Blue Water Crime: Deterrence, Legitimacy, and Compliance in Fisheries

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This study adds to the limited body of empirical evidence on the effect that legitimacy and deterrence have on compliance behavior. The theoretical models of compliance behavior tested include the basic deterrence model, which focuses on the certainty and severity of sanctions as key determinants of compliance, and models which integrate economic theory with theories from social psychology to account for legitimacy, deterrence, and other motivations expected to influence individuals' decisions whether to comply. Probit and Tobit econometric estimators are used to examine the compliance behavior of 318 Peninsular Malaysian fishermen who face a regulation banning them from fishing in a zone along the coast. The results of the empirical analysis provide additional evidence on the relationship of deterrence and legitimacy to compliance. The findings are also used to draw implications for compliance policy for regulated fisheries.

According to normative compliance theory, people tend to obey laws made and implemented by authorities perceived to be legitimate. A key determinant of perceived legitimacy, according to the procedural justice literature, is the fairness built into the procedures used to develop and implement laws and regulations.[1] Paternoster et al. (1997) note that while there are numerous theoretical perspectives suggesting that legitimacy is an important determinant of compliance, the empirical evidence making that connection is meager.[2] Our study adds to this limited body of empirical evidence.

We thank James J. Opaluch, Richard B. Pollnac, the late Thomas F. Weaver, and three anonymous reviewers for helpful comments. We also benefited from comments by seminar participants at the University of Namur (Belgium), Queensland University, and the 7th Conference of the International Institute of Fisheries Economics and Trade, 18–21 July, 1994, Taipei, Taiwan. This is publication 3596 of the Rhode Island Agricultural Experiment Station. Address correspondence to Jon G. Sutinen, Department of Environmental and Natural Resource Economics, University of Rhode Island, Kingston, RI 02881, USA (email: JSutinen@uriacc.uri.edu).

[1] See Paternoster et al. (1997) for a review and discussion of this literature.

[2] They cite four studies, in addition to their own, which offer empirical evidence that perceptions of legitimacy are related to compliance: McEwen & Maiman (1984); MacCoun et al. (1988); Lind et al. (1993); and Tyler (1990a). Paternoster et al. provide

The subjects of our study are fishermen. Fishermen are excellent subjects for the study of compliance. They are subject to numerous regulations that constrain their opportunities to earn income, and temptations and opportunities for offending repeatedly occur.[3] Passion, inadvertence, and accident rarely cause a fishery violation; most are the result of deliberate choice. The behavior of fishermen offers good evidence on which to test the role deterrence, legitimacy, and other factors play in explaining compliance.

Studying the compliance behavior of such regulated economic agents as fishermen is important for other reasons. Achieving compliance in regulated industries is both costly and difficult. Expenditures on enforcement commonly constitute the largest cost element in governmental regulatory programs. The viability of environmental protection and resource management programs is often threatened by low rates of compliance and high enforcement costs. This raises questions whether there are ways to improve the cost effectiveness of traditional enforcement and whether there are ways to secure compliance without heavy reliance on costly enforcement. Central to improving the cost effectiveness of enforcement and compliance programs is understanding the compliance behavior of the economic agents subject to regulations.

To this end, we present tests of alternative models of compliance behavior. The models tested include the basic deterrence model, which focuses on the certainty and severity of sanctions as key determinants of compliance, and models which integrate economic theory with theories from social psychology to account for both intrinsic and extrinsic motivations influencing individuals' decisions whether to comply.[4] The tests are conducted on data from interviews with fishermen in Peninsular Malaysia (self-reports of violations).

Becker (1968) was the first to develop a formal theoretical framework for explaining criminal activity. Following Smith (1966 [1759], 1985 [1776]) and Bentham (1967 [1789]), Becker assumes that criminals behave basically like other individuals in that they attempt to maximize utility subject to a budget constraint. In Becker's model, an individual commits a crime if the

evidence consistent with the hypothesis that procedural fairness improves the compliance with social norms.

[3] Fisheries are regulated to mitigate overexploitation and conflicts among user groups. The overfishing resulting from open access to fish resources is often addressed with regulations that restrict gear and vessel, set minimum fish size limits, time and area closures and quotas, and require licenses to fish (Anderson 1986; Clark 1990). User conflicts are often addressed with gear prohibitions or restrictions and zones to separate user groups. Fishermen, like most regulated economic agents, typically are controlled through monitoring, surveillance, and enforcement.

[4] That is, deterrence and normal determinants are derived as part of a unified theory and tested together rather than separately.

expected utility from committing the crime exceeds the utility from engaging in legitimate activity.[5] The basic deterrence framework used in these studies assumes that the threat of sanctions is the only policy mechanism available to improve compliance with regulations.

The basic deterrence model, however, has at least two important shortcomings for regulated industries such as fisheries: first, the model does not explain the available evidence very well and, second, the policy prescriptions of the model are impractical. The basic deterrence model assumes that when deciding whether to comply, self-interested individuals weigh only the potential illegal gain against the severity and certainty of sanctions. Therefore, if the illegal gains are greater than the gains from legal fishing, the expected penalty should be large enough to offset the difference between legal and illegal gains. Since enforcement is costly, the probability of detection and conviction should be kept low and penalties high (i.e., large enough for the product of their monetary value with the low probability to be larger than the difference between legal and illegal gains).

The probability usually is low in regulated fisheries. The typical odds of being caught violating a fishery regulation are below 1% and often at or near zero (Sutinen & Gauvin 1989; Bean 1990; Furlong 1991). Penalties, on the other hand, generally are not large relative to illegal gains. For example, in the groundfish fishery of the northeastern United States, Sutinen, Rieser, & Gauvin (1990) estimate that flagrant violators grossed about $15,000 *per trip* from violating closed area and mesh size regulations, resulting in illegal earnings of $225,000 for flagrant violators during 1987. Typical monetary penalties for those caught and sanctioned for these violations ranged from $3,000 to $15,000.

A similar pattern of potential illegal gains relative to the certainty and severity of sanctions tends to appear in most fisheries. Raising penalties to the point at which the expected penalty offsets illegal gain generally is not feasible. The courts are not willing to apply sanctions perceived as excessively severe. Rather, courts tend to impose sanctions that fit the crime, as measured by the illegal gains realized or the social harm caused by the *detected and proven* violation. The basic deterrence model predicts that the generally modest sanctions will not be an adequate deterrent to illegal fishing. Despite this apparent weakness, however, a high proportion (50% to 90%) of fishermen normally

[5] Becker's framework became the launching pad for a series of studies on the economics of crime. See Heineke (1978) and Pyle (1983) for an overview of the theoretical models used in the economic literature of criminal behavior. More recently, Sutinen & Andersen (1985), followed by Anderson & Lee (1986) and Milliman (1986), combined Becker's deterrence model with a bioeconomic model to investigate various aspects of fisheries law enforcement. All address the issue of optimal quantities of enforcement services and management policies.

comply with regulations (Sutinen et al. 1990; Sutinen & Gauvin 1989; Bean 1990).

Asked why they persist in complying when illegal gains are so much larger than the expected penalties, many fishermen refer to the need to "do the right thing." That is, they express an obligation to obey a set of rules (either their own or an authority's). The sense of moral obligation is common throughout society and may be a significant motivation that explains much of the evidence on compliance behavior.

The compliance literature contains two basic perspectives on compliance: instrumental and normative. Like Becker's view, the instrumental perspective assumes individuals are driven purely by self-interest and respond to changes in the tangible, immediate incentives and penalties associated with an act. The key variables determining compliance are the severity and certainty of sanctions. The normative perspective emphasizes what individuals consider just and moral, instead of what is in their self-interest. Individuals tend to comply with the law to the extent that they perceive the law as appropriate and consistent with their internalized norms. The key variables determining compliance in the normative perspective are individuals' perceptions of the fairness and appropriateness of the law and its institutions.

Tyler (1990a, 1990b) argues that compliance with a law or regulation is influenced by the extent to which individuals accord legitimacy to the enforcement agencies. Legitimacy is a normative assessment by individuals of the appropriateness or right of enforcement agencies to restrict their behavior. Tyler's work demonstrates that compliance is higher when individuals accord a high level of legitimacy to the enforcement agencies. Tyler emphasizes outcome and process variables. The outcome variables are those related to the final result of a regulation and have two criteria, one unrelated to fairness and another related to distributive justice. The process variables also are related to two criteria: efficiency or effectiveness and procedural justice. For example, the conservation objective of a fishery management regulation may lead to an increase in fish stocks, an outcome unrelated to fairness, while who gets more fish as a result of a regulation is an outcome related to the distributive justice criterion. How quickly and how often violators are detected and arrested and prosecuted is a process variable related to efficiency or effectiveness; how each violator is treated and how consistently the law is enforced is a process variable related to procedural justice. Tyler (1990a) concludes that process variables are more important in maintaining legitimacy than outcome variables.

