

Factors affecting compliance with fishery regulations: a UK case-study 1

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Abstract

Conventional economic models of regulatory compliance focus on an instrumental determination of individual behaviour in which the decision to comply or violate depends upon the perceived monetary costs and benefits. This suggests that compliance can only be achieved by ensuring that the expected costs are greater than the expected benefits, in other words by employing a deterrent effect. The policy implication is that desired levels of compliance must be achieved through enforcement, which is costly. More complete models of compliance behaviour take into account non-monetary factors such as social influences, moral norms and the perceived "legitimacy" of regulations and the regulatory authority. The paper describes a current investigation into the influence of non-monetary factors in determining compliance with quota restrictions among UK fishermen and discusses some preliminary results from the study.

Introduction

If fishery management regulations are to achieve their intended objectives, compliance is crucial. To the extent that quota limits are violated, for example, agreed TACs and desired levels of fishing mortality will be exceeded. Economic approaches to fisheries management, designed to correct market failure in the exploitation of fishery resources, also require compliance in order to be effective: quantitative rights-based systems such as ITQs, for example, depend for their success upon respect for individual quota holdings (eg. Squires *et al* 1995). Where incentives exist to violate regulations, considerable resources may have to be devoted to enforcement. Within the European Community, for example, the total annual cost of monitoring and enforcement is estimated to be around ECU 300 million (Commission of the European Communities 1997). It is often difficult, however, to measure the extent of violation and hence the productive value of enforcement expenditure (Sutinen and Hennessey 1986).

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In comparison with the extensive literature on the design and implementation of fisheries management instruments and policies, relatively little attention has been paid to the question of compliance and enforcement. Most economic studies of the enforcement problem in fisheries have moreover been theoretical rather than empirical, focusing on the impact of costly and imperfect enforcement on optimal levels of exploitation in a regulated fishery (eg. Sutinen and Andersen 1985, Milliman 1986) and on the selection of efficient regulatory instruments (eg. Anderson and Lee 1986, Anderson 1989, Mazany *et al* 1994)¹.

In these analyses, and in some empirical studies as well (see below), individual agents are implicitly assumed to make the rational decision to comply or violate according to a narrow utility function in which the anticipated benefits of illegal activity are directly compared to the anticipated costs (as a function of the subjective probability of detection and prosecution and the likely fine). In other words, a simple *deterrence* model of violation behaviour is employed, of the type originally formulated by Becker (1968)². Although such models do not require that all agents have an equal propensity to violate under a given set of conditions, the fact that non-monetary influences over behaviour are effectively ignored means that aggregate changes in levels of compliance (or in the 'supply of violations') can be related only to changes in the costs and benefits of illegal behaviour. The implications for policy can therefore be formulated only in terms of marginal changes in the probability of detection and prosecution (ie. the level of enforcement effort) and/or changes in the severity of sanctions in order to increase deterrence.

Empirical studies on individuals' compliance with fishery regulations have been reported by Sutinen and Gauvin (1989), Furlong (1991) and Kuperan and Sutinen (1995). Both Sutinen and Gauvin (1989) and Furlong (1991) explicitly recognise factors other than those directly related to the costs and benefits of violation in the determination of compliance behaviour, but their influence is not fully explored. Furlong (1991) includes in his theoretical compliance model a vector of variables to capture "personal and household" characteristics. In his estimation of the model using data from a survey of Quebec fishermen he includes variables for age, the proportion of the family currently unemployed and the proportion of family income derived from fishing: these are designed to serve as proxies for individual differences in "tastes" such as attitudes and proclivities towards violation. Sutinen and Gauvin (1989), in their study of compliance in the inshore lobster fishery of Massachusetts, similarly hypothesise that the incentive to violate is influenced by personal characteristics such as age, years in the fishery and income dependence.

Sutinen and Kuperan (1995) note that conventional deterrence models do not adequately explain relatively high observed levels of compliance (eg. Sutinen *et al* 1990) nor do they convey realistic policy prescriptions with their focus on the quantity of (costly) enforcement. Implicitly building upon the broader set of 'bases' of compliance proposed by Young (1979) (see Sutinen *et al* 1990), these authors develop an extended model to include social influence and moral obligation alongside the standard monetary incentive and deterrence factors. A moral obligation to comply is considered to depend on the individual's level of 'moral development' and the legitimacy accorded to the regulation and to the

¹ See Mazany (1993) for a review.

