Coping with creeping catastrophes: The capacity of national political systems in the perception, communication and solution of slow-moving and long-term policy problems

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First draft!

Paper to be presented at the Berlin Conference on the Human Dimensions of Global Environmental Change, Berlin, 22-23 February 2008

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1 Introduction[1]

Catastrophes are usually associated with phenomena like tsunamis, earthquakes or asteroid impacts – disasters that happen rapidly with immediately visible impacts. A different process logic is involved when problems and challenges evolve incrementally, in slow-motion (Pierson 2004), and when they only become visible from a long-term perspective. Jared Diamond recently referred to such changes as "creeping normalcy" pointing to changes which are perceived as normality if they happen in unnoticed increments(Diamond 2005). The concept was used to explain the varying adaptation capacities of human societies to long-term environmental changes.

There are two powerful metaphors which illustrate the inherent dangers of such processes: on the one hand the "boiling-frog" allegory which Al Gore was using in his movie "An Inconvenient Truth", and the "water-lilies" parable used in the first report of the Club of Rome. Meadows chose this parable to illustrate the danger of exponential development in resource depletion and describes it as follows: "A water-lily grows on a pond, doubling in size day by day, until it covers the whole water, suffocating all life below the water line. But even on the penultimate day, nobody thinks about cutting back its superfluous growth as half of the pond is still free. But in one more day the surface will be completely covered. Mathematics describes this as exponential growth" (Meadows 1972).

In the boiling-frog story it is said that if a frog is thrown into a pan of boiling water, it will immediately jump out, but if you put a frog in a jar of warm water and gradually heat it to boiling, the frog will stay until it boils to death. The frog's nervous system is apparently impervious to changes in temperature until their fatal consequence because it happens piecemeal-incrementally.

In the evolution of human societies, there are a number of processes that exhibit this pattern of "creepiness" where increments of problem growth remain unnoticed until their sudden phase jump or other forms of process escalation. The above mentioned climate change is just the most broadly discussed social and political problem of this kind. Other creeping catastrophes could be increasing social stress produced by aging societies, the slow accumulation of toxins in the food chain, or global pandemics like SARS and AIDS combined with increasing antibiotics resistance. All these processes have in common that they evolve "bit-by-bit" (incrementally), are cumulative, and result in possible long-term catastrophic consequences.

In this paper, we are not so much interested in the material side of this process pattern, but rather in its political and social consequences and how they can be dealt with. We try to determine if and how societies differ in the capacity to detect such creeping problems early, and claim that these differences are related to variations in their "central nervous systems", which control perception and adaptive behavior (Ashby 1956; Deutsch 1963). Today, "nerves of government" are much more inclusive and relate to widespread policy networks integrating a broad array of public and private actors into policy-making (Kenis & Schneider 1991; Raab & Kenis 2006).

The resulting questions are how these components are integrated and how political power is concentrated or dispersed. Do democratic political systems perform better with the perception of creeping challenges, or do we find examples of benevolent and advantageous

[1] The authors would like to thank Shen Ke, Marcin Stonawski and Sergi Vidal Torre for useful comments and Cathrine Brandt –Gaudry for linguistic support.

"eco-dictatorships"? Does de-centralization show some adaptive advantages, as recent management tracts make us believe (Brafman & Beckstrom 2006), and how much does collective action capacity, which usually is greater in small and homogenous collectivities, count,?

Based on a comparison of national policies related to global warming, the paper will discuss and then develop some hypotheses detailing how and why differently structured policy systems and their constituent policy networks show varying performance in the perception, communication, and coping with such long-term and slow moving policy problems. In a first section we will theoretically outline how political systems deal with long-term risks. We argue that internal and external factors both contribute to the varying pace and degree of governmental reaction. To illustrate our point, we will discuss two pressing issues on a macro-comparative scale: climate change and demographic change. We will conclude with a list of weaknesses these macro models exhibit and propose complementary research strategies.

