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**Enforcement and uncertainty in
the management of joint fisheries**

by

Ole Jakob Bergfjord

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

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Enforcement and uncertainty in the management of joint fisheries

Ole Jakob Bergfjord¹

Abstract

This paper seeks to study government's regulation of fisheries (or other natural resources) in the presence of the following two characteristics:

- 1) The fishery is shared between different countries, so there is at least one other country also regulating the fishery.
- 2) There is some level of political risk regarding future decisions in both/all countries, which is recognized both by fishermen and governments.

The main question we study is how this political risk should affect the government's policy. We focus on two aspects of government policy; enforcement levels and political uncertainty in own country. Our main result is that uncertainty about enforcement levels in the other country affects the optimal behaviour for the government in our country. If the optimal enforcement level in our country is a concave function of the enforcement level in the other country, uncertainty about the policy in the other country should reduce the optimal enforcement level in our country, which also implies that it is optimal for our country to remove more uncertainty about our policy than it would otherwise be. Conversely, if the optimal enforcement level in our country is a convex function of the enforcement level in the other country, uncertainty about enforcement in the other country should increase the enforcement level in our country, and it would be optimal to maintain a higher level of uncertainty about our own policy than otherwise.

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

Introduction and literature²

It is often difficult for governments to regulate the extraction of natural resources. One of the main obstacles for effective governance is uncertainty. The uncertainty could be related to the actual existing amount of the natural resource, short and long term environmental consequences of the extraction, future prices and demand for the natural resource, and the extent to which the firms involved in the extraction can be expected to comply with the regulations.

Obviously, such regulation is even more difficult when the resource is jointly managed by several different countries. In the rest of this paper, we will use a fishery as example of this problem, but the analysis should be applicable also to other natural resources.

A significant literature exists on the management of joined fisheries – see for instance Bjørndal and Munro, 2003 and Lindroos *et al.*, 2006 for reviews. Such fisheries are economically important, as well as challenging to analyse, because the two governments not are able to fully control or predict each other's actions (or lack thereof). Hence, game-theoretical models of various types are also useful – see e.g. Sumaila (1999) for a review of some of the fundamental work here.

This paper – and many of the references herein – is originally based on the Norwegian/Russian cod fishery in the Barents Sea, which is both economically important and controversial in some ways. The stock has decreased in recent years, mainly due to overfishing. The two countries agree on a total catch quota, which mainly is shared between the two countries (with smaller shares going to other countries with traditional interests in the fishery). Both the circumstances concerning the overfishing and the total amount of overfishing are, for obvious reasons, hard to specify in detail, but recently, Norwegian authorities have claimed that Russian fishermen are responsible for the lion's share of overfishing, which Norwegian authorities in turn claim is possible because Russian enforcement of quotas and other regulations is insufficient.

Even with this fishery as the starting point for our analysis, we will argue that many of the points are valid more broadly, both with regards to other fisheries and other situations with transboundary management of natural resources. Hence, we will not spend further time discussing the specific details and problems surrounding this fishery.

²The last half of this section is based on the introduction to Bergfjord (2009).

The beginning of this section mentions several different obstacles for regulation. In this paper, we will study the effect of different levels of – and uncertainty about – compliance to regulations among fishermen. A large body of literature exist on the enforcement and compliance in fisheries, and although most of these studies are concerned with management within one single country, many of the same principles apply to situations with joint management. The early work by Becker (1968) introduces a basis for this branch of literature – that fishermen maximize expected utility, by choosing a compliance level based on a) expected gains from non-compliance, b) risk (or perceived risk) of being detected, and c) level of punishment if detected. Several refinements to this basic framework are considered in later studies. An important issue is how other factors than expected utility affect fishermen's level of compliance. MRAG, 2005 points out that compliance tends to be higher the more the agents trust the government – a rather intuitive effect. Hatcher *et al.*, 2000 find that norms play a significant role – i.e., if fishermen believe others overfish or perceive the rules to be unjust, they tend to overfish more, whereas they are more likely to comply with their quotas if they have some kind of influence on the quota system. However, Hatcher and Gordon, 2005 conduct a second study of the same fishery where “traditional” economic criteria appear to be far more important than norms. Kuperan and Sutinen, 1998 and Sutinen and Kuperan, 1999 introduce some other factors of potential importance, including personal morals and trust in the scientific process behind the quotas, whereas Hønneland, 1999 develops a sociological model of compliance and non-compliance. With this in mind, we still choose to base our analysis mainly on traditional economic theory, where agents primarily act to maximize expected utility.