Research in psychology also hypothesizes that compliance with rules and regulations is related to both the internal capacities of the individual and external influences of the environment, where the socialization process is the linkage between the individual and society. There are two leading psychological theories to explain how socialization processes work with respect to compliance behavior: cognitive theory and social learning theory. Cognitive theory focuses primarily on the individual and stages of development (Kohlberg 1969, 1984; Levine & Tapp 1977; Tapp & Kohlberg 1977). According to cognitive theory, the key variables determining compliance are the individual's personal morality and level of moral development. Social learning theory, on the other hand, focuses primarily on the conditioning effects of the environment (Akers 1985; Akers et al. 1979; Aronfreed 1968, 1969; Bandura 1969; Mischel & Mischel 1976). According to social learning theory, the key variables determining compliance include peers' opinions and the extent of social influence an individual encounters.

In summary, the literature identifies the following factors as determining compliance: potential illegal gain, severity and certainty of sanctions, individuals' moral development and their standards of personal morality, individuals' perceptions of how just and moral are rules being enforced, and social environmental influences.[6] We adopt a view of individual behavior consistent with Smith (1966 [1759]), who explicitly portrays human economic motivation as being multidimensional, arguing that psychic well-being is based on acting morally and receiving the approval of others, as well as enhancing wealth.[7] The resulting model integrates economic theory with theories from social psychology to account for both tangible and intangible motivations influencing individuals' decisions whether to comply with a given set of regulations. The model accounts for morality, legitimacy, and social influence in addition to the conventional costs and revenues associated with illegal behavior.

The next section of the article explains the econometric framework and data used in the analysis. The results of the econometric estimates are presented in the third section; and the implications of the results for policy are discussed in the final section.

[6] Which of these variables are significant determinants of compliance with regulations is ultimately an empirical issue.

[7] For the intrinsic motivation influencing behavior, Smith imagines an "impartial spectator" within each of us, with which we "scrutinize the propriety of our own conduct." The contemporary economic literature concerning ethics and moral behavior is reviewed by Hausman & McPherson (1996).

Empirical Strategy and Data

Econometric Framework

Our objective is to test hypothesized relationships between illegal activity and a set of specific intrinsic and extrinsic conditions. The key dependent variables in this study are the violation decision variable (VIOLT) and the number of days a fisherman has fished in the prohibited zone (NFINS). VIOLT is a dichotomous variable; that is, a fisherman either violates or not. The violation decision is estimated using a Probit model (Maddala 1983).

NFINS is a censored dependent variable, taking values greater than or equal to zero. The data show that fishermen may be frequent violators, occasional violators, and nonviolators. Frequent violators are defined here as those who fish for more than a third of their total fishing days in the prohibited zone; occasional violators are those who fish less than a third of the total fishing days in the inshore areas. Some 25% of fishermen reported never fishing in the inshore zone. That is, some observations of the dependent variable take a zero value. Estimating the relationships for NFINS using ordinary least squares in this case would result in biased estimates of the coefficients (Fomby, Carter, & Johnson 1984). To overcome this problem, the NFINS relationships are estimated using a Tobit model (Maddala 1983).[8]

The general econometric model underlying the analysis is simply

$$y_i = \beta x_i + \varepsilon, \tag{1}$$

where y_i measures the ith individual's noncompliance with a regulation, and x_i is a vector of conditions reflecting the individual's perceived potential illegal gains and risk of detection and arrest, and measures of moral development, institutional legitimacy, and social influence. The variable y_i either measures whether the regulation is violated (VIOLT, the dichotomous variable) or the extent of the violation (NFINS, the number of times the regulation is violated per period).

Equation (1) is derived from a model in which a utility-maximizing individual decides whether and how often to violate a reg-

[8] The problem is one in which the dependent variable is a mix of zero values and values greater than zero. This kind of variable is called a censored dependent variable (Maddala 1983). One way to handle this problem is to remove the observations with zero values from the dependent variable and estimate the remaining observations using ordinary least squares regression. But this results in a loss of information. The preferred way is to use an estimator that allows for the use of all the information in the sample. The model needed is one that enables the explanation of two sources of variations in the dependent variable: one resulting from the changes in the explanatory variables for observations where the dependent variable is positive, and one resulting from changes in the probability of being above the zero limit. The Tobit regression model can explain these two sources of variation.

ulation (see Appendix A). The individual's utility is a function of the net income from fishing (legal and illegal), his personal moral standing, and his social standing. The individual's personal moral standing is assumed to depend on whether and how much he violates the regulation in conjunction with his moral development and the legitimacy he accords the regulatory institution. The individual's social standing depends on how much he violates the regulation in conjunction with the values and behavior of his peers.

Hypotheses

With intrinsic and extrinsic motivations in the model, the total and marginal conditions for utility-maximizing behavior are differentiated to generate a set of testable hypotheses.[9] The following hypotheses are derived from the total condition (i.e., an individual will violate if and only if expected utility of the violation exceeds the utility of not violating) and are stated in the context of a random utility framework.

The probability of an individual violating a regulation is less,

1. The higher the probability of detection and sanction (or the greater the enforcement inputs),
2. The greater the penalty if sanctioned,
3. The less profitable violating is compared to complying,
4. The higher the moral development of the individual,
5. The more legitimate the regulation as perceived by the individual, and
6. The more legitimate the regulation as perceived by the community at large.

A similar set of hypotheses, derived from the marginal condition, apply to the extent of violations by violating individuals.[10]

The Data

The data for this study were collected using a standardized questionnaire and personal interviews.[11] The questionnaire (available from the authors) was developed over a period of five months during which it was tested and retested on fishermen in the study areas. The questionnaire was reviewed by members of fishermen's associations and tested on at least five fishermen in each state. Changes were made to sequences in the questionnaire

[9] The formal derivation of the comparative statics on which these hypotheses are based is available from the authors.

[10] The only difference is the counterintuitive result from the marginal condition that an increase in the penalty increases the extent of the violation for risk-averse violators.

[11] The survey methodology is adapted from that used by Blewett, Furlong, & Toews (1987), Gauvin (1988), Sutinen, Rieser, & Gauvin (1989), and Bean (1990).

and the wording used to enable smooth implementation by the enumerators.

The questionnaire requests information on respondents' (1) household, fishing background, equipment, and landings; (2) views of regulatory procedures and outcomes (modeled on Tyler 1990a); (3) views regarding a hypothetical moral dilemma following the Kohlberg Standard Issue Moral Judgment Interview and Scoring System (Colby et al. 1987b); (4) personal compliance behavior, illegal gains, and experience with enforcement authorities; and (5) views of enforcement, including respondents' subjective estimates of the probabilities of detection, prosecution and conviction, and penalty if convicted.

In each of the four states where the survey was undertaken, 10 Universiti Putra Malaysia undergraduate students were trained as enumerators for the study. The survey was conducted over 7–10 days in each state. Respondents were selected randomly in landing complexes after they had landed their catch and completed the sorting and marketing arrangements with fish traders. All fishermen selected participated willingly, and the average interview took 45–60 minutes to complete. The sample sizes for each state are shown in Table 1. The size of the full sample is 318, consisting of 237 violators (about 75%) and 81 compliers (about 25%). In the sample were 202 (64%) Malay fishermen and 116 (36%) Chinese fishermen. Mean values of some of the variables for the four survey areas are shown in Table 2. More information on Peninsular Malaysian fisheries is presented in Appendix B.

Some of the values of key variables were missing in the data, usually because respondents refused to answer a question. The variables with missing data include NFINS, the number of days fishing inshore (i.e., the extent of the violation; 13.5% of the sample), EXPEVA, expenditures on evasion activities (7.2%), NCONTENF, the number of contacts with enforcement personnel during the year (5.3%), and the expected penalty if convicted (38%). The missing values of all but the last variable were replaced using an imputation method suggested by Sande (1979).[12]

[12] The method involves dividing the data into subclasses or cells, based on the data not missing and that are correlated with the variables with missing values (NFINS, etc.). The value given to the missing data point is the mean of the relevant cell. See Little (1992) for a discussion of a variety of methods for dealing with missing values.

Specifications and Results

The Violation Decision

The Basic Deterrence Model

The equation for estimating the violation decision in the basic deterrence model is

$$\text{VIOLT} = f^{V}\ (\text{CONSTANT, DCPUE, OPROB}), \tag{2}$$

where VIOLT = 1 for a fishermen who fishes at least once inshore during the year and 0 otherwise; CONSTANT is the intercept in the equation; DCPUE, the difference in the value of catch per unit effort between the inshore and offshore areas; and OPROB, the overall probability of detection, arrest, and conviction if caught violating. DCPUE is calculated by dividing the values of landings from offshore and inshore zones by the number of hours trawled offshore and the number of hours trawled inshore. DCPUE is simply the difference between these two values of catch per unit effort.

