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Eric Neumayer

London School of Economics and Political Science, Houghton Street, London WC2A 2AE, U.K.

Phone: 0171-955-7598. Fax: 0171-955-7412. Email: e.neumayer@lse.ac.uk

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Abstract

Economic theorists of international environmental cooperation and regime theorists who focus on the environment ask the same two basic research questions: why does international environmental cooperation emerge in some cases, but not in others, and why is cooperation 'wide' and 'deep' in some cases, but not in others? Unfortunately, the two schools of thought do not collaborate much in their respective attempts to answer these and related questions. Instead, mutual neglect is the general rule. This paper tries to show how regime theory can learn from the findings of the economic theory of international environmental cooperation and vice versa and how both can fruitfully learn from each other. An exploitation of mutual learning opportunities is likely to lead to a more comprehensive understanding of international environmental cooperation and can ultimately result in better informed policy advice.

1. Introduction

Many environmental problems are truly international or global. They cannot be tackled by a single country alone. Hence international cooperation is needed for a solution. But whereas environmental policy can use the enforcing power that sovereign nation-states ideally have within their territory, in general international environmental policy cannot take recourse to a supra-national authority with enforcing powers. International environmental cooperation has to be accomplished under anarchy.

Regime theory has long since addressed the question of how cooperation can be achieved and sustained in a world divided into sovereign nation-states.[1] It has done so with respect to many issues, especially security, economics and finance, not merely the environment. Independently from regime theory and starting from around the early 1990s a branch of international environmental economics that is called here the economic theory of international environmental cooperation has engaged in substantial research on the subject as well. It has tackled the question that has traditionally occupied regime theorists most: 'why does cooperation emerge in some cases and not in others?'[2] Unfortunately, the regime theory literature that focuses on the environment is not inspired by the results from this research. Similarly, the economic literature on international environmental cooperation is to a great extent ignorant of the contributions from regime theory and does not consider how it could benefit from a better understanding of its findings.

I would like to thank three anonymous referees for helpful comments.

1 For an overview, see, for example, Haggard and Simmons 1987 and Hasenclever, Mayer and Rittberger 1996.

2 Oye 1985b, p. 1.

Indicative of this mutual neglect is that the works of Scott Barrett and Carlo Carraro — presumably the most prominent representatives of the economic theory of international environmental cooperation — are hardly cited in any paper from regime theory. Usually, these papers do not mention or take any notice of the major results from the economic theory of international environmental cooperation. On the other hand, some of the papers of the economic theory of international environmental cooperation do cite contributions from regime theory.[3] However, reference is often cursory only and major results from regime theory are only occasionally integrated into model building. Furthermore, that papers from regime theory are cited in the economic literature of international environmental cooperation is the exception rather than the rule. Indicative of this neglect is Carraro's suggestion that 'the idea of ''issue linkage'' was originally proposed by Folmer et al. (1993) and Cesar and de Zeeuw (1996) to solve the problem of asymmetries among countries'[4], when this proposition actually goes back to early contributions from regime theory and negotiation theory.[5]

In the next two sections, I show how regime theory could benefit from a better understanding of the basic findings from the economic theory of international environmental cooperation and vice versa. Then several examples are provided on how the two schools of thought could fruitfully engage in mutual learning from each other in order to achieve international environmental cooperation that is 'wider' and 'deeper'.[6]

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3 For example, Cesar 1994; Cesar and de Zeeuw 1996; Batabyal 1996; Helm 1998; Ecchia and Mariotti 1998, Barrett 1999.

4 Carraro 1997, p. 9.

5 See, in particular, Iklé 1964; Tollison and Willett 1979; Haas 1980; Sebenius 1983.

6 International environmental cooperation is defined here to be 'wider' if it includes more countries with responsibility for the environmental problem. It is defined here to be 'deeper' if it increases the

Oran R. Young praises the returns from inter-disciplinary research in international affairs in suggesting that 'we have entered a period of profound change in our thinking about governance in international society that offers an exciting new research agenda for students of international affairs and an opportunity to bridge the gap that has long separated the main streams of research in the fields of international relations, international law, and political science.'[7] Young does not include the economic theory of international environmental cooperation. One possible reason might be that there still exists a gap between the fields he mentions and the economic theory of international environmental cooperation. In a nutshell, it is the aim of this paper to convince readers that it is worth while closing this gap.

2. Learning from the economic theory of international environmental cooperation

It would be beyond the scope of this paper to provide a full sketch of the economic theory of international environmental cooperation here. Instead, I shall concentrate on those results that might be of special interest to scholars of regime theory. One of the major contributions of the economic theory of international environmental cooperation has been an elaboration of what the absence of a central state authority in international affairs implies for the scope and depth of cooperation.

Before I come to this it seems appropriate, however, to explicate the assumptions on which the economic theory of international cooperation is based upon. Arguably, four of its assumptions are the most important ones: first, it is utilitarian in that it assumes that

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difference between the net benefits achieved by cooperation relative to the net benefits without such cooperation.

7 Young 1994, p. 12.

all aspects of decision-making can be captured by utility-relevant costs and benefits and that agents maximise a utility function; second, it assumes that agents decide rationally, taking into account all available information; third, if it applies game theoretic analysis, which it often does, it assumes that there is a unitary actor who, fourth, is faced with a well specified payoff matrix. Clearly, these assumptions are rather restrictive. However, they are often justified in order to construct a tractable model that results in testable propositions. As in other areas of the field, economists have never been very impressed by the low degree of realism of its assumptions as long as its propositions have performed well in tests. We will now look at some of the propositions the economic theory of international environmental cooperation has arrived at. In the next section, we will see, however, that at times the low degree of realism of its assumptions has led to significant shortcomings in its propositions.

SELF-ENFORCEMENT AND RENEGOTIATION-PROOFNESS.