² See, for example, Pyle (1983) for a review.

regulatory agency. Kuperan and Sutinen (1995) use this model to examine compliance with fisheries zoning regulations in Malaysia. From an analysis of survey data they concluded that non-monetary factors are important in determining levels of compliance, which cannot therefore be explained entirely in terms of a rational cost-benefit calculus.

The present study was designed to examine the importance of non-monetary factors in determining compliance with quantitative landings restrictions (quota limits) among fishermen in the United Kingdom. We were specifically interested in whether the sort of findings reported by Kuperan and Sutinen (1995) might be observed in the complex political and regulatory environment of a European fishery, and in particular in the extent to which perceptions of the legitimacy of the regulations and the regulatory authorities might have a measurable impact on levels of compliance.

We will leave to one side the question of the 'correct' economic interpretation of non-monetary factors, although their incorporation into a neoclassical utility function is not straightforward. Etzioni (1988), for example, argues that while moral norms and self-interest may act together to determine an individual's actions, they should be considered in terms of two entirely separate and irreducible utilities (in the extreme, morality may be thought of as tightly constraining the choices which an individual may make). Sutinen and Kuperan (1995) provide a short discussion of the definition of morality and social influence in the compliance context from the perspective of other disciplines, including psychology and sociology. Sociological theories of compliance, for example, include both instrumental models (equivalent to neoclassical deterrence models in economics but more readily incorporating informal sanctions such as peer group pressures) and normative models which focus on personal morality and on legitimacy - the belief that the law ought to be obeyed (Tyler 1990).

Modern views of legitimacy begin with Weber (1947) (see Sternberger 1968) and suggest that acceptance of the legitimacy of an authority will encourage compliance with its laws even where those laws conflict with individuals' own self-interest. In other words, legitimacy represents a perceived obligation to obey that is necessarily linked to political authority and is distinct from the influence of moral norms (indeed personal morality and legitimacy may conflict). The separation between legitimacy, morality and self-interest, however, is not an easy one, nor is legitimacy a singular or absolute concept. To the extent that legitimacy is enduring it may approach the normative status of morality, for example, whereas legitimacy judged contemporaneously in terms of outcome (see below) may in some cases be said simply to reflect self-interest (Tyler 1990).

Our approach to investigating the role of legitimacy is based on that employed by Tyler (1990) in his 'Chicago study' of US citizens' compliance with the law. Legitimacy is assessed with primary reference to a particular regulation and the regulatory system rather than to an authority in general terms, so that the obligation to comply is measured more or less directly. Where appropriate, attention is focused separately on *process* and *outcome* and on *fairness* and *efficiency* (or effectiveness): in other words, is the regulation effectively and fairly enforced, and is the regulation itself effective and fair in the results it produces? Like Kuperan and Sutinen (1995) we attempt to construct an econometric model to explain the observed pattern of compliance in terms of a number of non-monetary variables.

Data collection

The study population was the fishing industry of the *X* region of England,¹ including all vessels of over 10m in length and subject to quota restrictions. Vessels of 10m or under in length were excluded, since these are not normally subject to quota restrictions under the UKs quota management system. Vessels of over 10m which do not target quota species were also excluded. Three sub-populations were identified: vessels belonging to producers' organisation *A*, those belonging to producers' organisation *B* and vessels based in the region which do not belong to a producers' organisation (so-called 'non-sector' vessels). Sampling was done on a stratified random basis within each sub-population. PO vessels were stratified by vessel size (10-20m and over 20m) and by fishing method while the smaller number of non-sector vessels was stratified by size only. The final sample size and composition is summarised in table 1 below.

