1 | 13,5 | 12,2 | 16,2 | 2,7 | 74 |
| 51 - 55 year | 23,2 | 30,4 | 17,9 | 12,5 | 12,5 | 3,6 | 56 |
| 56 - 60 year | 33,3 | 21,7 | 11,7 | 11,7 | 21,7 | 0,0 | 60 |
| 61 year or older | 25,5 | 21,8 | 23,6 | 7,3 | 16,4 | 5,5 | 55 |
| *Location* | | | | | | | |
| F | 33,3 | 29,2 | 18,8 | 6,3 | 12,5 | 0,0 | 48 |
| T | 29,2 | 29,2 | 7,7 | 9,2 | 23,1 | 1,5 | 65 |
| N | 27,6 | 22,0 | 19,7 | 11,8 | 15,7 | 3,1 | 127 |
| NT/ST | 25,0 | 33,3 | 8,3 | 0,0 | 25,0 | 8,3 | 12 |
| MoR | 26,7 | 26,7 | 13,3 | 16,7 | 16,7 | 0,0 | 30 |
| SoF/H/R/VA | 27,8 | 27,8 | 11,1 | 11,1 | 16,7 | 5,6 | 18 |
| ***Sum*** | ***28,7*** | ***26,0*** | ***15,3*** | ***10,3*** | ***17,3*** | ***2,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence what the fisherman answers. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(6.262)}{1.968} + \underset{(2.395)}{0.277}x_1 + \underset{(1.029)}{0.064}x_2 + \underset{(0.206)}{0.013}x_3$$

The estimation shows that the length of the vessel has a significant influence on the attitude to the proposition. The sign of the coefficient shows that the larger vessel, the more negative is the respondent's attitude to the proposition. The model's *F*-value is $F_{(3,282)} = 1.289$ (p = 0.085) and $R^2 = 0.023$. There is no first order autocorrelation in the model (DW = 1.86) or multicollinearity. Table 8 shows that about 55 % of the respondents support the content of the proposition. By looking at the signs of the coefficients, we can formulate the following hypothesis; the smaller vessel, the younger fishermen and farther north the fisherman is located, the more he agrees in the proposition.

## 4.8 Discard and rule compliance

When the quota is filled the fishery is supposed to be terminated. However, there are situations, such as by catch, where fish without quota are captured. In order to investigate the practical decisions in that situation, we propose that "It is wrong to discard fish just because the quota is filled". To this proposition 80 % responded "completely right" or "fairly right" (Table 9).

*Table 9: It is wrong to discard fish just because the quota is filled.*

| | **Completely right** | **Fairly right** | **Neutral** | **Fairly wrong** | **Wrong** | **Do not know** | **N** |
|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | |
| < 15 meter | 69,5 | 13,0 | 5,5 | 2,5 | 6,5 | 3,0 | 200 |
| 15 - 19,99 meter | 54,9 | 9,8 | 17,6 | 5,9 | 9,8 | 2,0 | 51 |
| 20 - 27,99 meter | 69,4 | 16,3 | 4,1 | 6,1 | 4,1 | 0,0 | 49 |
| *Age* | | | | | | | |
| 40 year or younger | 63,6 | 10,9 | 9,1 | 9,1 | 5,5 | 1,8 | 55 |
| 41 - 50 year | 66,2 | 16,2 | 6,8 | 2,7 | 6,8 | 1,4 | 74 |
| 51 - 55 year | 67,9 | 16,1 | 7,1 | 1,8 | 3,6 | 3,6 | 56 |
| 56 - 60 year | 73,3 | 10,0 | 6,7 | 5,0 | 5,0 | 0,0 | 60 |
| 61 year or older | 63,6 | 10,9 | 7,3 | 0,0 | 12,7 | 5,5 | 55 |
| *Location* | | | | | | | |
| F | 64,6 | 10,4 | 10,4 | 2,1 | 12,5 | 0,0 | 48 |
| T | 67,7 | 15,4 | 1,5 | 3,1 | 9,2 | 3,1 | 65 |
| N | 65,4 | 11,8 | 10,2 | 4,7 | 4,7 | 3,1 | 127 |
| NT/ST | 66,7 | 16,7 | 8,3 | 0,0 | 0,0 | 8,3 | 12 |
| MoR | 80,0 | 13,3 | 3,3 | 0,0 | 3,3 | 0,0 | 30 |
| SoF/H/R/VA | 61,1 | 16,7 | 5,6 | 11,1 | 5,6 | 0,0 | 18 |
| ***Sum*** | ***67,0*** | ***13,0*** | ***7,3*** | ***3,7*** | ***6,7*** | ***2,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence what the fishermen answer. The independent variable *y* is ranged from "1" to "5" where "1" is "completely right" and "5" is "wrong". The result of the regression is as follows:

