

Working Paper No. 30/10

**Management of joint resources:
Regulations, risk and behavior**

by

Ole Jakob Bergfjord

SNF Project No. 5181

The effect of political uncertainty in fisheries management:
A case study of the Northeast Arctic cod fishery

The project is financed by the Research Council of Norway

INSTITUTE FOR RESEARCH IN ECONOMICS AND BUSINESS ADMINISTRATION

BERGEN, October 2010

ISSN 1503-2140

© Dette eksemplar er fremstilt etter avtale
med KOPINOR, Stenergate 1, 0050 Oslo.
Ytterligere eksemplarfremstilling uten avtale
og i strid med åndsverkloven er straffbart
og kan medføre erstatningsansvar.

Management of joint resources: Regulations, risk and behavior

Ole Jakob Bergfjord¹

Abstract

In this paper, some effects of political uncertainty are reviewed and the results used to evaluate shared natural resources, but in particular fisheries, with the following characteristics:

- Regulations exist, but individuals or firms have a choice whether to comply with the rules and regulations or not.
- Some level of political uncertainty exists about these rules and regulations, in particular as to if, when and how they might change in the future.

In light of previous literature, we look at how the presence of political uncertainty influences agents' behavior in these situations with regards to investment, compliance and rent seeking efforts, and also how the optimal behavior is affected by a situation with joint management of the resource between two or more countries

Whereas more formal analysis is needed, in particular empirical studies, the main result is that political uncertainty will have a negative effect on investment, which in turn will have other negative consequences. This is intuitive. Uncertainty is likely to increase compliance and reduce rent seeking, but these effects are likely to be much less important. Hence, political uncertainty is always likely to be undesirable. In a joint fishery even more so, as each nation here has the opportunity to make the other country carry some of the costs related to the uncertainty with regards to policy.

¹ ojb@hib.no, Departement of Economics and Business Administration, HiB, Pb 7030, N-5020 Bergen, Norway

Introduction

In fisheries economics, the topic of regulation and compliance has been important for a number of years. Two of the underlying reasons for this serve to underline some important differences between fisheries and other industries. First and foremost; fisheries have traditionally suffered from lack of well-defined property rights, increasing the need for regulations. The “tragedy of the commons” (Hardin, 1968) is an important problem in many fisheries, as it is often rational for both individual fishermen and countries to overfish to an extent that threatens the sustainability of the fish stock.

Second, the globalized nature of fisheries makes monitoring more difficult and costly than in many other industries and the issue of compliance more important. If building restrictions limit the number of floors in a new building, it can easily be observed whether the builder complies with this regulation, thus decreasing the need for – and cost of – monitoring and studies of “compliance”. On the other hand, if fishing restrictions limit some types of fishing behavior, there are many (profitable) ways not to comply with these regulations, traditionally with small probability of detection.

These two factors contribute to making regulation of fisheries more challenging than in many other industries. However, it is worth pointing out that our analysis in the rest of the paper could be valid for other industries sharing some of the same characteristics.

A substantial literature exists both on the regulation and management of fisheries (see e.g. Caddy and Cochrane, 2001 and Dankel *et al.*, 2008 for reviews), as well as on the existence and importance of compliance to these regulations (see e.g. Sutinen *et al.*, 1990; Kuperan and Sutinen, 1998; and Hatcher *et al.*, 2000.)

Our main focus is however not regulation or compliance with these regulations *per se*, but rather how uncertainty about the rules and regulations affect the agents’ behavior. Uncertainty leads to decisions that with some probability will turn out to be wrong, and more general, uncertainty leads to lost utility, as commercial fishermen generally must be assumed to be risk averse (Sutinen, 1979; Mistianen and Strand, 1990).

Again, such uncertainty can be found in most industries, but we will briefly look at some examples from (joint) fisheries to motivate the study.² First of all, fishermen face the uncertainty related to future policy in their own country. This includes the size of future

² In practice, measuring uncertainty is likely to be both important and difficult. The specific measurement of different types of political uncertainty is beyond the scope of this brief paper. Some examples of such measurements, although of uncertainty not directly related to fishery, can be found for instance in Brunetti and Weder, 1998.