Table 1 Sample details

Population	Population size	Sample size
PO <i>A</i> vessels	115	34 (30%)
PO <i>B</i> vessels	75	23 (31%)
Non-sector vessels	45	12 (27%)
All vessels	235	69 (29%)

All data were collected by means of face-to-face interviews with the skippers of the selected vessels during the winter of 1997/98. Structured questionnaires were used in order to record respondents' perceptions about the effectiveness and fairness of quota restrictions, the effectiveness and fairness of enforcement, the authority of management institutions, the involvement of fishermen in the management system, the compliance behaviour of others, personal experience of enforcement and conviction, as well as own compliance behaviour. Additional questions were designed directly to elicit perceptions of moral obligation to comply with quota restrictions. The age of the skipper, his length of involvement in the industry, his owner/employee status, the size of the vessel and its gross annual turnover were also recorded.

It should be noted that the regulatory environments under which the non-sector and PO vessels operate are somewhat different. Non-sector vessels must comply with the monthly quota restrictions (set directly by the Government) which are specified in their licences. PO members, on the other hand, are subject only to the restrictions imposed by their own PO². Non-sector vessels commit an offence if they land more than the quantity

¹ Because of the sensitive nature of the data the study region is not identified.

² Hatcher (1997) describes the management of quotas by producers' organisations in the UK.

specified in their licence within a calendar month. No such offence applies to PO members since if they exceed their restrictions they are merely infringing the (private) rules of their PO. In practice, however, all violations are hidden from both the Government Sea Fisheries Inspectorate and the POs' officers by falsifying landings declarations which are monitored by the POs as well as by Government. Whereas the logbooks required to be kept at sea allow a 20% margin of error in recording quantities of fish retained on board, landings declarations must be accurate. Despite the legalistic differences, therefore, in practice the act of violation is the same for all vessels: violation means exceeding quota restrictions and falsifying logbook records and/or landings declarations (certainly the latter) ¹.

Results

Of the 69 respondents interviewed, only one refused to answer questions about his own compliance record. Of the remaining 68 respondents, 18 (26%) stated that they did not exceed quota restrictions in the previous year, 30 (43.5%) stated that their landings were over-quota by 10% or less, while 20 (29%) admitted that their landings had been over-quota by a margin of 25% or more (see table 2).

Table 2 Over-quota % of landings

Response	%	Frequency
0%	26.1	18
10% or less	43.5	30
25%	13.0	9
50%	8.7	6
75%	5.8	4
100%	1.4	1
Refused	1.4	1
Total	100.0	69

Similarly, 18 respondents (26%) stated that none of their gross earnings in the previous year were attributable to over-quota fish, 24 (35%) stated that 1-2% of their earnings came from over-quota landings while 26 (38%) said that 5% or more of their earnings were due to over-quota landings (see table 3).

¹ The statutory maximum penalty in UK law for submitting a false landings declaration is £50,000.

Table 3 % gross earnings from over-quota fish

Response	%	Frequency
0%	26.1	18
1-2%	34.8	24
5%	10.1	7
10%	10.1	7
20%	10.1	7
30% or more	7.2	5
Refused	1.4	1
Total	100.0	69

Considering those respondents who reported no over-quota landings as *compliers* and those who reported significant (ie. greater than zero) over-quota landings as *violators*, the following cross-tabulations of responses to a selection of the questions provide an overview of the results from the survey.

Probability of detection

Table 4 If you were to retain on board and land over-quota fish, what would you consider to be your overall chances of getting caught?

Q36	Compliers		Violators	
	Freq.	%	Freq.	%
Very high (50% or more)	3	16.7	4	8.0
High (25%)	5	27.8	10	20.0
Quite possible (10%)	4	22.2	8	16.0
Moderately low (5%)	1	5.6	17	34.0
Very low (1% or less)	5	27.8	11	22.0

Legitimacy of the regulation: effectiveness

Table 5 Quota restrictions are effective in conserving fish stocks

Q1	Compliers		Violators	
	Freq.	%	Freq.	%
Agree strongly	0	0.0	1	2.0
Agree	5	27.8	5	10.0
Disagree	7	38.9	21	42.0
Disagree strongly	6	33.3	23	46.0

Table 6 *Quota restrictions would be effective if fishermen complied with them*

Q2 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Agree strongly	0	0.0	3	6.0
Agree	11	61.1	15	30.0
Disagree	5	27.8	21	42.0
Disagree strongly	2	11.1	11	22.0

