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The Political Economy of International Environmental Agreements: A Survey

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Abstract: This paper surveys the recent literature on the political economy of the formation of international environmental agreements. The survey covers theoretical modelling approaches and empirical studies including experimental work. Central to our survey is the question how the political process impacts different stages of agreement formation and stability. Relevant are the rules defined during pre-negotiations that govern negotiations, ratification and implementation. Strategic delegation and lobbying are directly relevant during the negotiation and ratification phases. Implementation, the choice of policy instruments at the national level, will also be impacted by lobbying and indirectly influence negotiations.

Keywords: international environmental agreements, coalition formation, coalition stability, environmental policy-making, strategic delegation, interest groups, free-rider incentives, determinants of international environmental cooperation, public goods experiments.

JEL Codes: D72, D 62, C 72, H 41

1 Introduction

This paper provides an overview of recent studies on the formation and stability of International Environmental Agreements (IEAs). We do not attempt, however, to survey this rapidly growing field in its entirety but rather concentrate on its political economy. Hence, we give an overview of the development and current theoretical modelling approaches and of empirical investigations into the political processes that drive the formation of IEAs and their design. Of the large literature that has emerged in the domain of public choice on the one hand and in the domain of IEAs on the other hand we attempt to survey what falls in the intersection of the two.

Efficient environmental mitigation policies for transboundary pollutants require international coordination and cooperation because of international spillovers (e.g. Ostrom 1990). Whereas we can usually assume that governments can design and enforce environmental policies at the national level, there is no supranational body that can take the role of a government at the international level. Property rights, i.e. emission rights for transboundary pollutants and resources, are usually not well-defined, let alone enforced. The role of IEAs is to define property rights and to overcome an environmental anarchy (Buchanan 1975, Weikard 2011). In much of the remainder, for ease of presentation of ideas, we will focus on the case of climate policies where greenhouse gas mitigation is a global public good. But international environmental agreements deal with many different issues like pollution and resource use and may refer to local, regional or global scales.

Different studies analyse directly the negotiation process and the outcome related to IEA formation (e.g. Young 1994, Miles et al. 2002, Barrett 2003 and Mitchell 2009). Environmental economic policy analysis offers important recommendations on the design of efficient and effective environmental policies. But frequently the models used as tools for analysis conceive governments as benevolent social planners whose goal is to increase the welfare of their citizens. Public choice scholars, however, have challenged this assumption as being too restrictive (e.g. Persson and Tabellini 2000; Oates and Portney 2001, Mueller 2003).

Our view is that political economy complements environmental economics with an analysis of the political process. Thus, political economy considers a governments' actions not as mainly driven by welfare maximising objectives but rather assumes that political agents are susceptible to being influenced by other agents, for instance through a desire of the government to increase its prestige, to enhance its possibilities of being re-elected or to increase its budget (Schumpeter 1942, Buchanan and Tullock 1962, Persson and Tabellini

2000). Therefore, governments can be seen to be influenced by voters and lobby groups where the media may play an important role. Political economy models can be interpreted as extensions of conventional economic models of collective decision making. For our purpose we adopt a broad definition as proposed by Oates and Portney (2003) who define "political economy" as:

> "the study of the collective or political processes through which public economic decisions are made" (Oates and Portney 2003, p. 327).

For the case of IEAs this definition suggests an analysis of the goals and constraints of governments at the international negotiation tables (Persson and Tabellini 2000, Mueller 2003). The position of governments is usually influenced by domestic political negotiations leading to results that differ from the welfare maximising policy, even from the perspective of an individual country. International negotiations are shaped by governments who interact with other political agents such as political pressure groups (lobbies) and the electorate or by intragovernmental processes such as competition between ministries. These aspects are important for the design of IEAs as international policies are confronted with different feasibility constraints at the national level.

Modelling political processes may help to explain why policy recommendations aiming at efficiency differ frequently from what is actually implemented. Furthermore, it may help to anticipate the acceptability of policy proposals and it may contribute to improvements of constitutional designs such that inefficiencies can be mitigated. Frey (1992), Kirchgässner and Schneider (2003) and Kollmann and Schneider (2010) distinguish four different types of agents relevant for shaping the process of policy-making: (1) voters, (2) politicians, (3) public bureaucrats, and (4) agents related to industries (e.g. capital owners, managers and employees).