quotas, gear regulations, and other regulations. A second type of uncertainty fishermen are facing is uncertainty related to enforcement of policies in their own country. For instance, when deciding whether to invest in a new vessel, many fishermen would not only be interested in future quotas for the relevant fish species, but also in to what extent the government will enforce the quotas. This enforcement level will directly affect the profitability of not complying with the quotas (which is an option considered by some fishermen), and it is also likely to indirectly affect profitability for compliant fishermen, as their catch will be affected by the degree of “cheating” among other fishermen. Finally, fishermen in joint fisheries face uncertainty related to the policy in the other country, as well as the enforcement level in this country. Often, a fisherman will hope for the government in the other country to do the opposite of what he would prefer from his own government (e.g., hold quotas low and enforce them rigorously). While this might not always be the case, we will not discuss this further – the main point is that a fisherman in such a joint fishery is affected by political decisions in the other country, and thus also by the uncertainty related to decisions and enforcement levels in this country.

Even though we argue that a fisherman will be affected by political uncertainty from political uncertainty in both his own country and the other country, it is a reasonable assumption that the effect of political uncertainty in his own country will be stronger, i.e., the fisherman in the country with the highest uncertainty will face the highest uncertainty.

Review and analysis

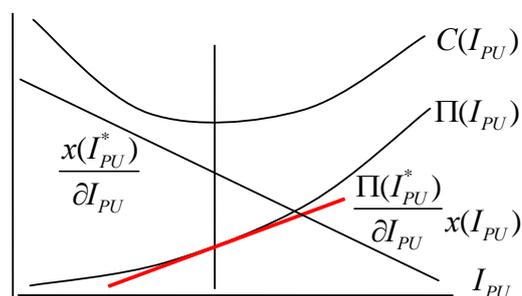
The assumption that the fishermen in the country with the highest uncertainty face the highest uncertainty allows us to use a very simple model, where the political uncertainty faced by any fisherman is lumped together and described by one single variable. This index variable, which is further described below, could be the result of any number of different uncertainties, related to uncertainty about policy and enforcement in their own country as well as in the other country.

In our simple model, fishermen in two countries initially face the same fishing opportunities, but different regulatory environments. The similarity with regards to initial fishing opportunities could be viewed in a context of two countries sharing a common fishery, but this is not a vital point here – our main concern is how differences in regulations will affect some behavioral aspects under otherwise equal conditions. Based on earlier work, the three main aspects we look at are rent seeking efforts, investment, and compliance.

Political uncertainty could be measured the same way as in Bergfjord and Brandt, 2009. A political uncertainty parameter $I_{PU} \geq 0$ is used, where $I_{PU}=0$ implies no uncertainty and the political uncertainty is increasing in I_{PU} . The political uncertainty measured by this parameter could be related to future policy (own or other country); enforcement (own or other country) – or a function of all these issues. In Bergfjord and Brandt, 2009 this parameter is exogenously chosen by the government, in order to minimize the total costs from risk and rent seeking. The main point of that paper is that in some cases, it might be optimal to keep $I_{PU} > 0$, because this makes rent seeking unattractive. It is shown in that paper that rent seeking is decreasing in I_{PU} , and the simple rule for governments developed (and illustrated) in that paper is quoted below:

“ It is optimal to choose $I_{PU}^* > 0$ following the rule $\frac{\partial C(I_{PU}^*)}{\partial I_{PU}} = 0$, if

$$\left| \frac{\partial x^*(I_{PU})}{\partial I_{PU}} \right|_{I_{PU}=0} > \left| \frac{\partial \Pi}{\partial I_{PU}} \right|_{I_{PU}=0} ”$$



x is here the cost of rent seeking, Π is the risk premium, and C is the sum of these two.

This in turn provides an answer to the first of our questions – how uncertainty affects rent seeking. The larger the uncertainty, the lower the rent seeking – whether the uncertainty comes from one or the other source. In our situation, with two different countries, this implies that the rent seeking efforts should be lower in the country with high uncertainty.

Our next issue is investment. An extensive literature has studied the link between (political) uncertainty and investment (see e.g., Bloom *et al*, 2009; Brunetti and Weber, 1998; and Bulan, 2005). Again, existing literature provides a relatively clear answer. Different models are developed for different purposes, but the conclusion remains relatively clear and

intuitive: Uncertainty reduces investment, so investment will be lower in the country with higher uncertainty.

The final issue we want to study is compliance and how compliance levels are affected by the level of political uncertainty. This is, to our knowledge, not previously studied in detail, but again, some instructive introductory results could be derived directly from our assumption about risk aversion.