$$\hat{y} = \underset{(6.388)}{1.694} + \underset{(1.208)}{0.117}x_1 + \underset{(0.369)}{0.019}x_2 - \underset{(-1.579)}{0.085}x_3$$

The model has no predictive power: $F_{(3,290)} = 1.095$ (p = 0.352) and $R^2 = 0.011$. There is no first order autocorrelation in the model (DW = 1.73) or multicollinearity. However, the coefficient for the location variable is almost significant on 10 % level. The sign of the coefficient is negative, so this partial relationship predicts that the farther south the vessel is registered, the more inclined is the respondent to agree on the proposition. Note also that 80

% of the respondents have a positive attitude to the proposition. By looking at the signs of the coefficients, we can formulate the following hypothesis; the smaller vessel, the younger fishermen and farther south the fisherman is located, the more he agrees in the proposition.

# 5 CONTROL AND SURVEILLANCE

The control and surveillance system is comprised by the authorities agencies set up to formally control the fisheries. Three different units is involved; the Directorate of Fisheries, the Coast Guard, and the sales organisations.

## 5.1 Evaluation of the control and surveillance system

Here we ask the respondents to characterise the effort of the fisheries control agencies, and 35 % respond that in their opinion, the authorities perform "a very good job" or "a pretty good job". With "a fairly good job" included, 67 % of the fishermen agree (Table 10). The most curious result here is the remarkable difference in the response from the fishermen in Troms and Finnmark, where 71 % of the fishermen from Finnmark responded that the authorities performed "a very good job", "a pretty good job", or "a fairly good job", only 63 % of the fishermen from Troms said the same. The variation in general is small. The fishermen from northern Norway to some larger extent responded that the fishery control agencies perform a better job than fishermen from the other regions, but here the differences are small.

*Table 10: Evaluation of the authorities' effort to control the conventional cod fishery.*

| | **Very good job** | **Pretty good job** | **Fairly good job** | **Fairly bad job** | **Very bad job** | **Do not know** | **Refuse to answer** | **N** |
|---|---|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | | | |
| < 15 meter | 5,5 | 29,0 | 33,5 | 20,0 | 7,0 | 3,5 | 1,5 | 200 |
| 15 - 19,99 meter | 7,8 | 27,5 | 27,5 | 25,5 | 5,9 | 3,9 | 2,0 | 51 |
| 20 - 27,99 meter | 6,1 | 28,6 | 34,7 | 14,3 | 10,2 | 6,1 | 0,0 | 49 |
| *Age* | | | | | | | | |
| 40 year or younger | 7,3 | 29,1 | 32,7 | 23,6 | 5,5 | 1,8 | 0,0 | 55 |
| 41 - 50 year | 5,4 | 28,4 | 40,5 | 18,9 | 4,1 | 1,4 | 1,4 | 74 |
| 51 - 55 year | 5,4 | 28,6 | 32,1 | 19,6 | 12,5 | 0,0 | 1,8 | 56 |
| 56 - 60 year | 8,3 | 23,3 | 38,3 | 16,7 | 10,0 | 3,3 | 0,0 | 60 |
| 61 year or older | 3,6 | 34,5 | 16,4 | 21,8 | 5,5 | 14,5 | 3,6 | 55 |
| *Location* | | | | | | | | |
| F | 4,2 | 29,2 | 37,5 | 10,4 | 12,5 | 4,2 | 2,1 | 48 |
| T | 3,1 | 27,7 | 32,3 | 26,2 | 7,7 | 1,5 | 1,5 | 65 |
| N | 8,7 | 28,3 | 35,4 | 18,9 | 4,7 | 3,1 | 0,8 | 127 |
| NT/ST | 0,0 | 25,0 | 25,0 | 16,7 | 8,3 | 16,7 | 8,3 | 12 |
| MoR | 10,0 | 26,7 | 20,0 | 30,0 | 10,0 | 3,3 | 0,0 | 30 |
| SoF/H/R/VA | 0,0 | 38,9 | 27,8 | 16,7 | 5,6 | 11,1 | 0,0 | 18 |
| ***Sum*** | ***6,0*** | ***28,7*** | ***32,7*** | ***20,0*** | ***7,3*** | ***4,0*** | ***1,3*** | ***300*** |