Many studies of the political economy of environmental policy-making are devoted to national environmental policies; early contributions are Buchanan and Tullock (1975) and Becker (1983). However, only few studies have explored the political economy of the formation of IEAs. For instance, Michaelowa and Greiner (1996), Carraro and Siniscalco (1998), Michaelowa (1998), Congleton (2001), Vogt (2002), and Böhringer and Vogt (2004) focus on political processes within a country. The studies by Haffoudhi (2005a and 2005b), Buchholz et al. (2005), Altamirano-Cabrera et al. (2007) and Roelfsma (2007) explore political economy approaches to IEA design and stability.

We divide our survey into three main parts: (i) theory (Section 2), (ii) empirical studies including experiments (Section 3), and (iii) implications for future research (Section 4).

2 Theoretical model approaches

With few exceptions, the literature on IEA formation considers monolithic governments that represent the interests of their nation in international negotiations (e.g. Hoel 1992, Carraro and Siniscalco 1993, Barrett 1997, Caparrós et al. 2004). Even though this approach has yielded many important insights, it ignores the fact that governments often have interests not in line with those of their domestic constituents. Moreover, they do not consider that the incentives embodied in elections and other political control systems may ultimately determine what these governments can and will decide at the international negotiation tables. Political scientists and public choice scholars have long advocated these ideas. In a representative democracy, national political actors influence policy decisions of their representatives – including positions taken in international negotiations.

Barrett (1998) distinguishes five different stages of international environmental treaty-making. These are: (1) pre-negotiations, (2) negotiations, (3) ratification, (4) implementation and (5) renegotiations. Ideally a political economy model of IEA formation has to cover the particularities of all five stages. For the ultimate success of an IEA, however, stage 4 is of major importance. This stage is crucial for the effectiveness of a treaty as industries and consumers must finally change their behaviour. However, the economic literature of IEA formation focuses in particular on stages 2 and 3.

Before we discuss stages 2 and 3 in more detail, we summarise recent models of minimum participation rules (MPRs). MPRs can be understood as the rules that determine the conditions under which a treaty becomes binding. These rules will impact the negotiations and can be located at the pre-negotiation stage.

Most IEAs employ MPRs that usually define a minimum number of countries that need to participate in an agreement. The standard approach analyses MPRs assuming homogenous countries and complete information (e.g. Rutz 2001, Rubio and Casino 2005, Courtois and Haeringer 2005, Carraro et al. 2009). The result is a stable grand coalition (participation of all countries). Weikard et al. (2009) study the impact of an MPR for the case of heterogeneous countries. Following Carraro et al. (2009) they consider an endogenous choice of the MPR. They find that an MPR will always be implemented. The efficient outcome requires participation of all countries. However, countries with sufficient bargaining power will be able to maintain a free-rider position and the grand coalition will not emerge. Black et al. (1993) consider uncertainty about coalition formation in a model with identical countries. Their model explains that it may be suboptimal to require participation of all countries. Harstad (2006) assumes heterogeneous countries as well as uncertainty about costs and benefits of the public good. The initial decision on the MPR is endogenised and

identified by majority voting. As the voting game may not have a Condorcet winner, a stable equilibrium MPR might not evolve endogenously.

We now turn to stages 2 and 3 that are closely linked. At the latter stage, ratification, national governments have to deal with multiple interests (Putnam 1988). National governments can only agree on those treaties that are likely to be ratified at national levels. There are two constraints: First, government's proposal at international negotiations should be acceptable to its domestic constituents because this, at the end, will help to win elections (Morrow 1991). Second, political pressure groups (or lobbies), such as business associations and environmental NGOs, are capable of affecting the behaviour of politicians by providing information, by financing election campaigns, or by bringing environmental concerns into the voters' minds (Grossman and Helpman 2001). These political factors play an important role when the national representatives meet at the international level to negotiate mitigation levels and policies, for instance. In the remainder of this section we explore both mechanisms of policy-making.