The economic theory of international environmental cooperation has taken the idea of 'cooperation under anarchy'[8] very seriously and has developed the concepts of self-enforcing and renegotiation-proof agreements.[9] What does this mean? As regards most international environmental problems the affected countries are confronted with a basic Prisoner's Dilemma, in the following sense: the countries have an interest in reducing emissions that give rise to the problem and all countries are better off with international environmental cooperation, but each and every one of them also has an incentive to free-ride on the others' efforts and to enjoy the benefits of abatement without incurring any

8 Oye 1985a.

costs of emission reduction. Therefore international agreements normally have to deter *external* free-riding, that is, they have to deter countries that would benefit from emission reduction from not signing up to the agreement and staying outside. Equally, they have to deter *internal* free-riding, that is, they have to deter signatory countries from not complying with the requirements of the agreement. What is important is that the mechanism employed to achieve deterrence has to be self-enforcing in the sense that a recourse to an external enforcement agency is not feasible: No country can be forced to sign an agreement and signatories cannot be forced to comply with the agreement.

There exist many mechanisms that could potentially achieve such deterrence. Most of them, such as trade and other economic sanctions as well as a refusal to cooperate in other issue areas, depend on what has become known as issue linkage – a topic to which I will come back later on. Assuming for the moment that issue linkage is impossible or undesirable for whatever reason, then the only variable left to a country is the amount of pollution it emits. Hence, the only mechanism left is to threaten not to undertake any emission reduction in order to deter external free-riding or to decrease emissions by less than required by the agreement in order to punish non-compliant countries and to deter internal free-riding. This threat has to be credible in the sense that it is in the interest of the threatening country (or countries) to actually execute the threat whenever other countries try to free-ride. In other words, a threat cannot be credible if a country is worse off after executing the threat than it would be without execution. Non-credible threats cannot deter because potential free riders will anticipate that they could get away with free-riding without being punished. Moreover, an agreement which estab-

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9 The major contributions are Barrett 1990, 1991, 1994a, 1994b, 1997a, 1997b; Carraro and Siniscalco 1993; Botteon and Carraro 1997; Endres and Finus 1998; Finus and Rundshagen 1998a, 1998b. But see also the references in other notes further below.

lishes such a mechanism to deter free-riding has to be renegotiation-proof. This means that the threat has to be credible also in the sense that the threatening country (or countries) must be better off actually executing the threat than refraining from execution and renegotiating a new agreement with the free-riding country (or countries). Agreements that are not renegotiation-proof cannot deter because potential free riders will anticipate that they could strike another deal after free-riding and could therefore get away without being punished.

The concept of renegotiation-proofness is more relevant and significant than might be clear at first sight. The suggestion that cooperation under anarchy is possible is often implicitly or explicitly based on the Folk Theorem from game theory, which implies that full cooperation in an infinite or not obviously finite Prisoner's Dilemma can be sustained as a subgame perfect equilibrium if the discount rate is 'sufficiently small' (the shadow of the future is 'sufficiently long').[10] One prominent supergame strategy that can achieve full cooperation as a subgame perfect equilibrium is the so-called trigger strategy. In a two-players game the trigger strategy is defined as follows: start with cooperation and continue cooperation until the other player defects after which defect forever. The problem with this and many other strategies is that they are not credible because they are not renegotiation-proof. The player who is punished by 'defection forever' has an incentive to suggest to the punisher to forget about the past and to start mutual cooperation anew. The punisher itself has an incentive as well to let bygones be bygones and to refrain from punishing forever. Hence the trigger strategy is vulnerable to renegotiation and cannot achieve mutual cooperation in a repeated Prisoner's Dilemma game. The players cannot get rid of the incentives for renegotiation because they cannot credibly commit to executing the 'defect forever' threat. Renegotiation-proof equilibria are

[10] See, for example, Axelrod (1984).

only a subset of subgame perfect equilibria, hence not all subgame perfect equilibria can be sustained via renegotiation-proof supergame strategies.

Renegotiation-proofness is quite a far-reaching requirement. Not only does it rule out certain supergame-strategies, it also rules out other proposals on how to promote cooperation. Black, Levi and Meza, for example, have shown how a minimum participation clause in international agreements can in principle induce more countries to join the agreement.[11] In their model, there are only two options: either at least as many countries sign the agreement as specified by the minimum participation clause or the agreement never comes into effect. This mechanism promotes participation as each country has to balance the benefits from free-riding against the benefits forgone if it does not sign the agreement and thereby contributes to increasing the likelihood that cooperation is inhibited once and for ever. Also, the clause assures each participating country that at least as many other countries will cooperate as required by minimum participation, which helps to reduce the concerns of the cooperating countries about widespread free-riding. However, the problem with this device is that it is not renegotiation-proof. If the minimum number of countries for the agreement to come into effect is not achieved the first time, the signatory countries can always renegotiate and lower the minimum participation clause. Alternatively, if the agreement does come into effect, the signatory countries have an incentive to revert to free-riding *ex post* and to break the agreement after it has come into effect. Indeed, the more successful the minimum participation clause initially was in increasing the number of signatories, the greater the incentive for a potential free-rider to break it afterwards.

The economic theory of international environmental cooperation has examined the implications on cooperation if countries are restricted to strategies that must be renego-

11 Black, Levi and Meza 1993.

tiation-proof. If issue linkage is impossible or undesirable, then one basic result holds: a self-enforcing and renegotiation-proof agreement will *either* consist of only a small subset of affected countries *or* if many countries are parties to the agreement then the gains from cooperation relative to the non-cooperative equilibrium are very small. In other words, large-scale cooperation will either not take place as only few countries sign the agreement or if it does take place it is virtually irrelevant as the agreed upon cooperation improves only marginally on what would have been achieved by unilateral action in the absence of the agreement. Cooperation is either narrow (instead of wide) or shallow (instead of deep).[12]

This result leads us to pessimistic expectations about a solution to an environmental problem exactly for those problems, for which international cooperation is most needed. To see this, note that for the case where the benefits from emission abatement are high and the costs are low (for example, ozone depleting substances), the basic result that cooperation will either be narrow or, if wide, will not be deep, does not matter much as countries have big incentives to solve the problem unilaterally. The same might even be true if the benefits from abatement are relatively low as long as the costs are low as well. Similarly, for the case where the benefits from abatement are low and the costs are high, the basic result from the economic theory of international environmental cooperation does not matter much as even the full cooperative outcome would not do much about the environmental problem due to high costs. The case where the basic result is really relevant is the one where benefits from abatement are high, but so are costs (for exam-