The proposition represents the independent *y*-variable. In the following we will test whether age of the fisherman, size of the fisherman's vessel and regional location influence what the fisherman answer. The independent variable *y* is ranged from "1" to "5" where "1" is doing "a very good job" and "5" is doing "a very bad job". The result of the regression is as follows:

$$\hat{y} = \underset{(12.654)}{2.944} + \underset{(0.100)}{0.008}x_1 + \underset{(0.223)}{0.010}x_2 - \underset{(-0.371)}{0.018}x_3$$

The model has no predictive power: $F_{(3,280)} = 0.061$ (p = 0.980) and $R^2$=0.01. There is no first order autocorrelation in the model (DW = 1.89) or multicollinearity . The estimated coefficients are not significant, except the constant term. The exogenous variables can not explain the variation in the dependent variable. There is no correlation between the structural variables age, length of the vessel and regional location and the evaluation of the performance of the government. Table 10 shows that about 60 % are relatively satisfied with the work the government has done in controlling the fishing of cod by the conventional fleet. By looking at the signs of the coefficients, we can formulate the following hypothesis; the smaller vessel, the younger fishermen and farther south the fisherman is located, the more he agrees in the proposition.

## 5.2 Efficiency of the types of fisheries control

The fishermen were asked the question: "Which type of control is according your opinion the most effective?" The fishermen could choose between the following four types of control: "control of the catch log at landing", "compare the raw fish purchaser's receipt with the catch-log", "compare the raw fish purchaser's receipt with stockholding and sale of fish", and "compare catch-log with final receipt from the raw fish purchaser". In addition they could choose "other control regime". These reporting routines are now changed as they are on-line. There are broad agreements across vessel size, fishermen age and location that "compares the fish purchaser's receipt from buying raw fish with stockholding and sale of fish" is the most efficient way to control the fishery, 42 % of the fishermen were of this opinion (Table 11). "Control of the catch log at landing" is also seen by many as an efficient method of control, but here there are larger variations in the response. This reaction can be related to the type of fishing gear, because it varies how easy it is to estimate capture based on different gear types. For some odd reason as many as 31 % of the medium sized vessels found "control of the catch log at landing" as an efficient control, while only 16 % of the largest and smallest vessels agreed. Table 11 shows that 42% of the respondents consider "compare the raw fish

purchaser's receipt with stockholding and sale of fish" as the most effective one. The answer seems also rational because this regime requires that the actors cheat at two transaction levels, respectively when the firm buy raw fish and when the firm sell the fish to the next level in the value chain.