2 Societal Development and adaptation

The issue of adaptation to environmental changes is a rather novel topic in social and political analysis. Traditional social theory strongly focused on the construction and maintenance of order. The question of how societies successfully overcome structural and behavioral changes in order to cope with critical problems was only raised in few "grand theories". One of these theories is Marxism, which holds the optimistic belief of a teleological sequence of changes in economic systems and forces of production. These are ultimately driven by social conflict, where the whole process leads to an increasingly powerful mastery of nature and society. The other approach with a similar teleological content is systems theory. It emphasizes general adaptive capacities and openness of social and political systems, the latter of which are based on increasing structural and functional differentiation (Almond 1965; Deutsch 1963; Parsons 1964).

A serious problem with traditional systems theory is that systems and systemic processes, for the most part, remain "black boxes" in which actors, relations and mechanisms are opaque (Bunge 1996; 1997). As an actor-centered and micro-institutional perspective, governance theory is a theoretical advancement in this respect. However, through its emphasis on order and the logic of coordination mechanisms, its perspective remains static and in some ways neo-holistic. Most governance theories emphasize comprehensive integrating structures (hierarchies, networks, markets, etc.), overlooking the heterogeneity and diversity of societal self-regulation. In addition, there are only few approaches which stress change and adaptation in their analysis (Williamson 1991). A much more dynamic and differentiated perspective is currently pursued by complexity theory (for an overview see Schneider & Bauer 2007). Its core objective is to explain adaptive success by differentiation, local interaction, and selection.

A fundamental problem from this point of view is to understand under which conditions societies attain complete adaptive failures, i.e. "collapse". Such consequences are characterized by a "drastic decrease in human population size and/or political/economic/social complexity" (Diamond 2005). From Tainter's perspective, collapse is a political process although it may have, and often has, consequences on other areas like economics and arts. A society collapses "when it displays a rapid, significant loss of an established level of socio-political complexity" (Tainter 1988). A decrease in complexity can be equated with a loss of differentiation, i.e. specialized subsystems and components, for instance the political one. From a systemic perspective systems maintain and reproduce their structures

through various social mechanisms (Bunge 1997), and collapse occurs when most of these mechanisms fail.

Our strategy for the next paragraphs will be twofold. First, we consider external factors which can lead to the collapse of a system in greater detail. Second, we try to display internal mechanisms of political systems contributing to stability and adaptation.

2.1 Failing Systems

As historical analysis has demonstrated, there are many reasons for the collapse of past societies (Diamond 1997; 2005). External factors threatening the existence of a society are, for example: climate change, hostile neighbors, depletion of vital resources, natural catastrophes and a variety of economic factors (Diamond 2005; Tainter 1988). In addition to these environmental challenges, internal societal tensions such as class conflict and elite misbehavior may also lead to collapse. Since we are not interested in all reasons for failure but rather in socio-political ones, we concentrate on a typical social process which is highlighted by both authors: *societies' perception and responses to critical problems*.

2.1.1 Complexity growth

Since complexity is a fundamental problem solving tool which creates competitive advantages, societies increase in complexity over time (Tainter 2000). Complexity growth in human societies is an adaptive process, a continuous search for solutions to emerging problems(Newell & Simon 1972). This process levies costs and yields benefits. It is an investment that societies make in problem solving. Tainter assumes that these investments increase when societies become more complex and, consequently, the returns diminish. Ultimately a growing society reaches a point where continued investment in complexity yields higher returns, but at a declining marginal rate. When this level is reached, a society enters the phase where complexity creates vulnerability. With regard to the question of why some societies are better equipped to cope with environmental problems, we consider the specific role and function of the political system.