[12] Cooperation can be wider and deeper if emission abatement is characterised by fixed costs, so that average costs are falling over a certain range of abatement, or if emission abatement creates positive technological externalities, so that abatement by one country reduces the abatement costs by other countries — see Heal 1994.

ple, greenhouse gas emissions). These are exactly the cases where a solution to the environmental problem would demand wide and deep cooperation most.[13]

The intuitive reason for this most basic result of the economic theory of international environmental cooperation is as follows: In order to deter free-riding, an agreement must specify that the non free-riding countries increase their emissions relative to an agreement without free-riding in order to punish free-riders for not decreasing their emissions at all (external free-riding) or by not as much as requested by the agreement (internal free-riding). In order to deter, the damage to the potential free-rider caused by the increase in emissions must be greater than the potential benefit from free-riding. The wider and deeper cooperation is, the higher is the benefit from free-riding so that the damage to the potential free-rider must also increase in order to deter free-riding. The problem is, however, that the bigger is the damage to the potential free-rider, the bigger is the damage to the punishing countries themselves as well. This self-inflicted damage due to the emission increase limits the punishment that is available for free-rider deterrence. It must not hurt the punishing countries more than the damage caused by the free-riding. Otherwise it will not be credible as the potential free-rider knows that it is not in the best interest of the punishing countries to execute the punishment.

What is more, there must not exist any incentive for the punishing countries and the free-riders to renegotiate the agreement and strike another deal. For this condition to hold, the punishment must not be very high or else the damage to the free-riding country is big as is its incentive to renegotiate another agreement. Because of these twin reasons the credible punishment available cannot be very substantial which means that it cannot deter much free-riding. Because external free-riding can be deterred only to a small extent, free-riding is ubiquitous and the number of countries participating in an agreement

[13] Barrett 1991, pp. 14f.

is small. Alternatively, because internal free-riding can be deterred only to a small extent, then the agreement cannot improve much relative to the non-cooperative equilibrium in order to keep the incentives for non-compliance small, if the number of signatories is large.

The consequences of the requirements of self-enforcement and renegotiation-proofness are challenging for regime theory with its belief in the possibility of wide and deep cooperation in spite of anarchy. But is it of any real-world relevance? This is a question that is difficult to answer. How do we know whether the gains from cooperation are small relative to the non-cooperative equilibrium? The fact that cooperation exists means that we cannot directly observe what the outcome would be without cooperation. And how do we know what the full cooperative outcome would look like? The few studies that have tried to gain evidence on this question in applying econometric techniques have supported the basic finding of the economic theory of international environmental cooperation: James C. Murdoch and Todd Sandler suggest that the Montreal-Protocol does not reduce ozone damaging chlorofluorocarbons (CFCs) by much more than the major producers would have reduced unilaterally out of their own selfish interest.[14] Hence, the Montreal Protocol 'may be more symbolic than a true instance of a cooperative equilibrium, since nations' CFC reductions prior to the treaty taking effect appear to fit the predictions of a single-shot Nash equilibrium'.[15] Similarly, Murdoch, Sandler and Keith Sargent find that for the Helsinki-Protocol limiting SO_2-emissions and for the Sofia-Protocol limiting NO_x-emissions the cooperative gains are small rela-

14 Murdoch and Sandler 1997.

15 ibid., pp. 332f.

tive to the non-cooperative equilibrium: '...nations achieved emission reduction levels and then drafted the treaty with these levels as targets.'[16]

LEAKAGE. Another major topic where regime theory could learn from the economic theory of international environmental cooperation is the aspect of leakage and how leakage exacerbates the problems of free-riding. Leakage describes the phenomenon that a decrease in emissions by the participants to an agreement is counter-acted by an increase of emissions by non-members. Such an increase can be a deliberate decision by the free-riding countries. Because the decrease in emissions by the participants lowers the marginal social damage of emissions by the non-participants their non-cooperative Nash equilibrium emissions rise. These non-members will therefore usually find it in their own best interest to deliberately increase emissions. However, this is just part of the story. The other reasons why emissions of non-participants might rise are more subtle and can hardly be traced back to a deliberate policy by these countries to exploit the emissions reductions of others. To understand this point, take the example of carbon dioxide emissions. If a sub-set of all countries agrees on limiting their carbon dioxide emissions, then production of carbon-intensive goods and services becomes relatively more expensive in these countries. Comparative advantage in these goods and services shifts to the non-participating countries who increase their production of carbon-intensive goods and services. Similarly, some especially carbon-intensive industries might migrate from signatory to non-signatory countries. Also, the reduction in demand for fossil fuels due to the limitation of carbon dioxide emissions by the participants to the agreement will lower world fossil fuel prices which increases demand for fossil fuels in non-member countries. All of these feedback mechanisms lead to an increase of

16 Murdoch, Sandler and Sargent 1997, p. 298.

emissions by non-participants quite involuntarily, that is, without the participating countries being able to blame the non-members for deliberately exploiting their emission reductions. How significant leakage would be depends on the underlying assumptions about how many countries form an agreement, reduce emissions by how much and use which instrument for emission reductions. Econometric estimates show that leakage could be anywhere between around 5% and 30%.[17] In any case, leakage can potentially be a quite important obstacle for international environmental agreements and it would certainly pay regime theory to give more attention to the ways in which the benefits of international environmental cooperation can leak away.

One problem is how to distinguish leakage that is due to price effects and shifts in comparative advantage from free-riding proper. Another problem is that leakage is very hard to avoid. Peter Bohm suggests that participating countries could purchase or lease fossil fuel deposits in order to neutralise the price effects from lower demand, but this suggestion seems to be utterly unrealistic.[18] Another theoretical possibility is to restrict imports of carbon-intensive goods from non-participating countries. As this would affect a wide range of goods, it would almost certainly clash with international trade regimes such as the World Trade Organization, however, and is therefore not likely to be employed.