First, when it comes to compliance, it is worth to separate different types of uncertainty. Whereas rent seeking and investment is affected by the overall level of political uncertainty, as measured for instance by I_{PU} , such an overall measure is less relevant when studying compliance. In particular, it is worth distinguishing between uncertainty regarding future policy on one hand, and uncertainty regarding enforcement (i.e., detection rates and punishment) on the other hand. Uncertainty about future policy should not affect compliance directly, whereas uncertainty about detection rates and punishment directly enter the utility function of fishermen deciding their compliance level. (See e.g., Becker, 1968 for an early contribution on how compliance level – at least to a large extent – is determined by utility considerations.) Uncertainty about both detection rates and punishment will, everything else equal and given risk aversion, reduce the utility from non-compliance. The utility derived from compliance will not be affected, so compliance becomes relatively more attractive, and the compliance level should rise.

In this particular area it is important to distinguish between uncertainty/variance and expected value. Uncertainty should increase compliance, but this is everything else being equal – in particular the expected level of detection and punishment. An empirical analysis is beyond the scope of this paper, but it seems reasonable to expect that countries with high variance/uncertainty related to detection rates and punishment typically would have low expected values. Furthermore, whereas Bergfjord and Brandt, 2009 discusses if and how governments could affect the uncertainty level, it seems reasonable to expect that any exogenous changes in order to affect the uncertainty related to detection and punishment will have a much larger effect on the expected value of these variables than on the variance. Another aspect of this is the possible violation of fundamental legal principles – whereas the expected value of detection and punishment could be changed, a very large uncertainty/variance of detection rates and punishment would not be acceptable in most societies.³

³ A fundamental consideration when deciding the level (expected value) of enforcement is of course the cost of enforcement. This is analyzed for instance by Hanneson, 2010.

In sum, earlier contributions and the assumption about risk aversion yields the following effects from political uncertainty:

Variable	Effect on variable from an <i>increase</i> in uncertainty
Rent-seeking	Decrease
Investment	Decrease
Compliance	Increase (if the increasing uncertainty is related to enforcement)

Table 1: Static effects on different variables from an increase in political uncertainty

Conclusions, implications and further research

We have seen that political uncertainty, whether in the fishermen's own country or in another country utilizing the same fish stock, affects several important behavioral aspects.

An increase in political uncertainty in country A should affect the fishermen in this country more than the fishermen in the other country (country B), and should hence decrease the relative level of rent seeking and increase the level of compliance in country A – which would appear to be a good thing. However, we will argue that this is unlikely to be the case. Although rent seeking will decrease, an increase in uncertainty will only be beneficial here if the decrease in rent seeking outweighs the risk premium loss among fishermen, which will rarely be the case. We have largely ignored this private effect of increased uncertainty, although, as argued by Bergfjord and Brandt, 2009 the private losses related to risk premiums among fishermen will usually outweigh the social gain from less rent seeking.

Also the increased level of compliance from higher uncertainty is of dubious value. First, compliance is only affected by some specific types of uncertainty (uncertainty related to enforcement) – any other type of uncertainty should not affect the compliance level. Second and more importantly, it is hard to imagine any real-life change in uncertainty level/variance of enforcement that not at the same time would imply a more important change of the expected value. Hence, even if a connection is established between uncertainty and compliance, it is not particularly interesting, as the (economic) determinant of compliance levels mainly is the expected value of compliance. Finally, it is worth noting that in many situations, there exists a direct link between uncertainty (variance) and enforcement level (expected value). High uncertainty usually implies relatively vague legal situations. This means that it is easier to claim to have misunderstood or not known the rules, or in other ways

claim some type of innocence for any detected violation. This should in turn decrease the expected punishment level and hence make compliance less profitable.

It is much harder to ignore is the effect of uncertainty on investment. Although different studies with different assumptions and approaches have achieved different results, higher uncertainty clearly causes a decrease in investment. For our two-country example, this has interesting implications. If the (relative) uncertainty increases in country A, the (relative) investment will decrease here. This is interesting on its own, but particularly if we look at the context of a fishery shared between country A and country B. A higher uncertainty in country A will, everything else equal, imply higher investment in the fishery in country B. Of course, everything else is never equal, and to empirically separate different causes and effects is beyond the topic for this paper, but some possible – and at times mutually exclusive – hypotheses could be proposed:

- 1) Over time, the higher investment in country B would strengthen the fleet in this country, strengthen country B's negotiating position, and increase its share of the total fishery. This would in some sense be a good solution, where the "low uncertainty", "high investment" – regime ends up getting a larger share of the fishery, resulting in a lower average production cost.
- 2) The (relative) low investment in country A results in an uncompetitive fleet. To maintain profitability, the government decreases the enforcement level, making it more profitable to violate quotas and regulations, actions which costs to some extent will be carried by the other country.
- 3) Related to the point above: An uncompetitive fleet will typically yield a very low profitability if complying with rules and regulations. Hence, the low investment level indirectly decreases compliance, as violations are relatively more profitable if compliance yields a low profit.