2.1 Strategic delegation

One way of extending (environmental) economic models in order to include elements of the political process is the use of median voter models.[1] The underlying assumption is that the majority winning political proposal coincides with the median voter's preferences (Black 1948, Downs 1957). The median voter theorem is applied in many political economy models but builds on rather restrictive assumptions like unimodal preferences and a one-dimensional policy space. Still the median voter theorem may be useful to understand the potential impact of voters' strategic behaviour on a country's position in international negotiations. In a strategic delegation model of IEA formation voters delegate their decision power to representatives at the international negotiation tables. The representatives, usually the government, then negotiate the terms and conditions of an international agreement. Given the free-rider incentives in transboundary pollution games one would expect that strategic voting exacerbates the problem. However, the impact of strategic delegation on IEA formation has not been fully explored yet.

The strategic delegation model generally used to analyse international policy-making is a two-stage game. At the first stage voters (using majority rule) elect their preferred politician who, at the second stage, will negotiate the international treaty. In the usual two-country setting voters take the result of the foreign election as given and then select the candidate

[1] For a discussion of the median voter theorem cf. Mueller (2003, Chapter 11).

that represents the most favourable position in the subsequent policy game. A key result from this approach is that voters may elect a politician with different preferences than their own; the outcome deviates from the median voter's true preferences. In essence the median voter strategically misrepresents his own preferences because this gives an advantage at the international policy negotiations (see Persson and Tabellini 2000, Chapter 12). The strategic delegation approach has mainly been applied to economic phenomena such as international tax policies and the provision of transboundary public goods. (e.g. Persson and Tabellini 1992, Dolado et al. 1994, Segendorff 1998, Böhringer and Vogt 2004, Buchholz et al. 2005, Roelfsma 2007, Kempf and Rosignol 2010).

Persson and Tabellini (1992) analyse a two-country, two-period model to study the effect of strategic delegation on capital taxation, considering that capital may become more mobile (e.g. as with the European Union integration). In their model the population in each country elects a government (through majority voting) that sets a tax policy taking the tax policy of the other country as given. Persson and Tabellini show that voters may find it optimal to elect a government that is less sensitive to the prospects of the tax policy because this offsets the economic consequences of higher capital mobility on the tax rate.

Dolado et al. (1994) study strategic delegation in an international monetary policy game. Their analysis focuses on the incentives that governments have to delegate the control of monetary policy to independent central bankers. They find that governments choose more conservative central bankers (with respect to the output/inflation ratio) than their own preferences as a means to commit to a more restrictive monetary policy.

Segendorff (1998) looks at the effect of strategic delegation on the bargaining process between two countries for the provision of a transboundary public good. Countries are assumed to produce two goods, one private and one public good that is shared between the two nations. The ideal allocation of both goods is a function of the preferences of the citizens. In each country, the principal may delegate the task of the negotiations to a citizen that is appointed as agent. Although, the analysis of Segendorff does not consider an electoral process, the principal may be thought of as the decisive (median) voter and the agent as the government. Delegation is a two-stage game where at the first stage principals simultaneously choose agents and at the second stage the agents bargain over the global provision of the public good. The bargaining is solved applying the Nash bargaining solution where the threat point is given by the reservation utilities of the agents. Segendorff finds that principals will choose agents that have stronger preferences for the private good than their own because this lowers the reservation utility and thus weakens the bargaining position of the other agent.

Böhringer and Vogt (2004) study a model where the median voter places a restriction on the costs of climate policies that would be incurred by a government upon joining an IEA. Hence, the willingness to pay (WTP) for the mitigation of the median voter determines the outcome of negotiations. Böhringer and Vogt apply their model to study the ratification of the Kyoto Protocol. They calculate costs with a computable general equilibrium model, whereas the WTP is calculated from survey data. Böhringer and Vogt argue that a focus on costs is warranted because benefits from climate protection can be considered negligible for the current generation. Comparing mitigation costs required to meet Kyoto targets and the median voter's WTP sheds light on the incentives to ratify. They find that the gap between cost and actual WTP is wide particularly for the USA, which may explain the USA's withdrawal from the Kyoto Protocol.