On the other hand, the existence of substantial leakage can also induce the formation of international environmental agreements with a large number of participating countries. This is because, all other things equal, the return from large-scale cooperation is higher if leakage is a substantial problem. These two countervailing effects of leakage

17 For an overview, see Smith 1998.

18 Bohm 1993.

can imply that two equilibria exist: one with few and one with very many participating countries.[19]

STRATEGIC INCENTIVES. More generally, regime theory could learn from the economic theory of international environmental cooperation about the strategic effects of certain measures that appear to promote cooperation, but might indeed very well reduce cooperation. To give an example: side-payments and joint implementation measures are often thought of as being beneficial for international cooperation as they induce non-participant countries to engage in some form of emission reduction as well. The model of Michael Hoel and Kerstin Schneider suggest, however, that the very existence of these measures can represent a very strong strategic incentive for potential participants to stay out of the agreement so that they have to be 'bought into it' later on.[20] Perversely, these unintended strategic side-effects can more than compensate for any cooperation gains side-payments and joint implementation measures can bring about. Furthermore, the model of Franz Wirl, Claus Huber and I.O. Walker shows that due to strategic incentives in joint implementation, cheating on both sides can be pervasive and the emission reductions achieved via joint implementation can be largely faked rather than real.[21]

19 See Botteon and Carraro 1997.

20 Hoel and Schneider 1997.

21 Wirl, Huber and Walker 1998.

3. Learning from regime theory

Regime theory covers a wide and broad range of approaches towards the study of international regimes.[22] It would be impossible to provide a complete overview here.[23] Instead I shall illustrate for a number of topics how the economic theory of international environmental cooperation could learn from regime theory.

The first issue has to do with the coordinating function of regimes. Many scholars of the economic theory of international environmental cooperation point out that their models are characterised by multiple equilibria that differ on how much cooperation is achieved and who gains by how much relative to others.[24] On this they could learn from regime theory on how regimes create 'bargaining forums'[25] to coordinate the selection of certain equilibria.[26] Without explicitly referring to the regime theory literature, Michele Botteon and Carraro acknowledge the beneficial role regimes can play in stating that 'how to move from one equilibrium to the other is a matter of coordination, which demands for new international institutions'.[27] Similarly, Engelbert J. Dockner and Ngo

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22 Regimes should be understood here as 'implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations' (Krasner 1983, p. 2), which is the standard definition of regimes.

23 See Haggard and Simmons 1987 and Hasenclever, Mayer and Rittberger 1996 for an overview of regime theory in general. For special reference to environmental regimes, see Young and von Moltke 1994 and Young 1998.

24 See, for example, Mäler 1991, p. 84f; Dockner and Long 1993, p. 15; Hoel and Schneider, p. 155; Botteon and Carraro 1997, p. 17. This point is also observed by regime theorists who employ game theory in their analysis. See, for example, Niou and Ordeshook 1994, p. 220; Kydd and Snidal 1995.

25 Levy, Keohane and Haas 1993, p. 40.

26 Compare Morrow 1994. At least some economists seem to recognise this function of regimes at last, see Ecchia and Mariotti 1998.

27 Botteon and Carraro 1997, p. 17.

Van Long implicitly refer to regimes when they state that 'our results suggest that there are good reasons for negotiators to meet and communicate even if no contracts can be expected to be signed' and that 'presumably preplay negotiations would lead to the choice of the most efficient strategy pair'.[28] 'Cheap talk', often denounced by economists as irrelevant because of its non-binding character,[29] becomes important once the existence of multiple equilibria and the necessity of a device for equilibrium selection is fully acknowledged. However, the presumption that the most efficient strategy pair will be chosen might well be wrong. The economic theory of international environmental cooperation could learn from regime theory that countries very often pay overwhelming attention to clearly perceivable distributional issues and are only little concerned about the rather abstract notion of Pareto-efficiency that dominates economic reasoning.[30] Most of the relevant literature of the economic theory of international environmental cooperation implicitly assumes that international environmental agreements will end up on the Pareto-efficient contract curve. Regime theory in general does not share this misguided assumption.

The selection among different equilibria resembles a coordination game for which many of the traditional findings from the simple Prisoner's Dilemma literature are not valid anymore. As distributional issues come to the forefront, a long shadow of the future can have a detrimental rather than beneficial effect on cooperation as it pays to hold out longer in the hope to reach a distributionally more favourable equilibrium for one-

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28 Dockner and Long 1993, pp. 15 and 24. Characteristically for many contributions from the economic theory of international environmental cooperation, the papers by Botteon and Carraro and by Dockner and Long do not contain a single reference to the regime theory literature.

29 Which is exactly the reason why it is called 'cheap'.

30 Young 1989, pp. 368f.

self.[31] Connected to this point, the economic theory of international environmental co-operation could learn from realist regime theory to take into account that countries are concerned about relative in addition to absolute gains and losses.[32] Economics with its preoccupation with efficiency has not paid enough attention to relative distributional issues and has to make up on this respect. A state might refuse to cooperate if it expects that its partners will gain relatively more from cooperation. Surely, what Joseph M. Grieco calls 'state positionality'[33] plays more of a role in security matters than in environmental issues, even though a good case can be made that states pay attention to relative gains and losses as concerns natural resource exploitation and the costs of emission abatement.[34] Also, Duncan Snidal has shown that if the number of states involved is large, relative gains maximisation will not constrain the scope for cooperation to a great extent.[35] Nevertheless, it would pay economists to take state positionality into account in model building and examine how robust the results are. Similarly, economists have to pay more attention to how power in international relations determines who is allowed to play the game, who gets to move when and how power can be used to change the payoff matrix of the game.[36]

More generally, the economic theory of international environmental cooperation could learn from the institutionally rich analysis of regime theory on the various functions regimes provide and how they foster international cooperation. Economists could profit from a better understanding of how regimes can enlarge the shadow of the future

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31 See Snidal 1985, p. 936; Fearon 1998.

32 Compare Grieco 1988.

33 ibid., p. 499.