2.1.2 Internal Models

Another aspect of the understanding of civilization processes exposed by complexity theory is the importance of "internal models" or representations of the "real world". Agents like societies, groups or individuals develop their own way of coping with the outside reality (Holland 2006). Internal models consist of rules which advise on how to act in a specific situation. This is an essential capability in the anticipation of problems. The evolution of these models is based on the intuition that an agent should prefer rules that use more information about a situation. According to Holland (Holland 1996), three possibilities of enhancements of these internal models are plausible: (1) reproduction according to fitness, i.e. the more appropriate a set of rules, the more likely it is to be chosen; (2) recombination, i.e. rules are paired, crossed and mutated to produce offspring rules, and (3) replacement, i.e. the offspring rules replace randomly chosen rules in the current model. The success of the enhanced internal model can only be seen over time.

The capabilities of a system to cope with the environment are best characterized by three basic elements (Holland 1996): 1/ A set of detectors which have the function to extract information crucial for survival; 2/ a set of rules which reflect the capability of processing the extracted information; 3/ a set of effectors through which an action on the environment is possible. In line with the argumentation presented here, the system-specific capabilities to handle long-term risks are threefold: A system needs components to detect and commu-

nicate a problem, to find solutions, and to mobilize and allocate problem-solving resources efficiently. The following section will allow a more insightful discussion by considering evolutionary models of societies.

2.1.3 Evolution

Complex societies develop complex political and cultural rule systems to cope with critical threats and problems. The main issue this why a society fails in this respect. Diamond suggests that several factors may be responsible for failure in collective decision-making (Diamond 1997; 2005). His categories deserve a more detailed discussion because they can be used as an analytical framework when considering how societies and states cope with environmental problems.

When we think of which essential parts of the problem-solving process can go wrong, we can separate the factors in a sequence of four phases (Diamond 2005). From a political science perspective, some of these phases are well known in the "policy cycle" literature (May & Wildavsky 1979).

First, a society can *anticipate* a problem before it arises. With respect to this capacity, appropriate "internal models" of the relevant agents are essential. However, anticipation can fail due to several reasons: One is that a society has no prior experience of a given problem and cannot imagine the possibility of its occurence. Another factor for failure is reasoning by false analogy. While the construction and use of analogies is a well known technique for the solving ill-structured problems (Simon 1973), analogies may be false and consequently suggest inappropriate strategies.

After anticipating a problem, a society has to *perceive* a problem when it occurs. There are several reasons for a failure of perception. 1/ The material origins of a problems can be imperceptible; 2/ Cultural and political factors can be responsible that an objective problem is subjectively not perceived as such; 3/ A failure to perceive a problem may be implied in its temporal pattern: If it grows incrementally, "bit-by-bit", and if these change are concealed by continual fluctuations, even if there is an exponential growth during the first stages, societies may conceive this as "creeping normalcy".

The third phase of problem solving is the *actual solving* process. Many societies fail at this stage, often because of conflicts of interest based on distributive effects of problem-solving, but also because of conflicting problem-solving philosophies. In many cases, particular interests contradict societal needs while the interest groups have a strong position in the political process. Other possible reasons are described in models on social dilemmas like the prisoners' dilemma or the logic of collective action. Finally, failure can also emerge from irrational behavior based on non-adaptive norms and values.

Even if a society has anticipated, perceived, and communicated the problem and has allocated relevant problem-solving resources, failure is still possible because the problem can be *beyond the solving capacities*. It could simply be too expensive to solve, efforts could be "too little, too late", or the attempted solution could backfire and make the problem worse.

2.2 The nerves of governance

Modern societies are differentiated and many heterogeneous agents and rule-systems contribute to the problem solving process. Following the "Nerves of Government" analogy by Deutsch, the various parts of a society are integrated in a central nervous system, communicating observations and perceptions between the components and controlling its collec-

tive behavior, which should contribute to problem-solving and adaptation(Deutsch 1963). To analyze this process properly, we need Diamond's distinction between anticipation, perception and solving because different societal agents (for example the media, science and NGOs) are responsible for different functions at different stages. Furthermore we incorporate Holland's "internal models" as political belief systems and social representations. If we want to investigate which factors contribute to success or failure when coping with global warming or other creeping problems, this analytical distinction seems promising. Modern societies have reached such a level of complexity that, as Tainter stated, complexity itself could be a reason for failure (Tainter 1988; 2000). In analyzing the efficiency and effectiveness of the problem-solving, a crucial question is whether the whole process still functions despite the fact that subsystems diversity renders common solving impossible. It is not sufficient for a subsystem to perceive a risk, it must communicate the problem effectively, and decision-makers must receive and trust their perception. Evidently, there are many possible frictions in complex societies.