Buchholz et al. (2005) study the effect of strategic delegation on IEAs. The underlying game is a three-stage game. At the first stage citizens elect politicians, i.e. the median voter elects his preferred candidate. At the second stage elected politicians negotiate over the level of economic activity and transfers (using the Nash bargaining solution). If an agreement is reached, it becomes binding. Otherwise countries adopt a non-cooperative policy, i.e. a Nash equilibrium that constitutes the threat point for the bargaining stage. The model comprises two symmetric countries that produce a domestic good and a transboundary environmental damage. Buchholz et al. (2005) show that in the equilibrium the median voter in each country chooses a government that cares less about the environmental problem than he does, because this improves the strategic position of the government at the bargaining stage. This holds irrespective of whether or not countries participate in an IEA. However, if countries sign an agreement, voters will elect governments that are less environmentally concerned than the governments elected when countries are non-signatories. Hence, strategic voting undermines the success of IEAs in tackling the environmental problem and the outcome does not reflect the median voters' true preferences for environmental quality.

Roelfsma (2007) analyses the effects of strategic voting on non-cooperative environmental policy-making for the case of two symmetric countries. He finds that elected politicians are either more or less concerned about the environment than the median voter. Countries will engage in a 'race to the bottom' or a 'race to the top' depending on the strength of the environmental preferences of the median voter.

Kempf and Rosignol (2010) focus on the provision of a transboundary public good through the negotiation of an international agreement. They analyse a model where the public good is financed by contributions from two neighbouring countries. The good is funded by taxes that are collected at the national level. The study focuses on two tax regimes: (i) an equal tax rate in both countries and (ii) tax rates that equalize gains. The political process is modelled

as a two-stage game, where at the first stage voters elect their delegate for the international negotiations and, at the second stage, both delegates meet and may or may not agree on the means for providing the good. Kempf and Rossignol find that both countries have an incentive to strategically delegate their representatives and that an agreement, if it is reached, involves higher taxes in both countries compared to the case without agreement. Furthermore, it will be impossible to reach an agreement if the public good is financed by a tax with an equal rate in both countries when incomes are sufficiently different. In that case the poorer country would prefer a higher and the richer country a lower tax rate. Any possible compromise would be rejected by one of the delegates.

2.2 Lobby groups

Olson (1965) extensively described lobbying activities in his seminal contribution on "the logic of collective action". In a representative democracy political decision-making is not solely influenced by the concerns of the general electorate. Government decisions may be influenced by lobbies' pressure and political outcomes may differ from the median voters' preferences. Olson notes that interest groups are confronted with free-rider problems. This limits the capability to organise common interests which is essential to influence decision-making. However, if interest groups are able to overcome this problem (e.g. by offering excludable services to members), then they can influence political decisions. Political economy studies dealing with lobby groups in policy-making may be classified in two categories depending on the motives of lobby groups: the electoral motive approach and the influence motive approach (Grossman and Helpman 1994, 1996). The first argues that lobbies wish to promote the candidate that reflects their preferences on a policy issue before upcoming elections. The second argues that lobbies aim to influence the policy choice of an incumbent politician.

According to the influence motive approach, an incumbent government maximizes its political support function by implementing a certain policy. The political support function usually includes contributions by lobbies and social welfare. The analysis abstracts from details of the electoral process, but contributions can be thought of as a means to influence voters. Thus, contributions do not need to be monetary but may also relate to, for instance, media pressure. Grossman and Helpman (1994, 1996 and 2001) assume that competing lobby groups offer contributions to a government. The contributions are conditional on the policy implemented and aim at avoiding the costs related to environmental regulations in the case of industry lobbies. Environmental lobbies would contribute in order to induce higher environmental standards (Hillman and Ursprung 1994). In the international domain

governments would take a particular position in IEA negotiations in return for contributions. This will usually result in policies that deviate from the welfare maximizing policies as well as from the median voters' preferred policy.