34 List and Rittberger 1992, pp. 93f.

35 Snidal 1991a, 1991b.

36 Compare Krasner 1991.

in making interaction more durable and more frequent[37] and how earlier mutually advantageous experience with regimes induces prospective partners to be more cooperative in the building of new regimes — an aspect that Keohane circumscribes as the reputational aspect of regimes.[38] The analysis of the economic theory of international environmental cooperation would be enriched by recognising how regimes provide ongoing negotiating processes that reduce transaction costs[39] and help making transfers and linkages by clustering issues[40]. The same holds true for a recognition of how regimes provide monitoring and verification services[41] as well as implementation review mechanisms[42]. It can learn from regime theory how important regimes can be in strengthening the domestic capacity of weak governments to comply with an agreement via a transfer of technical assistance and general aid.[43]

The economic theory of international environmental cooperation could also benefit from a better understanding of how important a participatory approach towards international agreement making and procedurally fair rules are for bringing about cooperation. For example, substantially the same bargaining outcome that is accepted by a party if it feels sufficiently involved in the bargaining process can be rejected if the party feels

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37 Axelrod 1984, p. 129.

38 Keohane 1984, p. 94.

39 This beneficial aspect has to be balanced against the problem that an ongoing negotiation process often lets a considerable amount of time pass by until the environmental problem is eventually tackled (Susskind 1994, chapter 1).

40 Milner 1992.

41 Levy, Keohane and Haas 1993, pp. 402f.

42 Young and Demko 1996, p. 233.

43 Levy, Keohane and Haas 1993, p. 405.

treated unjustly.[44] The importance of procedural fairness holds especially true when participants, as David Lewis Feldman observes, 'do not bargain from pre-established positions, but, in many cases, enter into negotiations precisely to learn more about a problem'.[45] An understanding of this aspect will also allow the economic theory of international environmental cooperation to comprehend why at times individual leadership in negotiations and an exogenous crisis or shock, such as a nuclear power accident or satellite pictures showing a hole in the ozone layer, are important in bringing about international cooperation.[46] Connected to this, the economic theory of international environmental cooperation could learn from the weak cognitivist or epistemic community branch of regime theory how important a consensus community of scientists can be for bringing about negotiations and shaping state actors' interests[47] and how regimes help states to re-evaluate their interests[48]. How international networks of scientists can serve as catalysts and facilitators for regime formation has mostly been ignored by the economic theory of international environmental cooperation.

The finding from Young and Gail Osherenko that states tend to agree on uncomplicated formulas and across-the-board or equal relative emission cuts even if efficiency is sacrificed could teach economists that complicated formulas for the allocation of the burden of abatement such as those in the models of Parkash Chander and Henry Tulkens, that can theoretically achieve efficiency, are hopelessly unrealistic and would

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44 Young and Demko 1996, p. 232 and 238f.

45 Feldman 1991, p. 379.

46 Young and Osherenko 1995, pp. 230ff.

47 Young and Osherenko 1995, p. 237; Mayer, Rittberger and Zürn 1995, p. 415. See, for example, Haas 1989, 1990a, 1990b, 1992a, 1992b, 1995.

48 Levy, Keohane and Haas 1993, p. 398 Levy, Keohane and Haas 1993, p. 398.

never be agreed upon in real negotiations.[49] As originally pointed out by Thomas C. Schelling, states look for 'focal points' or 'salient solutions' in international bargaining, not for highly complex formulas.[50] Some initial steps in building more realistic models have already been undertaken. The models of Alfred Endres and Michael Finus and Finus and Bianca Rundshagen explicitly assume that players agree on uniform solutions for all participants in a game of incomplete information.[51] They rationalise this assumption in suggesting that uniform solutions appear to be 'fair' to all participants and have low transaction costs as an agreement on differentiated solutions would take more time. Also, the models assume that negotiating partners agree on the 'smallest common denominator' solution at the end of the bargaining process. This is because no country can be forced to sign the agreement, hence the uniform solution cannot go beyond what the 'bottleneck country' is willing to do.[52] Both assumptions are frequently observed characteristics of international environmental agreements and represent an important step towards making the economic theory of international environmental cooperation conform more with the reality of international bargaining on environmental issues.

One concrete example on how regime theory might contest some of the empirical evidence that proponents of the economic theory of international environmental cooperation invoke in support of their propositions is the already mentioned study by Murdoch and Sandler.[53] From a regime theoretic perspective, this study suffers from at least two major shortcomings: first, even if the reductions agreed upon in the Montreal Proto-

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49 Young and Osherenko 1995, p. 233; Chander and Tulkens 1995, 1997.

50 Schelling 1960.

51 Endres and Finus 1998; Finus and Rundshagen 1998b.

52 It is assumed that transfer payments are infeasible.

53 Murdoch and Sandler 1997. I am grateful to an anonymous referee to draw my attention to this example.

col correspond with what Murdoch and Sandler predict as a Nash equilibrium, it might be misleading to call these 'voluntary' as they might have been undertaken in anticipation of the restraints an international environmental agreement such as the Montreal Protocol would impose on nation-states. Thus, Murdoch and Sandler are likely to underestimate the importance of international negotiations for bringing about these emission reductions. Second, and connected to the last point, it seems inappropriate to only look at the Montreal Protocol without looking at its various amendments which made emission reduction obligations more stringent. Even if the Montreal Protocol can be interpreted as codifying emission reductions nation-states would have undertaken anyway, it is much more doubtful whether the same could be said of the more stringent amendments to the Protocol that followed suit.

Another example is the similar finding in the already mentioned study by Murdoch, Sandler and Sargent on the Helsinki and Sofia Protocols.[54] If international environmental cooperation is not particularly deep here, this might have much more to do with the fact that it brought together countries with hugely different value systems at or shortly after the height of East-West tensions rather than with the problems of self-enforcement and renegotiation-proofness. Given these differing value systems both Protocols might therefore be interpreted as a very successful example of regime formation in the face of enormous obstacles to negotiation rather than as evidence that the requirements of self-enforcement and renegotiation-proofness will invariably prevent international environmental cooperation from becoming deep.

54 Murdoch, Sandler and Sargent 1997.

4. Achieving wide and deep cooperation: Prospects for mutual learning opportunities

So far I have tried to demonstrate how one school of thought can learn from the findings of the other. In this section, I shall present several examples for how regime theory and the economic theory of international environmental cooperation could fruitfully learn from each other. All the topics that I refer to here are part of ongoing projects by either regime theory or the economic theory of international environmental cooperation. However, it is the aim of this section to show how both streams of research might gain from cross fertilisation.