Finally, it could be interesting to look at how political uncertainty affects a shared fishery compared to a fishery utilized and regulated by one country alone. The main effect – lower investment, and hence higher production costs (hypotheses 1) – would of course be the same. If fishermen face high uncertainty, they will on average invest less, independent of whether the fishery is shared or not, or whether the political uncertainty is caused by only his own country or both countries. However, some problems would be avoided if only one country were involved in the fishery. Obviously, it will be less tempting for the government to

decrease the enforcement level – and also less necessary (hypotheses 2). There no longer exists a «other country» that will carry some of the cost from low enforcement, nor do national fishermen face direct or indirect competition from fishermen in the other country, which due to higher investment are more efficient. If a chain of implications goes from high uncertainty to low investment to low profitability by compliance to lower compliance (hypotheses 3), this would exist even in a single-nation fishery.

To conclude, political uncertainty has potentially large effects for shared fisheries. Many of these effects are previously analysed theoretically, but little empirical work is done to estimate different effects in fisheries. This could be interesting for future research.

Whereas political uncertainty in theory could have some positive effects (decreased rent seeking, increased compliance), we argue that these effects are unlikely to be very important, and usually will be overshadowed by the negative effect on investment from political uncertainty, whether this uncertainty comes from one's own or the other country, and is related to future policy or current enforcement level.

Referanser

Becker, G.S., 1968, "Crime and Punishment: An Economic Approach", *Journal of Political Economy*, 76, 169-217

Bergfjord, O.J. and Brandt, U.S., 2009, "Regulations, risk, and rent seeking behavior", *Journal of Risk and Governance*, 1(3), 1-18

Bloom, N., Floetotto, M., and Jaimovich, N., 2009, "Really Uncertain Business Cycles", *Working paper available at http://www.stanford.edu/~nbloom/RUBC_DRAFT.pdf*

Brunetti, A. and Weder, B., 1998, "Investment and Institutional Uncertainty: A Comparative Study of Different Uncertainty Measures", *Weltwirtschaftliches Archiv*, 134, 513–533

Bulan, L.T., 2005, "Real options, irreversible investment and firm uncertainty: New evidence from U.S. firms", *Review of Financial Economics*, 14, 255-279

Caddy, J.F and Cochrane, K.L., 2001, "A review of fisheries management past and present and some future perspectives for the third millennium", *Ocean & Coastal Management*, 44, 653–682

Dankel, D.J., Skagen, D.W., and Ulltang, Ø., 2008, "Fisheries management in practice: review of 13 commercially important fish stocks", *Reviews in Fish Biology and Fisheries*, 18(2), 201-233

Hardin, G., 1968, "The Tragedy of the Commons", *Science*, 162(3859)

Hannesson, R., 2010, "When is fish quota enforcement worth while? A study of the Northeast Arctic cod», *Journal of Bioeconomics* (forthcoming)

Hatcher, A., Jaffry, S., Thébaud, O. and Bennett, E., 2000, "Normative and Social Influences Affecting Compliance with Fishery Regulations", *Land Economics*, 76, 448-461

Kuperan, K. and Sutinen, J., "Blue Water Crime: Deterrence, Legitimacy, and Compliance in Fisheries", 1998, *Law & Society Review*, 32, 309-337

Mistiaen, J.A., and Strand, I.E., 2000, "Location Choice of Commercial Fishermen with Heterogeneous Risk Preferences", *American Journal of Agricultural Economics*, 82(5), 1184–1190

Sutinen, J.G., 1979, "Fishermen's Remuneration Systems and Implications for Fisheries Development", *Scottish Journal of Political Economy*, 26(2), 147–62

Sutinen, J., Rieser, A. and Gauvin, J.R., 1990, "Measuring and Explaining Noncompliance in Federally Managed Fisheries" *Ocean Development and International Law*, 21, 335-372