Fredriksson (1997), Aidt (1998), Conconi (2003) and Fredriksson et al. (2005) have further developed the political contributions approach in the domain of environmental policy-making. Fredriksson (1997) studies the influence of lobby groups on environmental tax policy and shows that there is a relation between the strength of lobby activities and the deviation from an optimal pollution tax. Aidt (1998) analyses the effect of environmentalist and industry lobbies on environmental policy in the presence of production externalities. Aidt shows that lobby groups, through the competitive political process, are important to internalize production externalities. Conconi (2003) analyses the effect of environmentalist lobbies on the determination of trade and environmental policies for large countries linked by trade and transboundary pollution problems. Conconi's results show that the impact of lobby groups on environmental policy depends on the trade policy regime, the type of decision-making process (if it is unilateral or cooperative) and the size of the transboundary environmental spillovers. Although there is a large literature on lobby groups and international policy-making, the analysis of the potential effects of lobbying on the formation and stability of IEAs has not been examined in detail – with the exception of Haffoudhi (2005a) and Altamirano-Cabrera et al. (2007). Haffoudhi studies the impact of lobby groups on the size and stability of IEAs. She finds that, for homogeneous countries, a global agreement would be sustained by means of industry lobby contributions. The result mentioned relies on a joint maximization of the political revenues of all signatory countries. This seems to be a rather strong assumption. Therefore, Altamirano-Cabrera et al. (2007) study the same problem using the canonical model, introduced by Hoel (1992), Carraro and Siniscalco (1993) and Barrett (1994) where countries first decide whether or not to join an IEA and then set their emission levels such that IEA members act jointly and maximize joint payoffs while the remaining singletons maximize their own payoffs. Altamirano-Cabrera et al. (2007) assume that signatories commit to reduce externalities to other signatories but do not benefit from foreign lobby contributions. Their finding is that signatory governments will usually accept contributions from the environmentalist lobby. Only partial coalitions emerge and the grand coalition is generally unstable.

2.4 External constraints and the "dirty work hypothesis"

Closely related to the lobby problem is the so-called "dirty work hypothesis" (Vaubel 1986, p. 48). This hypothesis has been applied to explain delegation of power to higher levels of

decision-making e.g. in case of the International Monetary Fund (James 1998, Mussa and Savastano 1999, Dreher and Jensen 2007, Dreher 2009, Dreher et al. 2009). Its logic can further be applied to central bank independence. If the European Council could influence monetary policy directly, each government would prefer to adopt a lax monetary policy that is in line with its median voter's preferences (e.g. Freytag 2007). The same line of argument can shed light on IEA formation. In case of international environmental problems governments have an incentive to implement policies that allow distributing the costs that particular interest groups would face to the general public, i.e. the voters. If, in addition, information costs (about the policy measure) increase with a higher degree of centralisation, knowledge gets more and more exclusive to organised interest groups. The loss in transparency allows politicians to support particular interests without facing an adequate opposition by less organised voters. This strategy pays off for the government as long as the support of particular interest groups is in line with the maximisation of votes. Decentralized policies (if applicable) offer a possible solution for the problem described.

3 International environmental cooperation: empirical and experimental studies

In what follows we provide a brief overview of empirical findings about international environmental policy coordination and cooperation. The survey of empirical work in this domain is complemented by a summary of recent experimental studies that explore the behavioural responses to problems of institutional choice.

3.1 Determinants of IEA formation

Several studies examine the impacts of democracy to identify what drives individual countries to sign an IEA. . There is support for the hypothesis that democracy has a positive impact on signing an IEA. An early contribution is Congleton (1992) where the results show that total emissions are larger under democracy. However, the output of methane per unit of GDP is significantly less compared to non-democratic regimes. Results obtained by Murdoch and Sandler (1997) as well as Murdoch et al. (1997) support the view that more political freedom is positively correlated with emission reduction. Gleditsch and Sverdrup (1996) use bivariate regressions and find that the ratification of IEAs as well as the presence of environmental organisations within a country positively affects national environmental policy-making. Neumayer (2002a) finds evidence that democracies are participating more frequently in IEAs. Fredriksson et al. (2005) study the effect of environmentalist lobby groups

and the degree of democracy on environmental policy-making. Their analysis for OECD countries shows an effect of lobby activities on policy-making. However, this effect is more likely to occur in countries with sufficiently high levels of political competition. Fredriksson and Wollscheid (2007) are able to show that the generally positive correlation between environmental performance and democracy is mainly due to the use of parliamentary systems. By contrast, in many cases, presidential congressional systems perform similar to autocracies. Fredriksson and Wollscheid relate this result to the fact that parliamentary democracies have a lower degree of separation of powers on the one hand and a higher degree of legislative cohesion on the other hand.

Beside democracy there are additional determinants of the success of IEAs. There is a positive correlation between trade openness and signing an IEA (Neumayer 2002b). Roberts et al. (2004) look at different parameters influencing IEA participation. Their empirical results identify three important variables with a significant positive impact: first, the narrowness of the export base, second, voice and accountability of citizens through their domestic institutions and third, the role of NGOs.