COMPLIANCE. One such example is the question of why states comply with international agreements and what this implies for the problem of free-riding. Abram Chayes and Antonia Handler Chayes have tried to show that non-compliance with the requirements of an agreement is the exception rather than the rule in the practice of international relations.[55] If non-compliance occurs it is often due to insufficient managerial capacity, rather than a deliberate decision to free-ride on others' efforts. Chayes and Chayes conclude from their findings that the 'free rider problem has been overestimated'.[56] This conclusion is highly contested, however. George W. Downs, David M. Rocke and Peter N. Barsoom have argued that the marginality of non-compliance is due to 'the fact that most treaties require states to make only modest departures from what they would have done in the absence of an agreement'.[57] Their argument is strongly supported by the basic result of the economic theory of international environmental co-

55 Chayes and Chayes 1995.

56 ibid., pp. 19f.

57 Downs, Rocke and Barsoom 1996, p. 380.

operation, which clearly shows that free-riding is a great problem as it is the impotence to deter free-riding on a large scale that limits the gains to be achieved from cooperation. Once the agreement has been reached, free-riding is no longer a major problem, but if free-riding had not been such a major problem in the first instance, another agreement with much deeper cooperation could have been reached. Indeed, because, implicitly and in effect, external free-riding is an extreme version of non-compliance, once free-riding has been deterred, non-compliance is no longer of concern.[58] Thus, the conclusion by Chayes and Chayes does not follow from their findings if one takes the stage of agreement making into account as well. On the other hand, the economic theory of international environmental cooperation could learn from regime theory that sometimes perfect compliance by 'weak' governments is not even the outcome that 'strong' governments expect. As Levy, Keohane and Haas observe, regime standards are often set higher than many countries with weak environmental preferences either want to comply with or countries with weak administrative capacity can comply with.[59] This is because high regime standards serve other functions as well, such as generating political concern in 'weak countries' and setting normative goals for them, communicating the intensity of preferences among regime members and legitimating technical aid or outright transfer payments that might otherwise be denounced as bribes or blackmail.

UNILATERAL ACTION. As another example for mutual learning opportunities, consider the issue of unilateral emission abatement by one country. Game theoretic models of Hoel and of Endres and Finus show how unilateral emission abatement by one country can be detrimental to the environment because it can lower the abatement incentives

58 See Barrett 1998a, pp. 328f.; 1998b, p. 36.

59 Levy, Keohane and Haas 1993, p. 404.

of other countries in a potential future agreement.[60] This result holds only true under certain restrictive assumptions, however. For example, countries are supposed to know exactly their payoffs and to maximise their own payoff with the exception of the unilaterally acting country. Regime theory could learn here from the economic theory of international environmental cooperation about how important it is to trace the perverse strategic effects a well-intended action can have under certain conditions. At the same time, the economic theory of international environmental cooperation could learn from regime theory that these very same conditions that give rise to their model results need not hold in reality. In real-world international bargaining, countries do not know their exact payoffs and unilateral action by one country can be regarded by potential participants to an agreement as a constructive, confidence building step towards regime building. Unilateral action can help overcome a deadlock in negotiations by pushing ahead and demonstrating that a country is credibly committed to cooperation and, possibly, also by proving to potential partners to an agreement that emission abatement is less expensive than commonly believed.

RULES, NORMS, AND CONVENTIONS. Maybe the highest return from mutual learning is likely to stem from exploring how the basic finding from the economic theory of international environmental cooperation could be overcome. How can wide and deep cooperation in international environmental affairs be achieved? This is the fundamental question that has to be tackled. There is no convincing answer yet, but there are some attempts to show how the problems of self-enforcement and renegotiation-proofness can be mitigated at least.

60 Hoel 1991; Endres and Finus 1998.

Schmidt, for example, proposes that the deposition of securities at third parties — for example, at international institutions — or the exchange of 'hostages' could help countries making threats credible. The idea is that these deposits or hostages are automatically lost if countries do not execute their threat to punish free-riders. In principle, threats that were not credible before can be made credible with such a device if the deposit or hostage is appropriately specified. The problem with this proposal, however, is that the deposit or the exchange of hostages is itself not renegotiation-proof. A country which stands to lose its deposit could always engage in negotiations with the agency holding the deposit to strike another deal and avoid the loss. Equally, countries can always engage in negotiations with each other to get their hostages back.[61]

Another attempt derives from the idea that behaviour is not fully determined by utility maximisation, but also governed by rules and norms. Hoel and Schneider show in a game theoretic model how deeper cooperation is possible if countries are inhibited from free-riding excessively because they follow the social norm and convention that free-riding is undesirable.[62]

Yet another attempt sticks to the assumption of utility maximisation, but includes more items in the utility function than usual. Carsten Schmidt, for example, uses the idea that countries might refrain from free-riding for fear of being blamed as opportunistic. In other words, the reputation of being regarded as a responsible member of the international community of nation-states represents an important factor in the utility function of state actors.[63] But where do these norms and conventions come from and why do states not simply break them if they run counter to their own selfish interests, as realism

61 Schmidt 1998, p. 22

62 Hoel and Schneider 1997.

63 Schmidt 1998, p. 32.

would have it?[64] Why do countries not want to be blamed as opportunistic? Here, regime theory can provide initial steps for a better understanding. Both Snidal and Litfin argue that once international regimes have come into existence, they gain, to some extent, an independent life on their own.[65] They change actors' expectations, they change the rules of the game, they make actors' decisions transparent, they initiate further steps and push issues forward — in short, they start to constrain state behaviour. After the establishing of regimes the states that created the regime are no longer free to do as they please.[66] States get accustomed to cooperation and successful interaction in one regime makes the establishing of the next one more likely. The strong cognitivist branch of regime theory, as it is called by Andreas Hasenclever, Peter Mayer and Volker Rittberger[67], even argues that successful regime building induces the participating states to develop a collective identity that helps them to sustain cooperation even in situations where one or the other state would otherwise defect.[68] But we need to better understand how these transformations come about and why sovereign nation-states are willing to agree in the first instance on mechanisms that constrain their very sovereignty later on. In there lies the real challenge to both regime theory and the economic theory of international environmental cooperation individually and to both of them together.