Legitimacy of the regulation: fairness

Table 7 *Would you say that the quota restrictions that apply to your vessel are generally*

Q6 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Very fair?	1	5.6	2	4.0
More fair than unfair?	5	27.8	12	24.0
Slightly unfair?	7	38.9	15	30.0
Very unfair?	5	27.8	21	42.0

Legitimacy of the regulation: respect by others

Table 8 *Do you think that most, many, a sizeable minority or just a few fishermen in the region regularly land over-quota fish?*

Q26 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Most	3	16.7	19	38.0
Many	5	27.8	12	24.0
A sizeable minority	6	33.3	13	26.0
Just a few	4	22.2	6	12.0

Legitimacy of the regulatory process: effectiveness

Table 9 *Overall, how well do you think that quota restrictions are enforced on UK vessels? Are they*

Q9 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Well enforced?	5	27.8	11	22.0
Adequately enforced?	7	38.9	21	42.0
Not adequately enforced?	2	11.1	12	24.0
Hardly enforced at all?	4	22.2	6	12.0

Legitimacy of the regulatory process: fairness

Table 10 In general, how fair do you think fishery inspectors are in deciding whether or not to inspect a particular vessel? Would you say that the pattern of inspections is on the whole

Q15 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Fair?	14	77.8	42	84.0
Not very fair?	4	22.2	6	12.0
Very unfair?	0	0.0	2	4.0

Legitimacy of the regulatory authority

Table 11 The UK government has a duty to restrict catches because it is a member of the EU

Q19 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Agree strongly	1	5.5	0	0.0
Agree	8	44.4	25	50.0
Disagree	6	33.3	20	40.0
Disagree strongly	3	16.6	5	10.0

Involvement in the regulatory system

Table 12 How big a say do you think you have in the design and operation of the quota management system? Are you

Q24 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Very involved?	1	5.6	3	6.0
Quite involved?	3	16.7	3	6.0
Involved a little?	4	22.2	7	14.0
Not involved?	8	44.4	31	62.0
Actively ignored?	2	11.1	6	12.0

Compliance behaviour of peers

Table 13 Considering the skippers of other vessels in your PO or other local non-sector vessels, would you say that

Q44 Response	Compliers		Violators	
	Freq.	%	Freq.	%
All comply with quota restrictions most of the time?	5	27.8	2	4.0
Most comply with quota restrictions most of the time?	11	61.1	17	34.0
A large minority regularly land over-quota fish?	2	11.1	9	18.0
Many regularly land over-quota fish?	0	0.0	8	16.0
Most regularly land over-quota fish?	0	0.0	14	28.0

Peer attitudes to violation

Table 14 Among other skippers in the PO or other non-sector skippers, is landing over-quota fish generally regarded as being

Q45 Response	Compliers		Violators	
	Freq.	%	Freq.	%
Very wrong?	1	5.6	2	4.0
Basically wrong, but understandable every so often?	2	11.1	4	8.0
Basically wrong, but an economic necessity?	10	55.5	36	72.0
Neither wrong nor right?	1	5.6	2	4.0
Fine if you can get away with it?	4	22.2	6	12.0

Moral obligation to comply

Table 15

Q47, Q49, Q50, Q51	% Compliers		% Violators	
	Agree	Disagree	Agree	Disagree
Quota restrictions should be complied with because they are the law	55.6	44.4	36.0	64.0
Quota restrictions should be complied with because otherwise you are taking more than your fair share	38.9	61.1	18.0	82.0
Quota restriction should be complied with even if you think they are not effective in conserving fish stocks	38.9	61.1	26.0	74.0
Quota restrictions should be complied with even if you think they are unfair	55.6	44.4	24.0	76.0