Frederiksson et al. (2007) focus on the impact of environmental lobbying on signing the Kyoto Protocol. Environmental lobbying is measured by the number of organised environmentalists within a country. They find a positive correlation between environment related interest groups and the probability that countries sign an IEA. A second finding is a positive correlation of IEA membership and corruption. This rather surprising result mainly refers to the particular incentives of developing countries to sign an IEA. It suggests that monetary transfers to environmental interest groups within developing countries (e.g. by international organisations) are more effective under corrupt regimes as interest groups can more easily shape political decisions in favour of their own interests. Von Stein (2008) studies the stringency of policies for the Kyoto agreement. The results suggest that flexible mechanisms can facilitate treaty implementation. The study further supports the hypothesis that NGOs are important for successful implementation of IEAs. Almer and Winkler (2010) look at the Kyoto protocol and find that countries that expect high damages from climate change are more likely to sign an IEA whereas a negative correlation is found for countries with high compliance costs. At the ratification stage there is empirical evidence of strategic interaction. Perrin and Bernauer (2010) explicitly look at the ratification stage of IEA formation. They use a multivariate econometric model based on likelihood estimation. The model allows treating separately endogenous and exogenous factors influencing a country's decision about treatment ratification. They find that exogenous factors like country size, geographical distance and a foreign country's level of GDP positively affect the national decision to sign an IEA. A negative correlation is found when foreign countries are seen as

competitors. Regarding the endogenous (country specific) factors a positive effect is reported for trade openness and a negative affect for pollution share and population size. No significant result is reported for the national per capita GDP.

Another interesting question refers to the preferences and motives of climate policy-makers. Freytag and Wangler (2008) find a link between free-riding on the ratification of the Kyoto Protocol and export expectations. They argue that free-riding of some industrialised countries may generate positive export expectations in non-free-riding countries. They focus on the German case and find evidence that export expectations for green technologies (proxied by patent counts) are positively correlated with the diffusion of green technologies at the national level. This might explain the observed heterogeneity among industrialised countries with respect to the stringency of climate change policies.

Lange et al. (2007) study environmental policy makers' preferences for equity. Their findings suggest that equity plays a more important role for representatives of developing countries. Thus, policy-makers from developing countries support the view that environmental regulation should be dependent on the level of development implying higher abatement levels for more developed countries. They also find a difference with respect to the preferences concerning environmental regulation of industries as representatives from richer countries disapprove more often the allocation of the costs to the polluter. Interestingly, representatives of developed countries who are in office for a long time are more in favour of allocating pollution permits according to population shares among countries. Thus, it seems that representatives of developed countries become more concerned about equity over time while and if they remain in office. However, the overall results suggest that the regional differences of the equity concerns depend on the level of development.

3.2 Experimental literature on cooperation and IEA formation

In recent years experimental research methods have been applied to improve the understanding of environmental problems (e.g. Milinski et al. 2008). A few experiments have been designed in order to provide insights in strategic interaction related to IEA formation. Moxnes and van der Heijden (2003) study the role of leadership in a so-called "public bad" experiment. In this experiment, two investment options are given. One consists of an investment generating negative externalities to group members and the other consists of an investment without externalities. The payoff structure is chosen such that it is a dominant strategy under selfish behaviour to invest the entire endowment into the choice option with externalities. Compared to a treatment without leadership, contributions to the public bad (in the leader-follower setting) are less if leaders start their investment with a positive

investment signal. However, the gains that are related to the leading position (lower externality costs) are not enough to compensate leaders for their costs of deviating from their dominant strategy. An important role of leadership is also reported by Sturm and Weimann (2008).

Strategic interaction at the ratification stage is part of the analysis by McEvoy (2010). He finds, different from the theoretical predictions, that free-riders (at the coalition formation stage) are not the first who opt out of the coalition. Most players wait and decide at the end of a pre-defined time period not to become a coalition member. McEvoy et al. (2011) look at the compliance and enforcement problem to contribute to a public good. They do not find support for their main hypothesis that member-financed enforcement to maintain compliance within a stable coalition results in greater participation and higher public good provision.