The overall probability of detection and conviction (OPROB) is a subjective probability obtained from fishermen directly through interviews. It is a product of a series of conditional

Table 1. Sample Size for Trawler Fishermen

Study area	Sample Size	Population	Sample as % of Population
East Johore	95	316	30.1%
Kelantan	73	110	66.4%
Perak	109	1,592	6.8%
Terengganu	41	310	13.2%
All areas	318	2,328	13.7%

Table 2. Mean Values of Key Variables for Trawler Fishermen

Variable	Unit	Kelantan	Terengganu	East Johor	Perak
AGE	Years	49.3	42.0	43.3	40.2
CPUEI	$	379.2	369.5	377.3	109.4
CPUEO	$	148.0	36.5	145.2	83.9
DCPUE	$	231.1	333.0	232.1	25.4
DFISH	Days	255.2	254.2	209.4	243.3
HP	HP	170.8	78.0	258.6	192.9
NCONTENF	No.	1.8	1.0	1.8	1.6
NENFOR	No.	37.8	143.5	31.3	59.3
NFINS	Days	19.0	102.3	8.1	21.0
NPBOATS	No.	2.5	3.2	2.4	2.5
PERTVIOL	%	41.8	76.0	40.1	22.5
PROBD	%	0.32	0.45	0.27	0.35
PROBG	%	0.76	0.96	0.94	0.98
TON	GRT	40.6	22.3	45.3	29.6
TYEARS	Years	10.1	12.0	14.7	14.6
YEARS	Years	29.6	19.9	23.3	18.8

NOTE: See Appendix Table 1 for definitions of the variables.

probabilities, namely, the probability of detection, the probability of arrest given detection, the probability of being brought to court given arrest, and the probability of being found guilty given that the fisherman is brought to court. The overall probability of detection variable (OPROB) is specified in three different ways for estimating equation (2): (*a*) as a raw probability obtained directly from the responses from the fishermen, (*b*) as a function of exogenous determinants of the overall probability of detection, and (*c*) as an instrumental variable estimated in the first stage.

Raw probabilities. Fishermen were asked to provide subjective assessments of the probability of their violation being detected by enforcement officials while fishing in the inshore areas (PROBD), the probability of arrest given detection (PROBDA), the probability of being taken to court given arrest (PROBDAC), and the probability of being found guilty given that the fisherman is taken to court (PROBG). From these subjective probabilities, the overall probability of detection and being found guilty for the individual is given by

$$\text{OPROB} = \text{PROBD}*\text{PROBDA}*\text{PROBDAC}*\text{PROBG}. \quad (3)$$

Exogenous determinants of the probability of detection. The probability of detection and conviction may simply be determined exogenously by enforcement inputs and fishermen's expenditure on evasion activities. In this case, the overall probability of detection and conviction (OPROB) itself does not enter equation (2) directly. Instead, the exogenous determinants of OPROB—enforcement inputs and fisherman's expenditure on evasion activities—enter directly to explain the violation decision. These variables are hypothesized to be horsepower (HP) of the engine in the fishermen's boat, expenditure on evasion activities (EXPEVA), number of patrol boats in operation (NPBOATS), and the number of times fishermen have seen enforcement personnel while at sea (NENFOR).

Estimated probabilities. The overall probability of detection and conviction is expected to be a function of enforcement and evasion inputs. Each fisherman's subjective probabilities may affect his own expenditures on capital inputs (such as larger engines and faster boats and detection evasion equipment such as radar and cellular phones), as well as his assessment of enforcement inputs. The perceived enforcement inputs include the number of patrol boats a respondent thinks are operating in his area, the number of times he has seen enforcement personnel at sea, and the number of times he has had actual contact with enforcement personnel (i.e., boarding or checks). The estimated overall probability of detection and conviction is modeled as:

$$\text{HOPROB} = f\,(\text{NPBOATS, NENFOR, EXPEVA, HP}), \quad (4)$$

where

HOPROB is the estimated overall subjective probability of detection and conviction,

NPBOATS is the number of patrol boats the fisherman believes to be operating in his area,

NENFOR is the number of times the fisherman has seen enforcement personnel at sea,

EXPEVA is the fisherman's expenditure on evasion activity,

HP is the horsepower rating of the engine in the fisherman's boat.[13]

Alternative specifications for the estimated overall probability of detection and conviction were tried. One specification included a variable for the number of actual contacts fishermen had with enforcement personnel via boat boarding and checks, NCONTENF. However, the variable NCONTENF was not significant and did not improve the fit of the model. Another specification included the number of days fished inshore, NFINS, as an explanatory variable for the overall probability since the more a fishermen fishes inshore, the more probable it is that the violation will be detected. The variable NFINS, however, turned out to be insignificant.

The estimated probability is used as an instrumental variable in equation (2). This is done because the decision to violate and the overall subjective probability of detection and conviction may be jointly determined. Two instrumental variables were used for OPROB, one using the ordinary least squares (OLS) estimator (HOPROB) and another using the Tobit estimator, since the subjective probabilities lie between 0 and 1. The difference between the two is negligible, and we report the results from the OLS estimation.

As shown in Tables 3 and 4, DCPUE, the difference between inshore and offshore values of catch per unit effort, is consistently significant in explaining the violation decision. Note, however, that there are fewer ambiguities in the measurement, interpretation, and direction of causation with the variable DCPUE than there are with the probability of detection variables. The significance of the DCPUE variable clearly indicates that one of the key factors pushing fishermen to violate the zoning regulation is the differential in income potential between the inshore and offshore areas. The positive sign on the DCPUE variable shows that the higher the catch per unit in the inshore areas, the higher the probability of a violation by the trawler fishermen. The significant and positive signs on the probability of detection variables PROBD, HPROBDA, and NENFOR contradict our theory. The reasons for and implications of this finding are discussed below.

[13] For a full list of the variables with their definitions, see Appendix Table 1.

The Extended Model of Compliance[14]

The model is extended to include the effects of moral obligation and social influence on compliance behavior. The moral ob-

Table 3. Probit Estimates of the Basic Deterrence Model Using Raw Probabilities and Exogenous Variables (*t*-Ratios in Parentheses)

Variable	I	II	III
CONSTANT	1.36***	0.58***	–0.035
	(2.85)	(5.82)	(–0.14)
DCPUE	0.0061***	.0060***	0.0067***
	(6.86)	(6.84)	(6.86)
PROBD	0.48*		
	(1.79)		
PROBDA	–0.47*		
	(–1.77)		
PROBDAC	–0.25		
	(–0.84)		
PROBG	–0.69		
	(–1.25)		
OPROB		–0.62	
		(–1.50)	
NPBOATS			0.030
			(0.40)
NENFOR			0.0063***
			(3.25)
EXPEVA			0.0000046
			(0.57)
HP			0.0011
			(1.45)
Log-likelihood	–133.45	–137.27	–128.88
Likelihood ratio test	94.01	86.36	103.14
McFadden's R^2	0.26	0.24	0.28

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

Table 4. Probit Estimates of the Basic Deterrence Model Using Estimated Probabilities (*t*-Ratios in Parentheses)

Variable	IV	V
CONSTANT	1.13*	0.36
	(1.69)	(0.70)
DCPUE	0.0056***	0.0061***
	(6.26)	(6.88)
HPROBD	–1.99	
	(–1.33)	
HPROBDA	2.61***	
	(2.07)	
PROBDAC	–0.32	
	(–1.08)	
PROBG	–0.74	
	(–1.33)	
HOPROB		1.27
		(0.28)
Log-likelihood	–133.70	–138.36
Likelihood ratio test	93.50	84.18
McFadden's R^2	0.26	0.23

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

[14] A formal specification of this model is given in Appendix A.

ligation to comply is assumed to depend on the individual's moral development and on the perceived legitimacy of the regulatory institution. We used Kohlberg's Standard Issue Moral Judgment Interview and Scoring System (Colby et al. 1987b) to rank fishermen according to their level of moral development. The variable MCODE provides a 1–3 ranking of individual fishermen on the Kohlberg scale of moral development. Fishermen were placed in three categories: preconventionalist (rank 1), conventionalist (rank 2), and postconventionalist (rank 3). The placement of a fisherman in a rank was based on his responses to a set of moral dilemma questions regarding the fishery regulation. Kohlberg's theory of moral development asserts that the preconventionalist and conventionalist are more likely to violate a regulation than is the postconventionalist (Colby et al. 1987a:16). This hypothesis is tested below.