- In summary, a descriptive analysis of the raw data suggests the following:
1. *Probability of detection*: Compliers perceive the probability of being caught to be somewhat higher than do violators.
 2. *Legitimacy of the regulation: effectiveness*: A higher proportion of compliers regard quota restrictions as effective in conserving fish stocks, particularly in principle (ie. if all fishermen complied with them).
 3. *Legitimacy of the regulation: fairness*: There is little difference in the perceived fairness of quota allocations under the UK's quota management system between compliers and violators. Most regard their allocations as more or less unfair.
 4. *Legitimacy of the regulation: respect by others*: Compliers perceive quota restrictions to be respected by a slightly greater proportion of the region's fleet.
 5. *Legitimacy of the regulatory process: effectiveness*: There is little difference in the perceived effectiveness of the enforcement of quota restrictions. In general the regulations are considered to be adequately or well enforced.
 6. *Legitimacy of the regulatory process: fairness*: Most respondents regard the pattern of inspections as fair.
 7. *Legitimacy of the regulatory authority*: Under the existing political framework, the duty of the UK Government to restrict catches is acknowledged by around half of all respondents.
 8. *Involvement in the regulatory system*: A slightly higher proportion of compliers regard themselves as being involved in the regulatory system.

9. *Compliance behaviour of peers:* Compliers have a higher estimation of the level of compliance among their peers.
10. *Peer attitudes to violation:* Most respondents think their peers regard landing over-quota fish as either basically wrong but necessary or not wrong. There are no clear differences evident between compliers and violators.
11. *Moral obligation to comply:* A higher proportion of compliers perceive an obligation to comply with quota restrictions despite a conflict with self interest and/or perceptions of effectiveness and fairness.

The Econometric Model

The likely simultaneity between the perceived probability of detection and the decision to violate (and therefore the self-reported violation rate) has been recognised in the literature (Sutinen and Gauvin 1989, Kuperan and Sutinen 1995). Furlong (1991) did not estimate simultaneous equations due to non-availability of appropriate data. Conclusions based on such studies should be read with care due to possible simultaneity bias.

The dual latent variable binary (probit) model we estimate in this study is that developed by Maddala (Maddala 1983, Greene 1995, 1997). The two simultaneous equations in the system are

$$\begin{aligned} y_1^* &= \beta_1 y_2^* + \beta_1' x_1 + \epsilon_1 \\ y_2^* &= \beta_2 y_1^* + \beta_2' x_2 + \epsilon_2 \end{aligned}$$

We therefore assume a bivariate normal distribution with zero means. The reduced forms, in which X (see Table 16) is the union of x_1 (a vector of explanatory variables) and x_2 (a vector of explanatory variables) are

$$\begin{aligned} y_1^* &= \beta_1' X + v_1 \\ y_2^* &= \beta_2' X + v_2 \end{aligned}$$

The starred y variables are latent variables. Their counterparts are y_1 and y_2 . Both y_1 and y_2 satisfy the assumptions of the probit model and take values of 0 or 1. In our model, y_1 is specified as a dummy variable: it has a value of zero if the perceived probability of detection is zero and 1 if the probability is higher than 0. The second dependent variable y_2 also has a value of zero if a fisherman is a complier and 1 if he is a violator. A two step procedure¹ is used to estimate the two reduced form equations by the maximum likelihood estimation (MLE) method. This gives rise to efficient estimates.

¹ William Greene pers. comm. We are also grateful to Prof. Richard Harris for his advice.

Estimation Results

Table 16 defines the variables used in the deterrence and violation equations^{1 2}. In this paper we will present only the results of the violation/compliance equation (y_2). Table 17 gives the results of the equation estimated using two-step MLE. Most of the coefficients have the expected signs. The perceived probability of detection coefficient has the correct negative sign and is significant, which confirms the hypothesis that deterrence has a negative influence on the probability of violation. This was also found by Kuperan and Sutinen (1995) using similar methodology, although our findings cannot directly be compared with other studies which have utilized different types of dependent variable (eg. illegal landings, net gain etc) (Sutinen and Gauvin 1989, Furlong 1991).

It was found that as the level of gross earnings increased, the probability of compliance increased. The probability of compliance was higher if fishermen considered that quota restrictions should be complied with even if they were thought to be unfair. If the fishermen considered that his peer group in the same area regularly landed over-quota fish then the probability of violation increased. Possibly the most interesting finding is that the probability of compliance increased if fishermen considered that they had a significant involvement in the design and operation of the quota management system. Other variables were not significant in this preliminary analysis.