*Table 11: Fishermen's evaluation of efficiency of types of control.*

| | **Control of the catch log at landing** | **Compare the raw fish purchaser's receipt with the catch log** | **Compare the raw fish purchaser's receipt with stockholding and sale of fish** | **Compare catch log with final receipt from raw fish purchaser** | **Other control regime** | **N** |
|---|---|---|---|---|---|---|
| *Vessel size* | | | | | | |
| < 15 meter | 16,0 | 18,5 | 41,5 | 13,0 | 11,0 | 200 |
| 15 - 19,99 meter | 31,4 | 7,8 | 33,3 | 9,8 | 17,6 | 51 |
| 20 - 27,99 meter | 16,3 | 14,3 | 53,1 | 2,0 | 14,3 | 49 |
| *Age* | | | | | | |
| 40 year or younger | 14,5 | 16,4 | 40,0 | 9,1 | 20,0 | 55 |
| 41 - 50 year | 24,3 | 16,2 | 37,8 | 8,1 | 13,5 | 74 |
| 51 - 55 year | 19,6 | 19,6 | 37,5 | 14,3 | 8,9 | 56 |
| 56 - 60 year | 20,0 | 11,7 | 41,7 | 10,0 | 16,7 | 60 |
| 61 year or older | 12,7 | 16,4 | 54,5 | 12,7 | 3,6 | 55 |
| *Location* | | | | | | |
| F | 16,7 | 16,7 | 29,2 | 12,5 | 25,0 | 48 |
| T | 21,5 | 15,4 | 41,5 | 15,4 | 6,2 | 65 |
| N | 22,0 | 15,7 | 41,7 | 7,9 | 12,6 | 127 |
| NT/ST | 8,3 | 16,7 | 66,7 | 8,3 | 0,0 | 12 |
| MoR | 13,3 | 10,0 | 56,7 | 10,0 | 10,0 | 30 |
| SoF/H/R/VA | 5,6 | 27,8 | 38,9 | 11,1 | 16,7 | 18 |
| ***Sum*** | ***18,7*** | ***16,0*** | ***42,0*** | ***10,7*** | ***12,7*** | ***300*** |

We tested whether the preferences for control-regimes were dependent on the following three structural variables; $x_1$: the size or length of the fishing vessel which the respondent owns, $x_2$: age of the fisherman (the respondent) and $x_3$: the fisherman's regional location have any influence on the fisherman's answer. The regional variable is represented by the region the vessel is registered. We treat the answer options as the endogenous, categorical variable *c*, and the variable is measured at nominal level. The variables $x_1$, $x_2$ and $x_3$ are ranked and they are measured on ordinal level. We applied a multinomial logistic regression as the estimator. Let $c_i \in C$ where $c_i$ is the control $i$ = 1, 2, 3, 4 and 5. We define the option

5 ($c_5$) as the reference category. The number of cases is 300. In the following we comment the result of the multinomial logistic regression.

The model is in generally terms: $C = f(x_1, x_2, x_3)$. The model fitting information indicates that the model has low explanatory power. The likelihood ratio test shows (similar to the *F*-test in the OLS regression); $\chi^2_{12} = 19.35$ and p = 0.080. The critical value, given 10 % significance level, is $\chi^2_{12} = 18.55$. We can conclude that it is 90 % probability that the model does not explain anything; it means that the exogenous variables, vessel length, age and regional location have no significant influence on the preferences for the control systems. Nor the goodness-of-fit statistics is significant; the Deviance is $\chi^2_{256} = 253.1$ (p = 0.539). The McFadden indicator for pseudo $R^2$ is 0.022, i.e. the model only explains 2.2 % of the variation in the dependent variable.

The likelihood ratio tests for identifying significant contribution from the exogenous variables shows that vessel length ($x_1$) has some influence even though it is not significant given 5% level (p = 0.092). Table 12 shows the result of the likelihood test.

*Table 12: Likelihood Ratio Tests.*

| | Model Fitting Criteria | | | Likelihood Ratio Tests | | |
|---|---|---|---|---|---|---|
| Effect | AIC of Reduced Model | BIC of Reduced Model | -2 Log Likelihood of Reduced Model | Chi-Square | df | Sig. |
| Intercept | 452,049 | 496,494 | 428,049 | ,093 | 4 | ,999 |
| Vessel size $x_1$ | 459,953 | 504,398 | 435,953 | 7,997 | 4 | ,092 |
| Age $x_2$ | 457,311 | 501,757 | 433,311 | 5,356 | 4 | ,253 |
| Location $x_3$ | 457,294 | 501,739 | 433,294 | 5,338 | 4 | ,254 |

Table 13 demonstrate that most of the estimated coefficients are not significant and the result emphasise the conclusion. However, three of the coefficients are significant or close to be significant.