The legitimacy accorded to the regulatory authorities by a fisherman is measured by 12 variables reflecting an individual fisherman's assessment of the outcomes and procedures associated with the regulation. The outcome variables are CONSERVE, CONFLICT, JUST, EVERYONE, INSHORE, and OFFSHORE (for definitions, see Appendix Table 1). For each of these variables the respondent ranked his level of agreement with each statement on a scale of 1 to 5, where a higher score indicates stronger agreement. The theory is that individuals who agree with these outcome variables are also likely to accord a higher level of legitimacy to the enforcement agency and thus exhibit greater compliance with the regulations (Tyler 1990a). The six process variables are RIGHT, VIEWS, NONCONST, NODETECT, PENALFIT, and ENFORADQ. Respondents ranked their level of agreement or disagreement with the statement on a scale of 1 to 5. Tyler finds that individuals who disagree strongly with statements like those used here tend to accord a lower level of legitimacy to the enforcement agency and exhibit a lower compliance rate. Tyler also concludes that the process variables are more important than the outcome variables in influencing legitimacy and that procedural justice is more important than procedural efficiency in influencing legitimacy and compliance.

As indicated above, the behavior of others is expected to influence the behavior of individual fishermen. In particular, fishermen are faced with competition for fish resources that are migratory, that is, moving from inshore to offshore. If a large proportion of fishermen is violating the regulation, nonviolators lose out to violators in the competition for fishery resources.[15] Also, the social reputation of a fisherman is not as likely to be

[15] Individuals face an "assurance problem" because the payoff for complying depends on the degree of assurance the individual has that others also will comply (Sen 1967). The higher the compliance by others, the stronger the individual's incentive to comply (Runge 1981, 1984).

Table 5. Probit Estimates of the Extended Compliance Model (*t*-Ratios in Parentheses)

Variable	VI	VII	Variable	VI	VII
CONSTANT	2.11***	1.56**	**Process variables:**		
	(4.29)	(2.18)	RIGHT	0.23**	0.24**
DCPUE	0.0066***	0.0069***		(2.01)	(2.02)
	(6.09)	(6.29)	VIEWS	−0.051	−0.042
OPROB	−0.82			(−0.57)	(−0.50)
	(−1.48)		NONCONST	0.78	0.074
HOPROB		5.29		(1.03)	(0.99)
		(0.93)	NODETECT	0.032	0.049
MCODE	−0.70***	−0.72***		(0.34)	(0.52)
	(−4.72)	(−4.82)	PENALFIT	0.076	0.071
PERTVIOL	0.012**	0.011**		(0.82)	(0.77)
	(2.26)	(2.20)	ENFORADQ	0.11	0.088
				(1.21)	(0.99)
Outcome variables:			Log-likelihood	−105.53	−106.26
CONSERVE	0.035	0.0087	Likelihood test	149.85	148.37
	(0.28)	(0.068)	McFadden's R^2	0.42	0.41
CONFLICT	−0.35**	−0.35**			
	(−2.72)	(−2.70)			
JUST	0.18	0.21*			
	(1.58)	(1.80)			
EVERYONE	−0.39**	−0.43**			
	(−2.66)	(−2.90)			
INSHORE	−0.085	−0.093			
	(−0.69)	(−0.77)			
OFFSHORE	−0.21*	−0.19			
	(−1.81)	(−1.66)			

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

affected if he violates in a community in which a large proportion of the fishermen is violating. To capture the effect of what others are doing, we used the variable PERTVIOL, the percentage of fishermen perceived to be violating the regulation. The variable is each fisherman's subjective assessment of the percentage of fishermen in his area violating the regulation prohibiting trawling in the inshore areas.

Table 5 shows the results of including the nonmonetary intrinsic and extrinsic variables in the model for explaining the violation decision. As in the basic deterrence model, the variable measuring the differential in income potential between fishing inshore and offshore, DCPUE, is significant and has the expected sign. The raw overall probability (OPROB) and the estimated overall probability (HOPROB) are both not significant. The moral development variable, MCODE, and the social influence variable, PERTVIOL, are significant and have the expected signs. Two of the outcome variables, CONFLICT and EVERYONE, are significant at the 1% level in both specifications of the model. The negative signs for CONFLICT and EVERYONE imply that fishermen are less likely to violate if they agreed with the statement that the objective of the regulation is to reduce conflict and the regulation benefits all fishermen, which suggests that fishermen favor the regulation if it reduces conflicts or benefits everyone. Two other outcome variables, JUST and OFFSHORE, are significant only at the 10% level and in alternative specifications of the model. The positive signs on the RIGHT variable indicates that if fishermen agree that the government is right in imposing the regulation, then fishermen are more likely to violate the regulation. This apparent contradiction of theory is discussed below. That only one of the process variables is significant implies that the decision to violate or not to violate does not depend strongly on process variables, the opposite of the conclusion of Tyler (1990a) that process variables are more important.[16]

Number of Days Fished Inshore

We turn now to look at another aspect of compliance behavior, the number of days fishermen fish in the prohibited zone (i.e., the extent of violation). The number of days a fisherman violates is important since it is the frequent or flagrant violators who threaten the success of a regulation. The decision whether to comply provides only a partial picture of the compliance problem since all fishermen who violate one or more times fall into one category. In practice, an occasional infraction may not be considered serious by either fishermen or enforcement authorities, but the frequent and flagrant violator may be sanctioned socially by other fishermen and/or targeted by enforcement agencies.

The number of days fished inshore has a minimum value of 0 for those who report not fishing inshore and a maximum value equal to the total number of days fished during the year. In the data collected, the maximum number of days fished inshore is 300 days. This means the dependent variable (NFINS) is censored in the sense that the lowest value is 0 and the highest value is 300. A Tobit model is used to estimate the number of days fished inshore for the sample of 318 observations. The first two columns of Table 6 present the results of the estimation.

The difference between inshore and offshore values of catch per unit effort (DCPUE) continues to be significant and have the expected signs. Unlike the estimates shown in Table 5, in this analysis the overall probability of detection has the expected sign and is statistically significant whether in raw or in estimated form. The moral development variable is also significant at the 1% level, and the negative sign is consistent with Kohlberg's theory of moral development. The PERTVIOL variable, reflecting each fisherman's subjective assessment of the proportion of fishermen

[16] The statistical model Tyler used for assessing the effect of these normative variables differs from the model used here in that he used a ranking variable of 1 to 5 for measuring compliance. Also, he used the inappropriate OLS statistical model.

Table 6. Tobit Estimates of the Number of Days Fished Inshore (NFINS) (*t*-Ratios in Parentheses)

	All		Violators Only	
Variable	VIII	IX	X	XI
CONSTANT	22.79*	61.50***	8.17	54.81***
	(1.75)	(3.07)	(0.59)	(2.69)
DCPUE	0.017***	0.018***	0.0093*	0.010***
	(3.37)	(3.59)	(1.92)	(2.1)
OPROB	–38.28**		–23.22	
	(–2.3)		(–1.19)	
HOPROB		–422.10***		–515.04***
		(–2.7)		(–3.2)
MCODE	–21.46***	–20.17***	–10.37**	–8.27*
	(–4.8)	(–4.56)	(–2.05)	(–1.66)
PERTVIOL	0.85***	0.85***	0.83***	0.87***
	(6.36)	(6.44)	(6.02)	(6.37)
Outcome variables:				
CONSERVE	–7.5**	–5.07	–6.30*	–3.07
	(–2.18)	(–1.46)	(–1.74)	(–0.84)
CONFLICT	–6.62*	–5.45	–2.56	–1.54
	(–1.91)	(–1.60)	(–0.72)	(–0.45)
JUST	0.53	0.94	–1.63	–1.47
	(0.14)	(0.26)	(–0.42)	(–0.39)
EVERYONE	–7.96*	–8.53**	–4.22	–4.50
	(–1.94)	(–2.11)	(–0.98)	(–1.08)
INSHORE	5.54	4.64	9.85***	9.02***
	(1.63)	(1.38)	(2.84)	(2.65)
OFFSHORE	–6.06*	–7.20**	–4.39	–5.03
	(–1.77)	(–2.14)	(–1.18)	(–1.39)
Process variables:				
RIGHT	8.29**	9.03**	3.30	3.91
	(2.29)	(2.51)	(0.84)	(1.016)
VIEWS	–4.77*	–4.56*	–6.04**	–5.97**
	(–1.86)	(–1.81)	(–2.25)	(–2.29)
NONCONST	3.68	2.93	3.80	2.91
	(1.54)	(1.24)	(1.51)	(1.18)
NODETECT	–3.85	–4.49	–4.10	–5.50*
	(–1.39)	(–1.62)	(–1.44)	(–1.94)
PENALFIT	–2.21	–1.34	–1.80	–0.83
	(–0.84)	(–0.52)	(–0.64)	(–0.30)
ENFORADQ	8.70***	8.80***	7.62***	8.03***
	(3.24)	(3.31)	(2.62)	(2.81)
σ	47.95	47.48	45.71	44.85
	(21.51)	(21.46)	(21.65)	(21.65)
Log-likelihood	–1,300.5	–1,299.8	–1,228.1	–1,223.6

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level

who are violating the regulation, is significant and exhibits the expected positive sign.