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64 Compare Bernauer 1995, p. 354.

65 Snidal 1996, p. 127; Litfin 1997, p. 181f.

66 The Montreal Protocol, for example, has a clause that allows a tightening of the agreement if it is approved by an overall two-third majority and a simple majority of both developed and developing countries. The international whaling commission provides a similar example with its combination of majority voting and the allowance for countries to object to certain decisions.

67 Hasenclever, Mayer and Rittberger 1996.

68 See, for example, Wendt 1992, p. 417; 1994, pp. 388-391.

Another promising way to mitigate the negative impact the requirements of self-enforcement and renegotiation-proofness have on the scope and depth of cooperation comes through the idea that states follow to some extent considerations of fairness. Fairness here means two things. First, players behave cooperatively if others behave cooperatively, even if, strictly speaking, it is in their selfish interest to free ride on others' cooperation. This aspect means that the problem of free-riding is less pronounced than if states were not concerned with fairness. Second, players are willing to punish defectors, even if, strictly speaking, it is in their selfish interest to refrain from punishment. This aspect means that free-riding can be deterred to a greater extent, as punishment can be more severe than dictated by the selfish interest of the punisher. Certainly, considerations of fairness encounter limits. If the incentives to free ride become overwhelming, then players defect even if the others maintain cooperation. Similarly, if the harm inflicted upon oneself due to punishing a defector becomes too big, the potential punisher has to let the defector get away without punishment. But if considerations of fairness play some role in international bargaining, then deeper cooperation becomes possible. This is confirmed by a model of Tim Jeppesen and Per Andersen who use the pioneering work by Matthew Rabin.[69] The challenge is to better understand why and to what extent states take considerations of fairness into account and what factors promote these considerations as well as factors that lead to their disregard.

ISSUE LINKAGE. Another mechanism to promote cooperation – and one that has long since been recognised – is issue linkage.[70] Issue linkage strengthens the incentives

[69] Jeppesen and Andersen 1998; Rabin 1993.

[70] The pioneering contributions are Tollison and Willett 1979; Haas 1980; and Sebenius 1983.

for mutual cooperation by linking games with an asymmetric payoff structure.[71] Issue linkage functions best if one set of players has a strong interest in cooperation in one issue, but not in another one, whereas another set of players has the opposite preference structure. Hence, in order to promote cooperation issue linkage depends on countries being asymmetric in their preferences and, in some sense, the more asymmetric countries are the better are the prospects for issue linkage. The aspect just considered looks at issue linkage as a means to transform mutual cooperation into the common interest of all players – something that is often already implicitly assumed in regarding the problem of international environmental cooperation as a Prisoner's Dilemma.[72]

But issue linkage can also be used if the underlying game is a Prisoner's Dilemma right from the start and it can mitigate the problems of self-enforcement and renegotiation-proofness for this game. Barrett shows how linking an international environmental agreement with trade can promote cooperation.[73] Trade sanctions are a more credible threat to deter free-riding than an increase in emissions because, according to Barrett, trade sanctions mainly harm the free-rider, whereas the emission increase considerably harms the punisher as well.[74] Hence, with trade sanctions free-riding can be deterred

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71 See Folmer et al. 1993, p. 315. Cesar and de Zeeuw 1996 show how full cooperation can be achieved via issue linkage even under the requirement of renegotiation-proofness.

72 Another mechanism to make mutual cooperation the interest of all affected parties is the outright payment of transfers. The record of international environmental agreements seems to suggest, however, that countries prefer issue linkage to the payment of transfers.

73 Barrett 1997b. For an excellent discussion of economic instruments for sustaining international environmental regimes more generally, see Heister et al. 1997.

74 A necessary condition is, however, that the trade sanctions are executed by a certain minimum number of countries and not just by one country alone (Barrett 1997b, p. 347). Indeed, cooperating countries that fail to execute trade sanctions against free-riders might themselves face trade sanctions.

more effectively as a more substantial punishment becomes credible, so wider and deeper cooperation can be achieved as a self-enforcing and renegotiation-proof equilibrium.[75] A similar mechanism is employed in the models in Carraro and Domenico Siniscalco and Botteon and Carraro.[76] International environmental cooperation is linked to joint efforts into research and development. The idea is that in contrast to emission abatement which benefits potential free-riders as well, research and development can be considered a club good which benefits the participants of an agreement only. Hence potential free-riders have an incentive to join the agreement if the gains from joint research and development exceed the gains from free-riding on the other countries' emission abatement.

These arguments seem to suggest that issue linkage is a very promising means to promote international environmental cooperation. One must not disregard the many problematic aspects of issue linkage, however. Indeed, the early contributions from regime theory, while praising issue linkage as a means to foster cooperation, have at the same time stressed the problems of linkage. Robert D. Tollison and Thomas D. Wilett, for example, emphasise the increase in transaction costs that can result from issue linkage.[77] James K. Sebenius' influential and insightful discussion of issue linkage points out that issue linkage can make mutual cooperation less rather than more likely if divisive issues are linked and a joint settlement is required.[78]

As concerns the employment of trade sanctions to bring about international environmental cooperation, all depends on one's implicit view on the benefits from trade. Many

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75 Sanctions are cheaper than transfer payments as they do not impose any costs as long as the deterrence of free-riding is successful.

76 Carraro and Siniscalco 1995, 1997; Botteon and Carraro 1998.

77 Tollison and Willett 1979.

78 Sebenius 1983.

proponents of trade liberalisation would object to the suggestion, implicit in Barrett's analysis, that trade sanctions do not harm the sanctioning party to a great extent. Indeed, they would object to the very idea that trade liberalisation is a Prisoner's Dilemma where all gain from mutual liberalisation, but every player gains even more if only the other players open their markets for trade. Many liberal international economists would instead maintain that it is always in a country's best interest to open its market no matter what other countries do.[79] If this view on trade liberalisation is correct, however, then trade sanctions are not necessarily a credible threat to deter free-riding and cannot promote cooperation to a large extent. The challenge is to find specific trade areas for which sanctions hurt the free-riding countries substantially more than the cooperating countries. Also, if trade sanctions are actually executed against free-riders then there is the risk that these countries retaliate in imposing sanctions as well and that cooperation in other issue areas might collapse.