*Table 13: The parameter estimates.*

| Question: Which controlling system is the most effective (a)? | | B | Std. Error | Wald | df | Sig. | Exp(B) | 95% Confidence Interval for Exp(B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower Bound | Upper Bound |
| Control of the catch log at landing $c_1$ | Intercept | -,126 | ,761 | ,027 | 1 | ,869 | | | |
| | $x_1$ :vessel size | -,004 | ,276 | ,000 | 1 | ,987 | ,996 | ,580 | 1,710 |
| | $x_2$ :age | ,182 | ,160 | 1,294 | 1 | ,255 | 1,200 | ,877 | 1,642 |
| | $x_3$ :location | ,011 | ,167 | ,005 | 1 | ,945 | 1,012 | ,729 | 1,403 |
| Compare the raw fish purchaser's receipt with the catch-log $c_2$ | Intercept | -,143 | ,799 | ,032 | 1 | ,858 | | | |
| | $x_1$ | -,447 | ,306 | 2,133 | 1 | ,144 | ,639 | ,351 | 1,165 |
| | $x_2$ | ,165 | ,165 | 1,002 | 1 | ,317 | 1,179 | ,854 | 1,630 |
| | $x_3$ | ,212 | ,170 | 1,559 | 1 | ,212 | 1,236 | ,886 | 1,724 |
| Compare the raw fish purchaser's receipt with stockholding and sale of fish $c_3$ | Intercept | -,199 | ,683 | ,085 | 1 | ,770 | | | |
| | $x_1$ | -,097 | ,246 | ,157 | 1 | ,692 | ,907 | ,560 | 1,469 |
| | $x_2$ | ,307 | ,143 | 4,600 | 1 | **,032** | 1,359 | 1,027 | 1,798 |
| | $x_3$ | ,241 | ,146 | 2,719 | 1 | **,099** | 1,273 | ,956 | 1,695 |
| Compare catch-log with final receipt from raw fish purchaser $c_4$ | Intercept | -,078 | ,931 | ,007 | 1 | ,933 | | | |
| | $x_1$ | -,810 | ,404 | 4,028 | 1 | **,045** | ,445 | ,201 | ,981 |
| | $x_2$ | ,259 | ,181 | 2,047 | 1 | ,152 | 1,296 | ,909 | 1,847 |
| | $x_3$ | ,111 | ,194 | ,327 | 1 | ,568 | 1,118 | ,763 | 1,636 |

a The reference category is: other control regime which is not an explicitly defined regime.

All categories of control systems $c_i$ are compared to the reference category $c_5$ "other systems". The estimated coefficients for the $c_3$-system, which table 11 indicates as a highly supported regime among the fishermen, show that the older the respondent is and the farther south the vessel is registered (regional location), the higher is the odds of supporting the $c_3$-system. The coefficient for the length of the vessel for the $c_4$-system indicates that the larger the vessel is, the higher is the odds that the respondent does *not* support the $c_4$-system.

# 6 SUMMARY AND CONCLUDING REMARKS

Non-compliance in fisheries leads to waste of resources and in economic terms, a welfare loss for the society. The objective of this paper is to analyse the fishermen's attitude to regulations and whether the compliance to the regulations is conditioned on the fishermen's age, regional location, or size of the vessel. The fishermen are exploiting common resources without information about other fishermen catches. Control of the fisheries is thus necessary. The compliance literature discusses alternatives to the punishment-and-control aspects of regulation. Overexploitation can be driven by economic incentives, but also other elements can be in play here. The fishermen can, for example, perceive the system as unfair and irrational. Statistical analysis is employed to show the fishermen's attitude to regulation and compliance. The analysis is based on a survey among coastal fishermen conducted in 2003. About 300 fishermen, i.e. about 13 % of the population of coastal fishermen take part in the survey.

Question and data presented in Table 1 measure how fair fishermen perceive the regulation system to be. The analysis documents that the older the fisherman is, the shorter the vessel is, and the farther north the fisherman is located; the larger is the share of the fishermen that will agree that the regulations are fair, in the opinion of this fisherman. The partial response with respect to vessel size is somewhat paradoxical since owners of larger vessels have been winners within the regime of the past 15 years aimed at distribute a limited resource to too many vessels. Overregulation has provided these vessels with the opportunity to often fish more than their initial vessel quota.