When viewing them as "nerves of governance", the analytical perspective of cross-national comparison is a useful tool for considering societies. Despite many external influences and transnational diffusion processes through globalization, the dominant and most important problem-solving mechanisms are still based on the nation state as the core of a political system. As a first example, we therefore compare the different national political systems and their structural characteristics to find similarities and differences in the problem solving process within the policy domain of global warming.

3 Capacities of problem-solving: hypotheses and conjectures

Which roles and functions do the various subsystems, agents, relations and mechanisms have in the above-mentioned stages of problem-solving? Is it possible to relate the varying capacities to cope with creeping problems to their structural features? In the following section we apply the complex systems perspective to global warming related policy-making and derive some hypotheses associated to varying capacities of national political systems when coping with this specific policy problem. In a first step we will identify system-specific characteristics which, in our opinion, influence governments' policy-outputs in a systematic way.

3.1 Anticipation

There are only two ways of anticipating a problem which has not yet become manifest. The first is to rely on introspection or a kind of supra-natural "revelation knowledge". The other is predictive knowledge based on empirical evidence. Problems can frequently be anticipated through scientific forecasts, and science then works as an early warning system. In this instance, science as a cultural subsystem of society is considered to be a crucial part of the "neural system of governance" of a society; it is the major force of production when it comes to the formulation of "internal models" enabling the anticipation of future problems. As we will argue, scientific anticipation alone is not a decisive factor for an effective start to societies' problem-solving process: it must be considered in conjunction with the importance a given society attributes to scientific knowledge.

Generally, the aim of science is to investigate a research object – a thing or system – in the search for truth(Bunge 1996). This simple postulate raises several causes for concern for the consideration of the climate change topic (Malnes 2006): 1/ The scientific perception of climate change itself is a problem because the process is very slow and it is not easy to separate man-made global warming from natural fluctuations (Houghton et al 1990). 2/ It

is even harder to identify causes for an irreversible and lasting change of world climate. 3/ The nature of the topic necessitates long-term forecasts which will be uncertain by definition. The role of science thus diminishes from the anticipation of a problem, to the anticipation of an inexplicable phenomenon and, finally, to the relation of uncertain causes for this appearance. This is a state of imperfect or uncertain science (Curry et al 2006; Malnes 2006; Philander 1998) which has far-reaching consequences for the anticipation function. The correct anticipation of a problem will fail to become socially relevant if a society does not consider science to be a credible tool for finding the truth. Beginning with the assumption that something like "quality science", which can at least produce "approximately true" statements, is possible, the theorized relation between the structural features of a society and the anticipation of critical problems can then be sketched out as follows: The more advanced science systems in national societies are, the greater reputation and status they will exhibit (i.e. supporting credibility), and the more likely it then is that problems get correctly anticipated. The issue, however, is how to measure these differences from a macro-comparative perspective.

3.2 Perception

Perception is the core around which the "neural society" metaphor gravitates. Two crucial aspects are considered: First, we analyze conditions for the scientific perception of a given problem. Second, we emphasize societal perception of facts and analyze mechanisms through which they become socially relevant and "problematic". The first is primarily a scientific task whereas the second refers to how sensitively mass media, social movements and interest groups function as societal "neurotransmitters" that link a change in environmental conditions to a credible threat. Aside from the above mentioned channels of interest intermediation transforming scientific findings in generalized knowledge, science may also be directly drawn into policy-making processes through integrated policy circuits: Science may be an influential agent in policy networks linking actors by information exchange. If the network operates effectively, relevant information may diffuse faster among political actors and the politicization of a given problem should be easier than in tightly controlled autocratic or hierarchical systems. Assuming that this network argument is true, we expect a government to be more sensitive to climate change problems when there are more possibilities of getting access to the political agenda via decentralized policy networks.