The performance of the legitimacy variables is marginally better in this model than in the model of the violation decision. Of the 12 variables used to measure legitimacy, 7 (4 outcome variables and 3 process variables) are statistically significant. The outcome variables CONSERVE, CONFLICT, EVERYONE, and OFFSHORE are statistically significant (though not consistently) and exhibit the expected signs. The interpretation is the same as above. In addition, the process variables RIGHT, VIEWS, and ENFORADQ are statistically significant. The positive signs for the RIGHT and ENFORADQ variables indicate that if fishermen agree that the government is right in imposing the regulation or that the enforcement of the regulation is adequate, then fishermen's violation rates are higher. This appears contrary to theory but may be plausible because it is rational for violators to support tough regulations, especially if enforcement is relatively weak and compliance due to moral and other reasons is high. The exclusion of voluntary compliers from the regulated or prohibited zone increases the marginal value product of fishing for the violators in the regulated zone. The other significant process variable is VIEWS, exhibiting the expected negative sign. The sign implies that the more a fisherman agrees that the views of fishermen were taken into account in the formulation of fisheries regulations, the lower his violation rate.

For further comparison, we made a Tobit estimate for violators only. The columns in Table 6 headed "Violators Only" present the results of the Tobit estimate of the number of days fished inshore by the violators only. The results on the variables DCPUE, MCODE, PERTVIOL, CONSERVE, VIEWS, and ENFORADQ are the same as for the whole sample (violators and nonviolators). The estimated overall probability, HOPROB, is statistically significant and of the expected sign, though the raw overall probability, OPROB, is not statistically significant. The performance of the legitimacy variables is not as strong as the performance of the legitimacy variables of the whole sample. Only one outcome variable, INSHORE, is statistically significant in both specifications. Its positive sign indicates that violators violate more if they believe that the regulation is benefiting inshore fishermen only. This makes sense because the outcome of the regulation that benefits one group, which is in essence in competition for the same resource with the other group, will attract noncompliance from the other group that feels it is not benefiting from the regulation. When groups feel that the outcome of the regulation favors one group against the other, it erodes the legitimacy the individuals in that group grant to the institutions enforcing the regulation, thus increasing noncompliance.

Two process variables that are significant in both specifications of the violators-only model are VIEWS and ENFORADQ. It is clear that for violators, as for the whole sample, whether the management authority considers their views in formulating regulations will influence legitimacy and compliance levels. As before, the positive sign for the ENFORADQ variable implies that violators who believe that there is adequate enforcement are also likely to violate more. Those fishermen who fish more days inshore stand to lose more from increases in enforcement. They are behaving rationally when they indicate that enforcement is adequate; to do otherwise might lead to more vigorous enforcement.

Discussion

The variable DCPUE is consistently significant with the expected signs in all our estimates of the violation decision and the number of days fished in the prohibited zone. This variable, reflecting the differential stock abundance and income potential in the two zones, plays a major role in the compliance decisions of fishermen. The variables MCODE and PERTVIOL also are consistently significant with the expected signs, providing strong support to the theory in the compliance literature that moral development and social influence are important determinants of compliance behavior.

The normative perspective on compliance behavior, which emphasizes the role of legitimacy of enforcement institutions and agencies in securing compliance, is not as strongly supported by our estimates. No set of legitimacy variables is consistently significant with the sign predicted by legitimacy theory. To the extent that our results have merit, they contrast with those of Tyler (1990a) and Tyler, Casper, and Fisher (1989), who conclude that process variables are more important. Our results indicate that outcome variables play a more consistent and significant role.

Issues of Theory and Estimation

An important area of concern is the inconsistent performance of the variables measuring the probability of detection and conviction. The first explanation of the poor performance is related to the subjective probabilities used in this study. Subjective probabilities are difficult to analyze because we do not know how these subjective probabilities are generated and what biases may be inherent in them. Tversky and Kahneman (1974) describe some of the biases in judgment about probabilities. They show that people rely on a limited number of heuristic principles that reduce the complex tasks of assessing probabilities and predicting values to simple judgmental operations. They conclude that in general these heuristics are quite useful, but they sometimes lead to severe and systematic errors of thinking under uncertainty.

A second explanation is that respondents may not understand the concept of probabilities. This has some support from the data where respondents from one of the survey areas (Besut, in Terengganu) reported higher probabilities of detection on average and also reported high violation rates. These findings point to the need for better ways or instruments for eliciting and assessing subjective probabilities. The issue of not understanding probabilities is also plausible, as fishermen in the survey areas typically had just six years of schooling. It is possible that the fishermen are not able to give good probability estimates for the overall probability of detection and arrest but can give fairly good estimates of the probability of detection (PROBD) and the probability of arrest given detection (PROBDA). These two subjective probabilities did make sense in the estimation.

A third reason for the lack of significance of the overall probability variable is that fines or penalties are not included as arguments in the model. This could not be done because a large proportion of respondents (38%) did not respond to the question on amount of fines paid for violation activities. It is possible that probabilities may not make a difference, but fines may make a difference in the deterrence model.[17] That is, it may not be probabilities but fines that really matter for a fisherman's decision. This would support the hypothesis of the basic deterrence model that it is the value of the expected penalties compared with the value of expected benefits that really determines whether a fisherman will violate a regulation.

A fourth reason for the insignificance of the probabilities of detection and conviction in the violation decision is that the simultaneity problem in the estimations has only been partially handled by using a two-stage estimate of the probabilities of detection and conviction. The identification problem with the probabilities of detection and conviction has not been solved. The system has not been fully identified. Fishermen who have higher probabilities of detection are also the fishermen who are fishing more in the inshore areas and are also those who spend more on evasion activities and more powerful boats. This itself makes them targets for greater enforcement action. Thus enforcement inputs such as NPBOATS, NENFOR, and evasion activities such as EXPEVA and HP are likely to be endogenous variables. There is not enough information on other variables linked to these endogenous variables to identify all of them for estimation.

Finally, a fifth reason for the failure of probabilities of detection and conviction to be significant is that there may be other influences in the study areas that are not captured in the model but are important enough to reduce the impact of the probabilities on the violation decision. An example of such influences may include syndicates that may be able to influence enforcement personnel or obtain early information on surveillance activities. We heard rumors about such practice from fishermen, and even the head of the enforcement section of the Malaysian Fisheries Department has voiced concern that there are insiders who warn

[17] Furlong's (1991) study of regulatory enforcement in the Quebec fishery, however, found the deterrent effects of penalties on violation rates statistically insignificant.

fishermen of the Department's planned surveillance activities so that they can avoid detection and arrest. Fishermen have also reported that those trawler owners who have arrangements with enforcement personnel have methods of signaling this by the way they store their nets in their boats and thus may avoid arrest. It must be emphasized, however, that we have no empirical evidence on these other influences.

As noted above, our estimates do not lend much consistent support to Tyler's theory of legitimacy. There are at least two possible explanations for our findings. One, obviously, is that the theory is wrong and must be modified. The behavior of economic agents is motivated largely by the desire for tangible gain (income); their survival and success depends on the ability to realize outcomes superior to most of their peers. Therefore, favorable regulatory outcomes may be more important than procedural fairness to economic agents caught up in the frenetic world of competition.

The other explanation relates to the measurement of the legitimacy variables. We attempted to develop measures analogous to those used by Tyler; however, instruments for measuring legitimacy are not nearly as well developed and refined as, for example, those for measuring moral development. Given the theory's great intuitive appeal and ability to explain casual empirical evidence, we suspect our measures of legitimacy are imperfect and require further testing, development, and refinement. Only then can we be confident of a sound empirical test of the theory.

Summary and Conclusions

Our analysis of Malaysian fishermen's compliance demonstrates that the extension of the basic deterrence model to include moral obligation and social influence variables results in a richer and superior model of compliance behavior. The analysis provides empirical support for the argument that in addition to tangible gains and losses, moral development, legitimacy, and the behavior of others are important determinants of compliance.[18] These variables are important both for the study of compliance behavior and for the design and implementation of regulatory policy.