Although the issue of compliance is fairly well researched, less is known about how this is affected by political uncertainty³, i.e., the uncertainty about future political decisions. Political uncertainty has received limited attention in the academic literature, and what has been written usually concerns completely different areas than this. Often the discussion is more about how relevant risks should affect decisions (see, e.g., Arrow and Lind, 1970; Majumdar and Mukand, 2004) than about how the decisions themselves represent risks to agents. One main reason is, of course, that such risk is difficult to model due to the lack of good estimates of outcomes and probabilities. A particular problem is that political risk is

³Although «risk» and «uncertainty» originally described different phenomena, recent literature seems to use the terms fairly interchangeably, possibly because very few (interesting) problems are characterized by risk in a strictly Knightian meaning of the word, i.e., with known states and probabilities. Throughout this paper, the terms are also used interchangeably.

more important in extreme situations, where no empirical data from relevant situations are to be found.

One area where political risk is discussed is within the finance literature⁴. However, studies here mainly deal with political risk related to investments in foreign (developing) countries, where different indices are used to estimate the risk in each country. These risks typically include risk of expropriation, weak property rights and legal systems (Clark, 1997). It is worth noting that these risks are comparable to the risks we study, and another perspective could be to establish “country risk indices” related to enforcement levels (or other factors of interest) in different countries.

Another main area for work on political risk is the study of the future for social security and pension benefits (see, e.g., McHale, 1999 and Shoven and Slavov, 2006). This area has become more important over time as more attention has been paid to the increasing pension obligations most developed countries are facing. Again, some of the literature here could be interesting if our problem is studied from another perspective. Both social security and fishery are areas where uncertainty occurs and has effects over time, thus emphasizing the need to include even the distant future into the model.

Finally, there is a relevant branch within the political economy literature (see, e.g., Persson and Tabellini, 2002 for an overview). Again, however, most of the literature seems to study how political decisions eliminate or optimally distribute risk, and less how political decisions introduce new types of risk.

In this paper, we will link political uncertainty with the issues of joint management, compliance, and enforcement, to study how the always-present political uncertainty affects two important policy decisions.

The first important decision is how the level of political uncertainty should affect the level of enforcement the government should choose.

The second important decision is if – and how – the government should treat the political uncertainty it itself imposes on fishermen. It is debatable to what extent this could/should be changed, but as we shall see, the perception of this uncertainty, both by fishermen and other regulating governments, could sometimes be important.

In section 2, we briefly look at the effect of political uncertainty on optimal enforcement levels. In section 3, we study adjustments of the political uncertainty associated with the government itself, before we conclude in section 4.

⁴ See e.g., Nordal, 2001 for a real option approach and Erb *et al.*, 1996 for a more practical study.

Political risk and enforcement

A recent study of enforcement, using the Norwegian/Russian cod fishery as an example, provides some interesting results for this section. Hanneson, 2008 concludes that if the enforcement level in the other country is too low, this reduces the optimal level of enforcement in our country too. This result is fairly intuitive. If fishermen in the other country are free to overfish with no/low risk of detection, enforcement towards our fishermen will a) be costly, and b) lead to higher compliance among our fishermen, reducing total catch in our country, thus further encouraging overfishing in the other country as the stock grows/stays larger than it would be without enforcement in our country.

A question little discussed in the paper mentioned above is how uncertainty about the enforcement level in the other country should affect the enforcement level in our country. In other words: If the enforcement level (by some measure) in the other country is X , and analysis gives Y as the optimal enforcement level in our country; will the optimal enforcement level in our country be higher or lower than Y if the enforcement level in the other country is uncertain, but with X as the expected value?