This argument also is valid at the global level. In the contemporary "global society", science is part of universal networks in which information exchange cannot be restricted to national boundaries(Fisher 2003). Problem perception in one national science system quickly diffuses to other regions and countries. Despite the fact that science and its communication network have become global, however, there is still some remarkable national variation in the scientific perception, definition, and evaluation of problems, as recent empirical research has shown (Bray & von Storch 1999).

The technical perception of a problem by scientists has to be related to its socio-political communication by intermediaries like social movements, interest groups, political parties and mass media, but also to the general cultural background in which a given problem such as climate change emerges (Verweij et al 2006). But social movements are not just "problem indicators", they also help to frame and crystallize issues, making them socially relevant. Through the framing of beliefs and values, people perceive otherwise unconsidered problems (Moser 2007). In the case of global warming, green NGOs are of particular importance (Andresen & Guibrandsen 2005; Carpenter 2001; Fisher 2003; Gough & Shackley 2001; Keohane 2002; Lubell et al 2007; Moser 2007). Since major impacts of climate

change will not occur in the near future, the topic is less tangible to the public and various stakeholders. Green NGOs therefore have to work for a sustained problem perception. Compared to single issue campaigning generally associated with the approaches of NGOs to environmental and public risks, climate change "ushers in a new era of engagement" (Gough & Shackley 2001).

It is not surprising that green social movements are closely linked with green parties. Since environmental problems and in particular global warming imply long-lasting and high-risk problems, the emergence of green parties from social movements can be understood as a consolidation of this issue area. In line with our neural model we assume that the more numerous and politically integrated social movements and green parties are in a given society, the better and more stable the societal perception of global warming will be.

Another risk transmitter is the media. It has a crucial function as a source of information and opinion about scientific findings for citizens (Carvalho 2007). Public perception of this domain is significantly influenced by the representation of scientific knowledge transmitted through various means of mass communication (Corbett & Durfee 2004; Krosnick et al 2000). Without a free press, the step from scientific perception to social perception is less likely.

Two aspects seem to be relevant in this context. The level of public concern about environmental issues tends to follow the degree of media attention(Trumbo 1996). Because environmental crises are not popular for national governments, we assume that autocratic or authoritarian regimes try to avoid media coverage of this field. Therefore we believe that the higher the degree of press freedom are in a society, the more likely the societal perception of global warming will be.

Mass media are also important for the understanding of perceived risks (Stamm et al 2000). Public understanding implies a relation between the causes and the effects of a problem. In this respect complete and credible information via the media is a necessary condition for public understanding. The ways in which people think about environmental problems is not necessarily accurate or complete. Nevertheless, these cognitive processes are likely to influence both the willingness and ability of societal agents to participate in problem-solving. We consequently assume that uncensored media coverage has two effects on problem perception: 1/ It transforms scientific perception of a problem into a general societal perception. 2/ It contributes to the understanding of the nature of the problem and thereby motivates collective action. Stamm et al. have found evidence that only individuals who understand the complex relation between causes and effects are willing to take action to impede the risk (Stamm et al 2000). The relation between these factors can be expressed in the following hypothesis: The better the understanding of the issue of global warming, the more likely it is that a society will take action to prevent the problem.

3.3 Agenda setting

The intermediate step between societal perception and a policy solution is the shift from the social to the political realm in problem-processing. A first stage in this process is the transformation of the issue to a topic on a political system's priority list. Communication science and policy research call this process "agenda-setting" (Kingdon 2003). A jump on the political agenda may be triggered through communication by non-governmental actors and mass media; however, it also may originate from the inside of politics – from bureaucracy or the parliamentary arena.