Implications for Policy

The results of our analysis provide modest support for traditional enforcement policy. Our estimates indicate that strengthening enforcement (i.e., by increasing the probability of detection and conviction) can reduce the number of violations by

18 We note that Frank (1988) argues that moral behavior is in the long-term self-interest of an individual.

those violating. However, the estimates of the deterrent effect of the probability of detection and conviction imply that adding enforcement resources will not likely reduce the number of violators. As indicated above, these results are weakened by the problems associated with measuring the appropriate probabilities. Other support for the deterrent effects is provided, in part, by the strong and consistent role played by potential illegal gains (DCPUE) in explaining respondents' compliance behavior. This is potent evidence that tangible incentives do matter, that decisions to violate and comply are strongly influenced by the expected net income of their options. If large enough, relative to illegal gains, the certainty and severity of sanctions should be an effective enforcement instrument.

The significance of the differential in income potential between fishing inshore and offshore (DCPUE), in both the decision to violate and the extent of violation, poses some serious problems for policymakers. If enforcement becomes more successful at keeping trawlers out of inshore areas, the difference in the catch per unit effort between the zones will become more pronounced, increasing the incentive to violate. The ability to obtain high levels of compliance will to a large extent depend on whether zoning regulations also can result in higher catch per unit effort in the offshore zones as well. If this does not occur, the pressure on enforcement resources will increase as trawler fishermen attempt to violate the regulations to make up for the difference in the stock between the two zones.

According to compliance theory, the willingness to comply stemming from moral obligation and social influence is based on the perceived legitimacy of the authorities charged with implementing the regulations. Other evidence (Tyler 1990a, 1990b) suggests that a key determinant of perceived legitimacy is the fairness built into the procedures used to develop and implement regulatory policy. To the extent that this view is valid, enforcement authorities should determine what policies and practices are judged fair by segments of the population subject to regulations. This may mean, for example, that civil penalties and other sanctions should be comparable in value with the larger of the harm done or gains realized. This may indicate that fishermen subject to surveillance and monitoring be treated with dignity and respect. This may also require that the boundaries of the closed zone appear to be reasonable and appropriate to fishermen.

If a high degree of compliance can be realized via the twin forces of moral obligation and social influence, the question arises whether enforcement is necessary. We argue that it is, that enforcement is an essential element of compliance policy. In almost any group of individuals subject to regulation there is often a core subgroup (usually small) of chronic, flagrant violators.[19] Chronic, flagrant violators tend to be motivated only by the direct tangible consequences of their actions. Moral obligation and social influence have little or no effect on their behavior. Only changes in the economic incentives—reducing the illegal gain or increasing the expected penalty—can control the amount of violations by this subgroup. In the absence of a tangible incentive mechanism (e.g., a monetary reward for complying), enforcement is the only means of controlling this subgroup.

Even if only a few fishermen are chronic, flagrant violators, there are serious consequences to elimination of enforcement. Eliminating enforcement would allow chronic, flagrant violators to flaunt their violation of the law. If a group appears to be immune to the regulations, those who normally comply may receive two messages: (1) that regulatory procedures are unfair, having no effect on flagrant violations of fishing regulations; (2) that the regulatory program is not effectively protecting the fishery resources and inshore fishermen. Each message weakens the moral obligation to comply and the moral basis on which social influence is exercised. As moral obligation and social influence are weakened, compliance begins to erode among those who normally would have complied with the regulations. Their subsequent noncompliant behavior influences others not to comply with the regulations, and ultimately compliance breaks down.[20] Thus, effective enforcement is needed to prevent such undesirable outcomes.

References

Akers, R. L. (1985) *Deviant Behavior: A Social Learning Approach.* 3d ed. Belmont, CA: Wadsworth.

Akers, R. L., M. D. Krohn, L. Lonza-Kaduce, & M. Radosevitch (1979) "Social Learning and Deviant Behavior: A Specific Test of a General Theory," 44 *American Sociological Rev.* 635–55.

Anderson, L. G., & D. R. Lee (1986) "Optimal Governing Instruments, Operation Level, and Enforcement in Natural Resource Regulation: The Case of the Fishery," 68 *American J. of Agricultural Economics* 678–90.

Aronfreed, J. (1968) *Conduct and Conscience.* New York: Academic Press.

——— (1969) "The Problem of Imitation," in L. P. Lipsutt & H. W. Reese, eds., *Advances in Child Development and Behavior,* vol. 4. New York: Academic Press.

Bandura, A. (1969) "Social-Learning Theory of Identificatory Processes," in Goslin, ed. 1969.

[19] Gauvin (1988) and Bean (1990) estimate that roughly 10% of the fishermen in the Massachusetts lobster and Rhode Island clam fisheries frequently and flagrantly violate major regulations. The other 90% of fishermen normally comply, exhibiting much lower violation rates. These estimates are similar to the results reported in numerous other studies (see Feldman 1993 for a review).

[20] This process of deteriorating compliance is believed to have occurred in northeastern U.S. fisheries in the late 1980s (Sutinen, Rieser, & Gauvin 1990).

Bean, C. (1990) "An Economic Analysis of Compliance and Enforcement in the Quahaug Fishery of Narragansett Bay." Unpub. Master's Thesis, Univ. of Rhode Island.

Becker, Gary (1968) "Crime and Punishment: An Economic Approach," 76 *J. of Political Economy* 169–217.

Bentham, Jeremy (1985 [1789]) *An Introduction to the Principles of Morals and Legislation,* ed. W. Harrison. Oxford: Basil Blackwell.

Blewett, E., W. Furlong, & P. Toews (1987) "Canada's Experience in Measuring the Deterrent Effect of Fisheries Law Enforcement," in J. Sutinen & T. Hennessey, eds., *Fisheries Law Enforcement: Programs, Problems and Evaluation.* Marine Technical Report 93, Univ. of Rhode Island.

Colby, A., L. Kohlberg, B. Speicher, A. Hewer, D. Candee, J. Gibbs, & C. Power (1987a) *The Measurement of Moral Judgement,* vol. 1: *Theoretical Foundations and Research Validation.* New York: Cambridge Univ. Press.

——— (1987b) *The Measurement of Moral Judgement,* vol. 2: *Standard Issue Scoring Manual.* New York: Cambridge Univ. Press.

Feldman, P. (1993) *The Psychology of Crime.* New York: Cambridge Univ. Press.

Fomby, T. R., H. Carter, & S. R. Johnson (1984) *Advanced Econometric Methods.* New York: Springer Verlag.

Frank, R. H. (1988) *Passions within Reason.* New York: W. W. Norton.

Furlong, W. J. (1991) "The Deterrent Effect of Regulatory Enforcement in the Fishery," 67 *Land Economics* 116–29.

Gauvin, J. (1988) "An Econometric Estimation of Compliance Behavior in the Massachusetts Inshore Lobster Fishery." Unpub. Master's Thesis, Univ. of Rhode Island.

Goh, C. T. (1976) "The Fishing Conflict in Penang and Perak: Personal Memoir," 12 (1 & 2) *Malaysian Economic Studies* 17–25.

Goslin, D. A., ed. (1969) *Handbook of Socialization Theory and Research.* Chicago: Rand McNally.

Hausman, Daniel. M., & Michael S. McPherson (1996) *Economic Analysis and Moral Philosophy.* New York: Cambridge Univ. Press.

Heineke, J. M., ed. (1978) *Economic Models of Criminal Behavior.* New York: North-Holland Publishing.

Kohlberg, Lawrence (1969) "Stage and Sequence: The Cognitive-Development Approach to Socialization," in Goslin, ed. 1969.

——— (1984) "The Relationship between Moral Judgement and Moral Action," in L. Kohlberg, ed., *Essays on Moral Development,* vol. 2: *The Psychology of Moral Development.* New York: Harper & Row.

Levine, Felice J., & June Louin Tapp (1977) "The Dialectic of Legal Socialization in Community and School," in Tapp & Levine, eds. 1977.

Lind, E., C. Kulik, M. Amrose, & M. van de Vera Park (1993) "Individual and Corporate Dispute Resolution: Using Procedural Fairness as a Decision Heuristic," 38 *Administrative Science Q.* 224–51.

Little, R. J. (1992) "Regression with Missing X's: A Review," 87 *J. of the American Statistical Association* 1227–37.

MacCoun, Robert, E. Allan Lind, Deborah Hensler, D. Bryant, & Patricia Ebener (1988) "Alternative Adjudication: An Evaluation of the New Jersey Automobile Arbitration Program." Santa Monica, CA: Institute for Civil Justice, RAND Corporation.

Maddala, G. (1983) *Limited Dependent and Qualitative Variables in Econometrics.* New York: Cambridge Univ. Press.

McEwen, Craig, & Richard Maiman (1984) "Mediation in Small Claims Court: Achieving Compliance through Consent," 18 *Law & Society Rev.* 11–49.