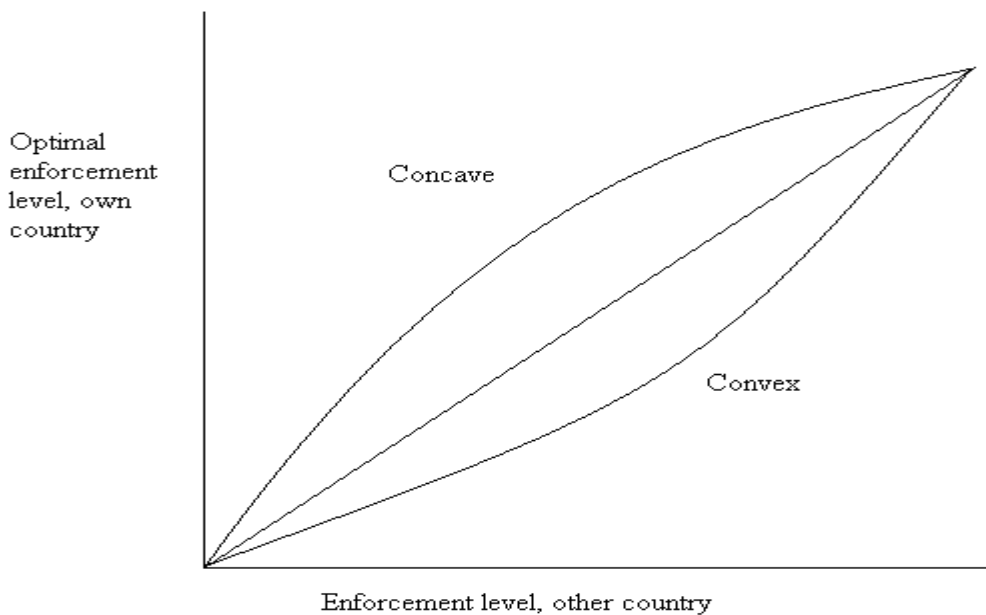


Figure 1: Optimal enforcement level as function of enforcement level in the other country

The result follows directly from the function properties. If our optimal enforcement level is a convex function of the enforcement level in the other country, the introduction of uncertainty about the other country's enforcement level means that our enforcement level will be higher

than without the uncertainty. On the other hand, if our optimal enforcement level is a concave function of the enforcement level in the other country, our enforcement level will be lower than without uncertainty.⁵ It is not obvious which of these conditions hold, or whether the function in fact is either strictly concave or strictly convex.

Adjustment of political risk

Whereas uncertainty about the enforcement level in the other country might be important to take into account for governments when setting their own enforcement level, fishermen are often more concerned about the uncertainty related to their own government, in particular about future policy changes. Such uncertainty might be related to changes in future enforcement level or punishment, but also to issues not directly related to criminality (or the potential for criminality), such as quotas or quota structure or other regulations.

Bergfjord and Brandt, 2009 analyze a situation where agents' rent seeking efforts are related to the political uncertainty they are facing. They use the figure below to illustrate the trade-off between rent seeking and risk:

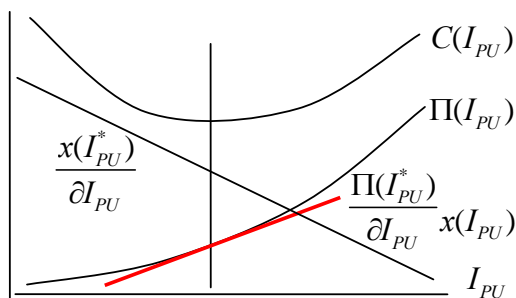


Figure 2: Aggregated costs related to political uncertainty

In this framework, Π measures the lost utility due to political risk and x measures the cost of rent seeking at different levels of political risk. The total cost C is the sum of these two components, and as derived in the paper mentioned above, this sum can, under some conditions, reach a minimum at other levels of political uncertainty than 0.

In fisheries and other practical applications, this indicates that keeping some level of uncertainty regarding future regulations and government actions sometimes might be beneficial. Fishermen's utility is reduced, but so are their opportunities for various types of rent seeking, which in some cases will lead to a positive net effect. Two basic and intuitive

⁵This assumes that we choose the average of the enforcement levels in the relevant area.

static results are derived: More political risk is beneficial in a situation where this strongly discourages rent seeking, and less political risk is beneficial the more risk averse agents are.

The same model could be used in our setting with joint management. However, the government must now take into account how their actions are perceived by the other government. Based on the simple figure above and the result from the previous section, we get the following argument: If the function mentioned in the previous section is concave, high uncertainty in our country will lead to a lower optimal enforcement level for the other country. This, in turn, is usually negative for our country – if given the choice, we will usually prefer the other country to enforce as strictly as possible. Thus, in this case uncertainty in our own country implicitly carries a cost – the cost of lower enforcement in the other country, and the optimal level of uncertainty is moved towards the left in figure 1 – to a lower level of uncertainty than one would expect only considering risk attitudes and rent seeking opportunities. If the function is convex, we get the opposite argument. In this case, uncertainty in our country will lead to a higher optimal level of enforcement in the other country, which could be interpreted as a benefit from uncertainty. In this case, the optimal level of uncertainty will thus be higher than if one only considered risk attitudes and rent seeking opportunities.

Conclusion

We have found that optimal enforcement level and level of political risk – every things else being equal – depends on the relation between enforcement level in the other country and optimal enforcement level in our country. So far, so good. The key phrase here is, as always, the *ceteris paribus* condition. Although difficult to model, it seems reasonable to argue that several factors contribute to a setting where political uncertainty, compliance, enforcement and rent seeking are all related.

The first issue is the link between political uncertainty and enforcement. It is here assumed that political uncertainty is an exogenous variable, controlled by the government for instance to minimize the total cost of this uncertainty (rent seeking + lost utility from uncertainty). When comparing two different countries, it is unlikely that different levels of political uncertainty exist because the two governments consciously have decided on different levels. Rather, the difference will probably be due to real differences in government quality, where one country is unable (or unwilling) to get to the same low level of political uncertainty as the other country. In turn, one would expect that this quality difference also would affect

both the quality and cost of enforcement, which in turn would affect the optimal level of enforcement, and the optimal level of compliance.