There are several dimensions where political systems can differ with respect to the openness and permeability of their policy-agendas. One important factor is the possibility of access from social movements and NGOs to policy-makers through policy networks. Political systems vary widely in terms of their degree, how they integrate new and rather weak interests (Kriesi 1995). In this respect we agree with Jost and Jacob, who state that inclusive political systems which are open to different actors and their interests are likely to perform better in the political perception of societal problems (Jost & Jacob 2004).

3.4 Problem-solving

Once a problem is on the political agenda, the struggle for a policy solution is often a process which is driven by conflicting interests and the quest for power. Accordingly, it seems to be appropriate to take the structural patterns of governmental systems (in the narrow sense) into account. The most fundamental question is if the dispersion and sharing of political power enhances or reduces the capacity for collective action(Norris 2008). In recent political science literature there are two contrasting hypotheses: On the one hand, Tsebelis' veto player model states and demonstrates in a formal manner that as the number of veto players a political system includes grows (i.e. the greater the dispersion of power), the smaller is its capacity to change the status quo (Tsebelis 2002).

Lijpharts empirical study on the variety of democratic political system, in constrast, points to slight performance advantages of decentralized political systems (Lijphart 1999). Lijphart's power dispersion sums up the arrangement of executive power, party systems and electoral regimes, interest group structures, but also the vertical division of power in federal systems. From this perspective there are two major streams of argumentation: On the one hand, it is conceivable that "majoritarian systems" with only one real center of power is able to produce policy solutions faster and more radical than consensus models. On the other hand, governments in more consensus-oriented democracies, which have to look at several different actor positions when designing a policy, could be affiliated with more encompassing and mature policy solutions. For instance, a minority party like the greens in Germany can be considered more influential in consensus systems because they, at the very least, must be integrated in the policy-making, whereas in majority systems environmental problems could be ignored because they lack importance. In several policy areas, Lijphart thus shows some empirical evidence that consensus systems display a series of performance advantages when compared to majoritarian democracies.

4 Empirical findings and implications for research design

The previous sections sketched a theoretical framework of political systems coping methods for long-term risks. We argued that different political and social systems structures contribute to both the varying pace and degree of governmental reaction. To illustrate our point, we will now discuss two pressing issues on a macro-comparative scale: climate change and demographic change. We will conclude with a list of weaknesses theses macro models exhibit and propose complementary research strategies.

4.1 The case of climate change

The issue of anthropogenic global warming was first hypothesized by Arrhenius more than 100 years ago (Arrhenius 1896). Only in recent years has climate change been perceived as a pressing global risk that needs to be tackled both on the national and on the global level by a growing number of governments. Polities react in rather different ways to this challenge: While some countries take the lead, others lag behind. We will try to test whether

this differential response is caused by the capacity of the national political systems to promote a public debate, by the decision-making capacity of governments, by economic and interest group pressures, or by the population size of a country.

4.1.1 Operationalization

The first argument rests on the conjecture that open, democratic countries with high degrees of civil rights, pluralism and freedom of press and assembly might be more likely to have a lively public debate about the upcoming risk. We therefore use readily available measures of good governance (the Worldwide Governance Indicators of the World Bank)(Kaufmann et al 1999), electoral participation (one part of the Vanhanen Index)(Vanhanen 2000), and the overall "success" of political systems in effectively deciding upon upcoming issues, fighting corruption, and providing services (the Failed States Index) as indicators of the states' capacity to serve as the arena of extensive public discourse (www.fundforpeace.org/). We expect democratic countries to actively engage in climate protection policy while we expect authoritarian countries to shy away from becoming very active.

The second construct is the decision-making capacity of countries. We use Tsebelis' veto player data to test whether the number of veto players in a country affects their level and pace of policy response (Tsebelis 2002). In addition, Lijphart's executives-parties dimension is used (details can be found in section 3.4)(Lijphart 1999).