Milliman, Scot R. (1986) "Optimal Fishery Management in the Presence of Illegal Activity," 13 *J. Environmental Economics & Management* 363–81.

Mischel, W., & H. N. Mischel (1976) "A Cognitive Social-Learning Approach to Morality and Self-Regulation," in T. Lickona, ed., *Moral Development and Behavior.* New York: Holt, Rinehart & Winston.

Ong, K. S., & W. Weber (1977) "First Prawn Trawling Survey Off the West Coast of Peninsular Malaysia," *Fisheries Bull.* No. 18, Ministry of Agriculture, Malaysia, Kuala Lumpur.

Paternoster, Raymond, Ronet Bachman, Robert Brame, & Lawrence W. Sherman (1997) "Do Fair Procedures Matter? The Effect of Procedural Justice on Spouse Assault," 31 *Law & Society Rev.* 163–204.

Pauly, D., & R. Neal (1985) "Shrimp versus Fish in Southeast Asia: The Biological, Technological and Social Problems," in A. Yanez Arancibia, ed., *Recursos Pesqueros Potenciales de Mexico: La Pesca Acompanante del Camaron.* Prog. Univ. de Aliment., Inst. Cien. Mary Limnol. Inst. Nacl. de Pesca. UNAM, Mexico.

Pyle, David J. (1983) *The Economics of Crime and Law Enforcement.* New York: St. Martin's Press.

Runge, Carlisle Ford (1981) "Common Property Externalities: Isolation, Assurance, and Resource Depletion in a Traditional Grazing Context," 63 *American J. of Agricultural Economics* 595–606.

——— (1984) "Institutions and the Free Rider: The Assurance Problem in Collective Action," 46 *J. of Politics* 154–81.

Sande, G. (1979) "Discussion on Hot Deck and Other Imputation Techniques," in *Symposium on Incomplete Data, Preliminary Proceedings.* Washington: U.S. Department of Health, Education & Welfare, Office of Research & Statistics.

Sen, A. (1967) "Isolation, Assurance, and the Social Rate of Discount," 81 *Q.J. of Economics* 112–24.

Smith, Adam (1896 [1763]) *Lectures on Justice, Police, Revenue and Arms,* ed. E. Cannan. New York: Oxford Univ. Press.

——— (1966 [1759]) *The Theory of Moral Sentiments.* New York: A. M. Kelly.

——— (1985 [1776]) *An Inquiry into the Nature and Causes of the Wealth of Nations.* Modern Library Ed. New York: Random House.

Sutinen, Jon G. (1993) "Recreational and Commercial Fisheries Allocation with Costly Enforcement," 75 *American J. of Agricultural Economics* 1183–87.

Sutinen, Jon G., & P. Andersen (1985) "The Economics of Fisheries Law Enforcement," 61 *Land Economics* 387–97.

Sutinen, Jon G., & J. R. Gauvin (1989) "An Econometric Study of Regulatory Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts," in P. A. Neher, R. Arnason, & N. Mollet, eds., *Rights-Based Fishing.* Boston: Kluwer Academic Publishers.

Sutinen, Jon G., & K. Kuperan (forthcoming) "A Socio-Economic Theory of Regulatory Compliance," *International J. of Social Economics.*

Sutinen, Jon G., A. Rieser, & J. R. Gauvin (1989) *Compliance and Enforcement in Northeast Fisheries.* Saugus, MA: New England Fishery Management Council.

——— (1990) "Measuring and Explaining Noncompliance in Federally Managed Fisheries," 21 *Ocean Development & International Law* 335–72.

Tapp, June L., & Lawrence Kohlberg (1977) "Developing Senses of Law and Legal Justice," in Tapp & Levine, eds. 1977.

Tapp, June Louin, & Felice J. Levine, eds. (1977) *Law, Justice and the Individual in Society: Psychological and Legal Issues.* New York: Holt, Rinehart & Winston.

Tversky, Amos, & D. Kahneman (1974) "Judgements under Uncertainty: Heuristics and Biases," 185 *Science* 1124–31.

Tyler, Tom R (1990a) *Why People Obey the Law.* New Haven, CT: Yale Univ. Press.

——— (1990b) "The Social Psychology of Authority: Why Do People Obey an Order to Harm Others?" 24 *Law & Society Rev.* 1089–1102.

Tyler, Tom R., Jonathan D. Casper, & B. Fisher (1989) "Maintaining Allegiance toward Political Authorities: The Role of Prior Attitudes and the Use of Fair Procedures," 33 *American J. of Political Science* 629–42.

Statute Cited

Government of Malaysia (1985) Laws of Malaysia, Act 317, Fisheries Act 1985. Kuala Lumpur, Malaysia: Government Printer.

Appendix Table 1. Definitions of the Variables

Variable	Definition/Question
AGE	Age of the fisherman
CPUEI	Value of catch per unit effort in inshore area
CPUEO	Value of catch per unit effort in offshore area
DCPUE	Difference in the value of catch per unit effort between inshore and offshore areas
DFISH	Total no. of days fished in a year
EXPEVA	Expenditure on evasion activity
HOPROB	Estimated overall subjective probability of detection and conviction
HP	Horse power rating of engine in the boat
NCONTENF	No. of times fisherman was stopped and checked by enforcement officers during the study period
NENFOR	No. of times fisherman saw enforcement officers at sea during the study period
NFINS	No. of days the fisherman fished in the inshore areas during the study period
NPBOATS	No. of patrol boats operating in the fisherman's fishing area during the study period
PERTVIOL	Percentage of fishermen perceived to be violating the zoning regulation
PROBD	Fisherman's perceived probability of detection by enforcement authorities if he undertakes a violation activity
PROBG	Fisherman's perceived probability of being found guilty if arrested and brought to court
TON	Gross registered tonnage of the boat
TYEARS	Years as a trawler fisherman
YEARS	Years as a fisherman
Legitimacy variables:	
CONSERVE	The principal reason for the 5-mile restriction on trawlers is to conserve and protect the fishery resource
CONFLICT	The principal reason for the 5-mile restriction on trawlers is to avoid conflict between inshore and offshore fishermen
JUST	The 5-mile offshore zoning regulation is a just regulation
EVERYONE	The 5-mile offshore zoning regulation improves the long-term well-being of all fishermen
INSHORE	The 5-mile offshore zoning regulation improves the long term well-being of inshore fishermen
OFFSHORE	The 5-mile offshore zoning regulation improves the long-term well-being of offshore fishermen
RIGHT	The government is doing the right thing imposing regulations with regard to fishing in certain areas of the sea
VIEWS	The views of fishermen are taken into account in the formulation of fisheries regulations
NONCONST	The 5-mile offshore regulation is not enforced consistently
NODETECT	Many trawler fishermen who fish in the inshore areas are getting away with it (i.e., not detected or penalized)
PENALFIT	The penalties given to trawler fishermen who are caught violating the 5-mile offshore zoning regulation "fit the offense"
ENFORADQ	Enforcement in inshore fishing areas is adequate

Appendix A
Specification of the Theoretical Model

The individual fishermen's utility function depends on profits from violation, intrinsic factors and extrinsic factors, and can be specified as follows:

$U^j\ [\pi^j\ (\bullet),\ m\ (t_1,\ h,\ l),\ s\ (t_1,\ V)]$,

where

U^j is the utility to individual from fishing activity,

$j = c,\ n,$ where c is an index of being caught and sanctioned and n represents not being caught and sanctioned,

$\pi^c = f^0\ (t_0,\ k,\ x_0,\ w_0) - c\ (k)\ t_0 + f^1\ (t_1,\ k,\ x_1,\ w_1) - c\ (k)\ t_1 - F$, profit when caught and sanctioned,

$\pi^n = f^0\ (t_0,\ k,\ x_0,\ w_0) - c\ (k)\ t_0 + f^1\ (t_1,\ k,\ x_1,\ w_1) - c\ (k)\ t_1$, profit when *not* caught and sanctioned,

$m\ (t_1,\ h,\ l)$ is the level of personal moral standing (h is the moral development level of the individual and l is the level of legitimacy the individual accords to the regulation and the regulatory institution),

$s\ (t_1,\ V)$ is the level of the individual's social standing (V is a vector of social norms in the community measured in terms of aggregated violation in the community).

Other variables are c, the cost per unit of fishing time; k, a vector of evasion equipment and activities by fisherman; t_0, time fishing legally offshore; t_1, time fishing illegally inshore; x_0 is the stock abundance offshore; x_1 is the stock abundance inshore; w_0 is weather and other exogenous conditions offshore; w_1 is weather and other exogenous conditions inshore. The variable p is the probability of detection and conviction, and F is the penalty if the violator is caught and sanctioned.