Dannenberg, Sturm and Vogt (2010) study unilateral preferences on equity. They ran an online experiment with subjects who had been involved in climate change negotiations. The underlying game was set up in order to test equity preferences based on Fehr and Schmidt (1999). One of the findings is that subjects have a significant aversion against advantageous inequality (one dislikes being relatively better off than others) whereas the aversion against disadvantageous inequality (one dislikes being relatively worse off than others) is only moderate. In contrast to other empirical findings (e.g. Lange et al. 2007) Dannenberg, Sturm and Vogt (2010) do not find significant regional differences in equity aversion. One explanation for the difference of the empirical findings and the experimental results might be that national interests (a country's position at the IEA formation stage) outweigh individual equity concerns.

Cherry and Dickinson (2008) examine the role of choice options to contribute to a public good. They find that voluntary contributions to the public good increase if there are more options available. This suggests that IEAs need to offer different ways to contribute to the public good. Freytag et al. (2010) report results of a threshold public goods game over six rounds with exogenous milestones and punishment. Milestones are meant to represent international policies, e.g. international environmental agreements. They find that milestones have a significant effect in those cases where the public good implies the conservation of a status quo, such as, for instance, a given level of environmental quality.

Recent experimental work of Dannenberg, Lange and Sturm (2010) and McGinty et al. (2011) directly targets individual group formation behaviour for the provision of a public good. Both studies are motivated by games of IEA formation. In the experiments participants were playing two-stage games where they announce their willingness to join at the first stage and play a public goods game at the second stage. In the study of Dannenberg et al. agents

have identical payoff functions. In the control treatment no coalition could be formed. Comparing coalition formation to the control treatment small and insignificant increases in the overall provision of the public good were observed. McGinty et al. (2011) consider experiments where payoffs differ across agents. They introduce this heterogeneity in order to test the impact of different transfer schemes among coalition members. They find that a well-designed transfer scheme that distributes the coalition payoff proportionally to outside options enhances membership and average contributions significantly.

4 Knowledge gaps and implications for research

In this survey, we have identified some gaps in the study of the political economy of IEA formation. These gaps define needs for future research. Generally, as it is obvious from a comparison of sections 2 and 3, the basic theoretical framework for the study of IEAs is largely unrelated to the empirical approaches. This observation does not extend, however, to experimental studies. The reasons are probably threefold. (i) The standard two-stage game of IEA formation offers a "traditional" view with countries as players but no room for political processes. Extensions of this model are possible but very rare so far. (ii) Empirical studies offer interesting findings but little insight into the mechanisms that drive policy outcomes. (iii) Finally, it is notoriously difficult to test "a theory of international environmental agreements" – even if it existed– due to a lack of data that are comparable across different kinds of agreements.

More specifically we wish to highlight four areas for promising research. First, for the case of strategic voting there is a need to build convincing voting models that better reflect the "real" aspects of the political process. For instance, most models consider simultaneous voting in different countries that precedes international policy-making and the analysis is restricted to just two countries. Games that offer a convincing sequential structure are yet to be developed.

Second, ratification of IEAs could be modelled as sequential games where at each moment each parliament/government may decide whether to ratify or to wait. Such a model set up would allow for a role of lobby groups after the negotiations when the main commitments are already drafted. The ultimate "fate" of the IEA is, thus, subject to a different type of pressure given the particular decision-making process of a parliament or congress and the way in which lobby groups can influence it.

Third, on the empirical side, a better match of concepts and data will be one way forward. For instance, some empirical analyses of lobbying rely on data describing corruption (see, for instance, Fredriksson et al. 2007). Although in some cases there may be a positive

relation between corruption and lobbying, this cannot be generalised. After all, while corruption is illegal, most lobbying activities are legal. For European countries, for instance, that are generally characterised by low levels of corruption but powerful lobbies, a corruption indicator will fail as an appropriate indicator of pressure on governments at the international negotiation tables.

Finally, from the perspective of political relevance, it seems promising to further study the role of institutions for the stability and success of IEAs (e.g. MPRs, definition of emission and resource rights, allocation mechanisms etc.). Furthermore, technological and structural change towards more environmentally friendly production processes impact and are impacted by IEAs (Nagashima and Dellink 2008), Nagashima et al. 2011). Hence, the political economy of industrial policies is also linked to IEA formation. In section 3.1 we report that transition towards democracy and trade openness has been found to be important. This shows that the analysis of IEAs may also be addressed from a comparative systems point of view.

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