The second issue is the direct link between political uncertainty and compliance. We have argued that uncertainty about political decisions in the future sometimes can be beneficial to prevent undesirable behavior today. Another effect of regulatory changes or uncertainty thereof is that the higher the political uncertainty is, the more likely it is for fishermen to misunderstand – or pretend to misunderstand – the regulatory system. This “confusion effect” could well be more important than the trade-off between political risk and rent seeking discussed above.

We have argued that, depending on the relationship between enforcement level in the other country and our enforcement level, it could sometimes be useful to increase the level of political uncertainty in our own country. This is also a result from Bergfjord and Brandt (2009), where rent seeking is the reason why it sometimes seems optimal to keep the level of political uncertainty higher than the minimum. However, based on the considerations above, it by and large seems like a good idea to stick with the traditional thinking – that reducing the political uncertainty is a good thing. If steps to increase the uncertainty is viewed as a sign of bad governance, rather than a rational strategy – which could very well be the case – the effect would be different from the original intention.

References

- Arrow, K.J. and Lind, R.C., 1970, "Uncertainty and evaluation of public investment decisions", *American Economic Review*, 60, 364-378.
- Becker, G.S., 1968, «Crime and Punishment: An Economic Approach», *Journal of Political Economy*, 76, 169-217.
- Bergfjord, O.J., "Essays on aquaculture, risk and politics", 2009, University Press of Southern Denmark, Denmark.
- Bergfjord, O.J. and Brandt, U.S., 2009, "Regulations, risk, and rent seeking behaviour", *Journal of Risk and Governance*, forthcoming.
- Bjørndal, T. and Munro, G., 2003, «The management of high seas fisheries resources and the implementation of the U.N. fish stocks agreement of 1995», In H. Folmer and T. Tietenberg (Eds.), *International Yearbook of Environmental and Resource Economics 2003/2004: A Survey of Current Issues*, Edward Elgar, Cheltenham, UK.
- Clark, E., 1997, "Valuing political risk", *Journal of International Money and Finance*, 16(3), 477-490.
- Erb, C.B., Harvey, C.R., and Viskanta, T.E., 1996, "Political Risk, Economic Risk, and Financial Risk", *Financial Analysts Journal*, 52(6), 29-46.
- Hannesson, R., 2008, «When is fish quota enforcement worth while? A study of the Northeast Arctic cod», SNF Working Paper 27/08,
http://bora.nhh.no/bitstream/2330/2141/1/A27_08.pdf
- Hatcher, A., Jaffry, S., Thébaud, O. and Bennett, E., 2000, «Normative and Social Influences Affecting Compliance with Fishery Regulations», *Land Economics*, 76, 448-461.
- Hønneland, G., 1999, «A Model of Compliance in Fisheries: Theoretical Foundations and Practical Application», *Ocean & Coastal Management*, 42, 699-716.

- Kuperan, K. and Sutinen, J.G., 1998, «Blue Water Crime: Deterrence, Legitimacy, and Compliance in Fisheries», *Law & Society Review*, 32, 309-338.
- Lindroos, M., Kronbak, L.G., and Kaitala, V., 2006, «Coalitions in fisheries games», In Bjørndal, T., Gordon, D., Arnason, R., and Sumaila, U. (Eds.), *Frontiers in the Economics of the Fishery: Papers in Honour of Professor Gordon Munro*, Blackwell, Oxford, UK.
- Majumdar, S. and Mukand, S.W., 2004, “Policy Gambles”, *American Economic Review* 94(4), 1207-1222.
- McHale, J., 1999, “The Risk of Social Security Benefit Rule Changes: Some International Evidence”, *NBER Working Paper 7031*.
- MRAG, 2005, «*Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries*», A report prepared for the UK’s Department for International Development (DFID).
- Nordal, K.B., 2001, “Country Risk, Country Risk Indices and Valuation of FDI: A Real Options Approach”, *Emerging Markets Review*, 2(3), 197-217.
- Persson, T. and Tabellini, G., 2002, “*Political Economics: Explaining Economic Policy*”, MIT Press, Massachusetts, USA.
- Shoven, J.B. and Slavov, S.N., 2006, “Political Risk versus Market Risk in Social Security”, *NBER Working Paper 12135*.
- Sumaila, U.R., 1999, “A review of game-theoretic models of fishing”, *Marine Policy*, 23(1), 1-10.
- Sutinen, J. G. and Kuperan, K., 1999, «A socio-economic theory of regulatory compliance», *International Journal of Social Economics*, 26, 174-193.