Question and data presented in Table 2 measure the relationship between quota size and compliance. The statistical analysis indicates that the bigger the quota is, which first of all increases the expected income, the more inclined the fishermen are to follow the regulations. The analysis also shows that the fishermen are more inclined to agree on this proposition the larger the vessel, and the older the fisherman himself is. However, fishermen are more inclined to disagree the farther south they are located.

Data on the proposition that there is positive relationship between the perception of the system as fair and the motivation to comply is presented in Table 3. Within this proposition, the hypothesis that the older the fisherman is, the shorter the vessel is, and the farther north the fisherman is located is supported by statistical analysis.

Data on the proposition that there is positive relationship between degree of fishermen's participation in the formulation of rules and the motivation to comply with the regulations is presented in Table 4. The statistical analysis provides no significant results with respect to age, size of the vessel, or regional location. There is a general support for the hypothesis that compliance increases with degree of participation.

Data on the proposition that there is positive relationship between degree of understanding of the regulations and willingness to comply with the system is presented in Table 5. The statistical analysis shows no significant results with respect categories such as age, size of vessel, and regional location. However, the respondents in general agree that to understand the system increase the degree of compliance.

Data on the proposition that there is positive relationship between what the individual fisherman and the other fishermen do with respect to compliance is presented in Table 6. The statistical analysis documents no significant effect with respect the categories age, size of vessel, and regional location. On the other hand, there is an overall support among the fishermen that group behaviour explains a lot of individual behaviour among the fishermen.

Data on the proposition that the more alternative fisheries that exists that contribute to the reduction of the income risk, the higher is the compliance, is presented in Table 7. The statistical analysis shows partly that there is a general support for the hypothesis, independent of categories, and partly that there is significant inclination to disagree with the hypothesis the farther south the fishermen are located.

Data on the proposition that there is difficult to respect the quotas when the availability of fish is high, is presented in Table 8. There is a weak overall tendency to support the proposition. The analysis shows that it is only the size of the vessel that has a significant effect, i.e. the smaller the vessel is, the more inclined the owner is to support the proposition.

Data on the proposition that it is wrong to discard fish just because the quota is filled is presented in Table 9. There is a general support of the proposition. The analysis shows that there is a significant effect from the location variable, i.e. the farther south the fisherman is located the more he supports the proposition.

Data on how the fishermen evaluate the authorities' effort to control the conventional cod fishery is presented in Table 10. There is an overall tendency among the fishermen to evaluate positively the effort to control the coastal cod fishery. If we apply the results of coefficients estimates, even though they are not significant, we can conclude that; the smaller

vessel the fisherman owns, the younger the fisherman is and finally, the farther south he is located, the more he agrees with the proposition.

We also analyzed statistically the coastal cod fishermen's preferences for different control regimes. The descriptive statistics presented in Table 11 documents an overall preference for a control regime that compares the raw fish purchaser's receipt with stockholding and sale of fish. The multinomial logistic regression confirms statistically that the preferred system is not randomly selected. The probability of support for the system increases significantly the older the fisherman is and the farther south he is located.

In a political perspective, it is an objective to apply means that contribute to compliance and thus reduction of the socio-economic costs of non-compliance. The analysis shows that the motivation and degree of compliance *increases* (1) if the structure of the fisheries, for example the number of participants in the fisheries and aggregated fishing capacity, contribute to positive profit, (2) if the system is based on "fairness" for each sub-group of fishermen, (3) by increased participation by the fishermen in the design of the control and regulation system, i.e. degree of compliance can increase with democratization, (4) the more the fishermen understand the regulations, i.e. it is important to reduce the complexity of the system and find robust and simple rules, (5) the less fellow fishermen cheat, the less will other fishermen follow this practise, (6) the more flexible the system is with regard to the fishermen's opportunity to fish alternative species as this will reduce the risk of decreasing income, and (7) the more flexible the regulations are with regard to providing the coastal fishermen with the opportunity to catch more fish the more available the fish is close to the coast.