Cross-sectional analysis of such behavioural (subjective) variables may yield misleading conclusions if there are unobserved individual fixed effects which are correlated with other personal characteristics, unidentified other factors or the reported violation rate itself. This problem could for example be addressed using panel data. Here this problem has been partially taken care of by using the latent variables simultaneous equations system proposed by Maddala (1983). Two other problems have been reported in the literature. One is a measurement error problem and the other is the question of causality in the relationships exhibited. We believe that the technique we use here takes care of these problems and that the results are unbiased, efficient and consistent.

¹ Means and standard deviations are not reported here but are available from the authors.

² Note that no variable was included to measure directly the incentive to violate due to the difficulty of obtaining reliable estimates.

Table 16 Definition/description of variables

Dependent variables	
D	Perceived probability of detection (positive = 1; zero = 0)
V	Violators = 1; compliers = 0
Explanatory variables	
R	Gross earnings coded 1 to 12, from less than £50,000 (= 1) to £800,000 or more (= 12)
A	Age of skipper
Y	Years in fishing
E ₁	Coded 1 if landings have been checked by an inspector never or just once in 12 months)
E ₂	Coded 1 if no experience of conviction in 10 years
M ₄	Coded 1 if disagree that quotas should be complied with even you think they are unfair
S ₁	Coded 1 if a significant number of peers are considered to land over quota fish
S ₂	Coded 1 if peers not thought to consider over-quota landings as very wrong
L ₁	Coded 1 if disagree with the effectiveness of quotas in practice
L ₄	Coded 1 if most or many fishermen in region are thought to land over-quota fish
L ₅	Coded 1 if quotas are considered not adequately enforced
L ₇	Coded 1 if disagree that Government has a duty to restrict catches as an EU member
L ₈	Coded 1 if considered not involved or actively ignored in the regulatory system

Table 17 Simultaneous Probit Model

Variable	Coefficient	t-values
D	-0.383*	-1.710
R	0.388*	1.740
Y	0.012	0.411
M ₄	1.329**	2.220
S ₁	2.587***	2.798
S ₂	-1.297	-1.563
L ₁	0.750	0.995
L ₄	-0.256	-0.441
L ₅	-0.156	-0.274
L ₇	0.221	0.438
L ₈	1.594***	2.412
Constant	-2.727***	-1.764

Log-likelihood = -19.84; zero-slopes $\chi^2(11) = 38.91$; % correct predictions = 82%
 *** significant at 1% level; ** significant at 5% level; * significant at 10% level

Discussion

In the predominantly social sciences literature on local management, participatory management or 'co-management' approaches to fisheries governance, it is often suggested (implicitly if not explicitly) that greater involvement of fishermen in the management process will lead to increased levels of compliance with regulations because those regulations will be accorded greater legitimacy (eg. Jentoft 1989, Pinkerton 1989, Nielsen 1994, Jentoft and McCay 1995, Ostrom 1995, Dubbink and van Vliet 1996, Nielsen and Vedsmand 1997, Symes 1997). While theory, intuition and even circumstantial evidence might argue the case, there appears to be little in the way of direct empirical evidence to support or refute such a notion.

Preliminary findings from the present study certainly support the view that non-monetary factors influence the compliance behaviour of fishermen in the UK. The fact that most of the 'legitimacy' variables were not significant in our initial violation model may of course reflect generally poor perceptions among all respondents about many aspects of the existing management regime. We have, however, found a significant effect from variables for aspects of moral obligation, perceived behaviour of others and involvement in the system.

Refinements of the data analysis described are being undertaken and some additional data not presented here have yet to be analysed. There is some evidence, for example, that perceptions of the legitimacy of fishermen's own producers' organisations are quite different to those of the EU or the UK Government. There is also evidence that perceptions would be significantly different if there were, for example, greater autonomy over fishing within national limits (although not all fishermen appear to interpret such a scenario in a similar fashion).

Further analysis of the data from this study may clarify some of the findings. At this stage, however, it seems clear that there is potential for more work in this area.

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