Another problem of international environmental agreements employing trade sanctions is that they can potentially clash with existing and quite powerful international trading regimes such as the World Trade Organisation (WTO). The Montreal Protocol on the banning of ozone-damaging substances is the major agreement so far that has included the threat of trade sanctions, both against the substances themselves as well as against goods produced with the help of these substances.[80] Participation in the Protocol is by now almost universal and trade sanctions were never actually employed, which might partly explain why no member to the WTO has ever challenged the trade clauses in the Protocol. There seems to be a consensus among scholars, however, that the Proto-

[79] See, for example, Bhagwati and Hudec 1996.

col's trade incentives have been very important (see, for example, French 1994, p. 62; Brack 1996, p. 55; Barrett 1997b, p. 346; OECD 1999, p. 4). But major doubts remain whether the Protocol is compatible with the obligations under the WTO regime.[81] The same holds potentially true for future agreements. How future international environmental agreements that employ trade sanctions to deter free-riding can be made compatible with WTO and other trade regimes is a major topic for fruitful research.[82]

As concerns linking international environmental cooperation to joint research and development efforts, problems arise if there are diminishing returns to these efforts, because then it can be optimal to exclude some countries from the linked agreement even though they should be participants to the agreement judged from the environmental perspective alone. In some sense, this is the opposite problem to free-riding and it can damage rather than promote environmental cooperation under certain conditions.[83] A more fundamental problem with this form of linkage is that it remains unclear why countries have not long since realised the mutual gains from joint research and development efforts independent of the problem of international environmental cooperation. In other words, why do countries wait until the free-riding problems in an international environmental agreement necessitate linkage in order to reap the excludable benefits from joint research and development?

All the mentioned problems of issue linkage notwithstanding, it could form a major object for common research of regime theory and the economic theory of international

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80 Other agreements with major trade implications are CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flores, and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

81 See Brack 1996; OECD 1999.

82 See Neumayer (2000).

83 See Carraro and Siniscalco 1998, p. 567; Botteon and Carraro 1998, p. 185.

environmental cooperation. The question is how the problems of linkage can be reduced and how linkage has to be employed such that it best promotes international environmental cooperation. In this respect, Stephan Kroll, Charles F. Mason and Jason F. Shogren have provided an interesting finding that deserves further attention.[84] In laboratory experiments, they have studied the question whether issue linkage is likely to promote cooperation more if the linkage is implicit (two games played simultaneously in a parallel institutional framework) or explicit (the linked game is played in a joint institutional framework). They have found that the participants in their experiments were much more likely to cooperate in the joint than in the parallel framework. It would be interesting to explore whether this finding is robust and whether it is relevant outside the laboratory as well. If so, then this finding would clearly call for explicitly linking issues in one single negotiation rather than holding parallel but separate negotiations at the same time — under the condition that transaction costs are not substantially higher for explicit issue linkage.

5. Conclusion

This paper has tried to show that there is a lot to gain for both regime theory and the economic theory of international environmental cooperation from learning from each other. Regime theorists have first coined the metaphor of ‘cooperation under anarchy’, but regime theory can learn from the economic theory of international environmental cooperation about the adverse consequences on cooperation that follow from the requirements of self-enforceability and renegotiation-proofness of international environmental agreements as well as from emission leakage and ‘perverse’ strategic incentives.

84 Kroll, Mason and Shogren 1998.

The economic theory of international environmental cooperation, on the other hand, can benefit from a better understanding of the myriad roles regimes play in promoting cooperation and can learn from the institutionally rich analysis of regime theory.

Learning from the other school of thought is important, but it is merely a first step and it is somewhat one-sided. Examples were provided for which the two can fruitfully learn *from each other* such as the consequences of unilateral action on international cooperation and why nation-states comply with international agreements and what this implies for the problem of free-riding. The most interesting question, however, is one that each school of thought has long since examined of its own: how can cooperation in international environmental affairs become wider and deeper? The focus should be on two things: first, on the role regimes play in developing social norms, conventions and considerations of fairness that limit free-riding and second, on the role of issue linkage, especially with respect to trade sanctions.

The question is of course whether mutual learning is possible at all and whether it would not diminish the relative strengths of both regime theory and the economic theory of international environmental cooperation. Would, for example, trying to include some of the insights from regime theory not diminish the elegance and explanatory power of the models employed within the economic theory of international environmental cooperation? Admittedly, this is a possibility that cannot be dismissed offhand. It would be beyond the scope of this paper to explore the limits of mutual learning opportunities here. However, in principle I can see no reason why mutual learning would have to be impossible or counter-productive. After all, as mentioned, some economists like Endres, Finus and Rundshagen have already successfully integrated insights from regime theory about the prevalence of fairness considerations and uniform solutions into their model building. Conversely, scholars of regime theory who have employed game theory in examining what influence free-rider incentives, punishment costs and insider-outsider

dynamics have on the emergence and effectiveness of regimes have certainly advanced regime theory. To make my point clear this paper has stressed and possibly at times even over-emphasised the differences between the economic theory of international environmental cooperation and regime theory. To some extent at least, the two schools of thought are at times not quite as far apart in their methodological and conceptual framework as might have been suggested here. However, it remains true that even in these cases explicit notice of the other school of thought is rarely taken.

Because of space restrictions, this paper could only sketch some of the major findings from both schools and outline the topics for which mutual learning opportunities are greatest. All these topics have long since been examined by each school separately and in this respect this paper has not proposed any new topic for studying. What it has hopefully achieved, however, is to convince readers that if scholars from both schools of thought took more notice of each other and aspired to learn from each other's findings, then this would lead to a more comprehensive analysis and better understanding. With these come better policy advice. If we can help policy makers to succeed in tackling international environmental problems, then we do our best.

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