# 7 REFERENCES

Aarset,B. (2006). Oppfatninger om holdninger til reguleringer blant kystfiskere med rettigheter i torskefiske. SNF rapport nr. 20/06. Samfunns- og næringslivsforskning as. Bergen.

Becker,G.S. (1968). Crime and punishment: An economic approach. Journal of Political Economy 76, 169-217.

Furlong,W.J. (1991). The deterrent effect of regulatory enforcement in the fishery. Land Economics 67[1], 116-29.

Gezelius,S.S. (2001). Legitimacy, compliance, survival. Natural resource harvesters and the state. Department of Sociology and Human Geography, University of Oslo.

Gezelius,S.S. (2002). Do norms count? State regulation and compliance in a Norwegian fishing community. Acta Sociologica 45, 305-14.

Hardin,G. (1968). The Tragedy of the Commons. Science 162, 46-65.

Hønneland,G. (1998). Compliance in the Fishery Protection Zone around Svalbard. Ocean Development and International Law 29[4], 339-60.

Hønneland,G. (1999a). A model of compliance in fisheries: theoretical foundations and practical application. Ocean & Coastal Management 42[8], 699-716.

Hønneland,G. (1999b). Co-management and communities in the Barents Sea fisheries. Human Organization 58[4], 397-404.

Jentoft,S. (2000). Legitimacy and disappointment in fisheries management. Marine Policy 24[2], 141-8.

Jentoft,S. and K.H.Mikalsen. (2004). A vicious circle? The dynamics of rule-making in Norwegian fisheries. Marine Policy 28[2], 127-35.

Kuperan,K. and J.G.Sutinen. (1998). Blue water crime: Deterrence, legitimacy, and compliance in fisheries. Law & Society Review 32[2], 309-37.

Nielsen,J.R. (1998). Compliance and legitimacy in Danish Fisheries Management - an analytical framework. Tromsø, IIFET.

Rapp,O.M. (2000). Ett av 200 anløp kontrolleres. Aftenposten . Oslo.

Sutinen,J.G. and J.R.Gauvin. (1988). An Econometric Study of Regulatory Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts. 1-39. Kingston, RI, Department of Resource Economics, University of Rhode Island. Workshop on Rights-based Fisheries, Reykjavik, Iceland. 1988.

Sutinen,J.G., A.Rieser, and J.R.Gauvin. (1990). Measuring and Explaining Noncompliance in Federally Managed Fisheries. Ocean Development and International Law 21[3], 335-72.

Wallis,P. and O.Flåten. (2000). Fisheries management costs: Concepts and studies.

*Appendix 1: Spearman's correlation between vessel length, age of fisherman and regional location of boat and fisherman.*

| | | | LENGTH OF VESSEL | AGE OF THE FISHERMAN | REGIONAL LOCATION |
|---|---|---|---|---|---|
| Spearman's rho | **LENGTH OF THE VESSEL** | Correlation Coefficient | 1,000 | -,182(**) | ,162(**) |
| | | Sig. (2-tailed) | . | ,002 | ,005 |
| | | N | 300 | 300 | 300 |
| | **AGE OF THE FISHERMAN** | Correlation Coefficient | -,182(**) | 1,000 | ,017 |
| | | Sig. (2-tailed) | ,002 | . | ,766 |
| | | N | 300 | 300 | 300 |
| | **REGIONAL LOCATION** | Correlation Coefficient | ,162(**) | ,017 | 1,000 |
| | | Sig. (2-tailed) | ,005 | ,766 | . |
| | | N | 300 | 300 | 300 |

** Correlation is significant at the 0.01 level (2-tailed).

The Spearman's correlation index (a non-parametric version of Pearson's correlation coefficient) shows that there is a statistical relationship (negative) between size of the vessel and age of the fisherman, and there is also an indication of statistical significant dependency between vessel size and geographical location. The correlation index indicates that the older the fisherman is, the shorter boat he is applying. Further shows the index that the farther south the fisherman is located, the longer is the fishing vessel.