An individual fisherman is assumed to maximize his expected utility from fishing in both the inshore and offshore zones. There are two conditions governing the fishing vessel (FV) owner's compliance behavior, a total and a marginal condition (Sutinen 1993; Sutinen & Kuperan forthcoming). The total condition is that the FV owner violates if and only if at the optimal $t_0^*,\ t_1^*$,

$$\text{Max } EU = pU^c\ [\pi^c,\ m,\ s] + (1-p)\ U^n\ [\pi^n,\ m,\ s] > \text{Max } U\ [\pi,\ m,\ s], \quad \text{(A1)}$$

where $U\ [\pi,\ m,\ s]$ is the utility from fishing legally at the optimal t_0. Thus the FV owner violates if the expected utility from violation is greater than or equal to the utility from fishing legally. If we define

$G\ (k,\ x_0,\ w_0,\ x_1,\ w_1,\ p,\ F,\ c,\ h,\ l,\ V) = \text{Max } pU^c\ [\pi^c,\ m,\ s] + (1-p)\ U^n\ [\pi^n,\ m,\ s]$,

$Q\ (k,\ x_0,\ w_0,\ c,\ h,\ l,\ V) = \text{Max } U\ [\pi,\ m,\ s]$,

$Y^*\ (k,\ x_0,\ w_0,\ x_1,\ w_1,\ p,\ F,\ c,\ h,\ l,\ V) = G(\bullet) - Q(\bullet)$,

then equation (1), the violation decision, estimates Prob ($Y^* > 0$).

The first-order conditions for maximizing expected utility from fishing in both zones are given by

$$f_t^1 - c = \{pU_\pi^c\ (\theta) - (1-p)\ U_\pi^n\ (\beta)\}\ /\ \{\ pU_\pi^c + (1-p)\ U_\pi^n\}\ , \quad \text{(A2)}$$

$$f_t^0 - c = 0\ , \quad \text{(A3)}$$

where subscripts denote partial derivatives and

$$\theta = F_t - U_m^c - U_m^c l_t - U_m^c h_t - U_s^c - U_s^c v_t \ ,$$

$$\beta = U_m^n + U_m^n \, n_t + U_m^n \, l_t + U_s^n + U_s^n \, v_t \ .$$

Equations (A2) and (A3) are solved implicitly for t so that t_1, the time spend fishing inshore, can be specified generally as

$$t_1 = t \ (k, x_0, w_0, x_1, w_1, p, F, c, h, l, V) \ . \tag{A4}$$

For the extent of the violation, equation (1) estimates (A4) above.

Appendix B
Peninsular Malaysian Fisheries

The fisheries sector is a significant part of the Malaysian economy. In 1990 the ex-vessel value of marine landings was RM 1,960 (US$800) million, accounting for 2.6% of the gross domestic product and some 950,000 tons of fish. About 90,000 persons were engaged in the marine fisheries sector, representing 1.5% of the labor force in the country. If indirect employment in fishery-related activities (such as processing and distribution and ancillary industries) is considered, employment in the fisheries sector accounts for 4% of the total labor force. Fish also accounts for 60% of the animal protein consumed in the country. The average annual per capita consumption of fish is about 21 kilograms, three times higher than any other source of protein food. Malaysia also is a net exporter of fish and fishery products, and RM 170 million was earned from fish and fishery products trade in 1989.

Fishery resources in Malaysia are managed through a limited entry program that requires all fishing vessels and gears to be licensed. In 1990 there were over 23,000 licensed fishing vessels in Peninsular Malaysia operated by nearly 60,000 licensed fishermen. The majority of the vessels (73%) operate off the West Coast. The four states chosen for the study, Perak, East Johore, Kelantan, and Terengganu, account for 44% of all licensed fishing vessels in Peninsular Malaysia.

Fishing Regulations

The specific focus of this study is on the zoning regulation for trawlers, an important element of fisheries management in Peninsular Malaysia. The zoning concept is one in which fishing grounds are allocated by types of fishing gear, size of vessel, and ownership. The Fisheries Act (1985) of Malaysia specifies that trawl nets can be used only in waters beyond 5 miles from the coast. The specific zones designated according to vessel size and gear type are as follows.

Zone A Within 5 miles from the shoreline is reserved for traditional fishing gears; trawlers are not allowed to operate in this zone.

Zone B Between 5 to 12 miles from the shoreline is reserved for trawlers and purse seiners using boats of less than 40 gross tonnage.

Zone C Between 12 to 30 miles from the coast is reserved for trawler operators using boats greater than 40 gross tonnage owned by Malaysian fishermen.

Zone D Beyond 30 miles from the coast is reserved for foreign or partially Malaysian owned fishing vessels greater than 70 gross tonnage.

In addition, trawler operators are allowed to fish in zone B only from 6 A.M. to 7 P.M. The Fisheries Act of 1985 also empowers the Director-General of the Fisheries Department to regulate fishing effort in order to prevent overcrowding and overexploitation of the resource.

The principal rationale behind the zoning approach for managing the fisheries is to reduce conflict between inshore (traditional) and offshore (commercial) fishermen (Goh 1976:19). The zoning regulation is intended to reduce the negative externalities that offshore fishermen impose on inshore fishermen when the offshore fishermen operate in the inshore waters.[21] The zoning regulation may also have conservation benefits, as it is believed that much of the early breeding and growth of tropical fisheries take place close to the shoreline (Ong & Weber 1977). Also, concentrations of demersal and pelagic fish in most of Southeast Asia only occur down to a depth of about 50 meters, and penaeid shrimp only occur close inshore (Pauly & Neal 1985).

Fisheries Enforcement

Three agencies are responsible for enforcing fisheries regulations in Malaysia: (1) the Enforcement Section of the Fisheries Department, Ministry of Agriculture, (2) the Marine Police, and (3) the Royal Malaysian Navy. A National Maritime Coordination Committee coordinates operations among the three enforcement agencies through its operations arm, the Maritime Enforcement and Coordination Centre. The Centre's primary task is to coordinate all air and sea surveillance and enforcement activities in the Exclusive Economic Zone of Malaysia.

The lead fisheries enforcement agency is the Fisheries Department's Enforcement Section, which has the legal authority to bring formal charges for violations of fisheries regulations. The Marine Police can board vessels and arrest fishers, but must turn over the cases to the Enforcement Section for prosecution. The Navy mainly provides material and logistical support and assistance to the other two agencies.

The Enforcement Section has seven Regional Enforcement Units and seven Area Enforcement Units spread along the coast of the country. In 1991 these enforcement units had 95 patrol boats manned by 384 crew members. Over one-fifth of all government fisheries-related expenditures were for fisheries enforcement.

Air and sea patrols plus dockside inspections are the three principal modes of enforcement. Air patrols are used primarily to detect encroachments by foreign fishing vessels of the Malaysian EEZ. Sea patrols are used to detect, board, and arrest potential violators, both domestic

[21] The offshore fishermen's trawlers tend to damage the traps, gill nets, and other fixed gears used by inshore fishermen. Violent clashes between trawler and nontrawler fishermen led to a total ban on trawling in 1964. The ban was lifted in 1965 and replaced by the zoning regulation in 1967. Violent confrontations continued for another 10 years in spite of the zoning regulations.

and foreign fishing vessels. Sea patrols are the main enforcement tool for detecting and apprehending violators of the zoning regulation that bans trawling within 5 miles of shore. Dockside patrols are used to detect vessels operating without a license and using prohibited fishing gears.

Five types of sanctions are used: (1) verbal warnings, (2) administrative fines, (3) court-determined fines, (4) seizures of catch, gear, and vessel, and (5) permit sanctions. The administrative fines, known locally as a compound, can either be paid or contested in court. Compounds can be used only for first- and second-time offenders. The court must prosecute third-time and more frequent offenders. Fishers usually choose to pay the compound, since it is far more costly to go to court. Also, the conviction rate has averaged about 90%. The most common offense for domestic fishing vessels is violation of the ban on trawling in coastal waters. The average compound and the average court-imposed fine in 1991 were nearly 9 times the revenue of a day of illegal trawling in the prohibited zone. No data are available on the amount of seizures or permit sanctions imposed.

About 90% of all arrests since 1985 were for violations by trawlers of the 0–5 mile zone reserved for inshore fishermen. The number of arrests and the severity of sanctions have been on the increase during the past decade. The expenditures on fisheries enforcement increased by over 300% during the 1980s and have continued to increase in the 1990s. During the late 1980s enforcement expenditures accounted for about 16% of all government expenditures on fisheries. Despite the large expenditures on enforcement, violations continue to mount. There is clearly a need for better understanding of cost effectiveness of enforcement and for finding less costly ways of securing compliance with the nation's fishery regulations.