Economic and interest group pressures are captured in an indicator about the share of the secondary/industrial sector in the economies of the countries ("% Ind."). If there is a large industrial sector, industry interests are more likely to exert pressure on the national government. On the other hand, if agriculture and the service sector are bigger, domestic pro-industry interest group pressure will be less powerful, and the government will be more active in the promotion of climate protection policies. An economic catch-all variable is the gross domestic product per capita. This variable might exert multiple influences: If people in a country are rich, they are more likely to have post-materialist attitudes. At the same time, wealth is correlated with democracy, in order for the post-materialist electorate to assert its positions. The argument is that societies with a high GDP per capita do not have to face any severe problems and can concentrate on less urgent and instantaneous matters like climate change (see worldbank development indicators at www.worldbank.org/data/).

The final hypothesis to be tested is the level of risk-exposure of each country. Very small countries with less than one million inhabitants are often directly threatened by extreme weather conditions or rising sea levels. This is captured by a dummy variable indicating whether the population size of a country is below one million.

In addition, we will include the absolute level of CO2 emissions as a control variable: Countries with a large amount of emissions are presumably more likely to produce larger changes in emissions than countries with a low emission level. This is due to the higher variance of large numbers.

Finally, we use two dependent variables: The first is the duration between the agreement on the Kyoto protocol (11 December 1997) and the date of ratification, acceptance, accession or approval of the protocol measured in days. These time spans (from now on referred to as the pace of government activity) show which countries are early adopters and which countries are laggards. The second dependent variable is the change in CO2 emissions per capita between 1990 and 2004. This is not a direct measure of the output, i.e. government

policy, but rather a measure of the impact. The assumption is that governments are able to steer the level of CO2 emissions if they only assign a high priority to the upcoming risk.

4.1.2 Why are countries early adopters or laggards?

The pace of government activity can be assessed by looking at the Kyoto survival data. Since all countries have not ratified the protocol, this data is right-censored. We therefore use a nonparametric Kaplan-Meier maximum likelihood estimation (see Efron 1988 with further references to survival analysis). The density function (here calculated with a kernel density estimator despite the censoring) and the survival functions (Kaplan-Meier fit) are shown in figure 1.

The first plot shows the hazard rate of all countries. The number of new adopters increases to a certain level (the early adopters), then is constant until there is a large increase in accessions, possibly induced by the first wave of adopters (the critical mass has been reached at this point), and decreases again. There is a third wave of late adopters before fewer and fewer countries ratify the protocol.

The question is: What factors – beside diffusion – are responsible for early versus late adoption? We include several of the above mentioned covariates in our model and estimate their effect one by one. Plots 2 to 6 present our findings. The black survival rate represents the 0 of a dummy variable, while the red line is the 1 of the same dichotomous variable.

In the second graph, energy use (kg oil equivalent) per $1,000 GDP was dichotomized at the median value of the distribution in order to partition countries into a group of energy-efficient users (value 0) and one of rather inefficient countries (value 1). There is a clear difference in the survival rates of the two groups: Over the whole time period, wasteful countries are laggards (the red ladder). This could be due to country-internal characteristics such as strong industry lobbying or an electorate that benefits from low energy-efficiency (e.g. cheaper fuel).

This leads to the third plot, where we test the executive-versus-parties dimension of Lijphart (c.f. section 3.4). It is evident that consensual political systems are slower in the beginning and then adopt the Kyoto protocol almost all at once while executive systems start earlier and show more continuity. This supports the claim that governments with a higher capacity to make decisions react faster to the long-term problem of climate change. We have tried to corroborate this finding by using Tsebelis' data set of veto players, but the number of observations (21 polities) is too small for any quantitative analysis.

The fourth plot shows a dummy variable for population size. Countries with less than one million inhabitants are represented by the black curve, others by the colour red. Small countries appear to adopt the protocol earlier, which might be due to the fact that many of them, like Fiji or the Maldives or Caribbean countries, are directly threatened by a rise of the sea level or extreme weather conditions. During the first years after the agreement, there is a particularly rapid adoption rate among these polities.

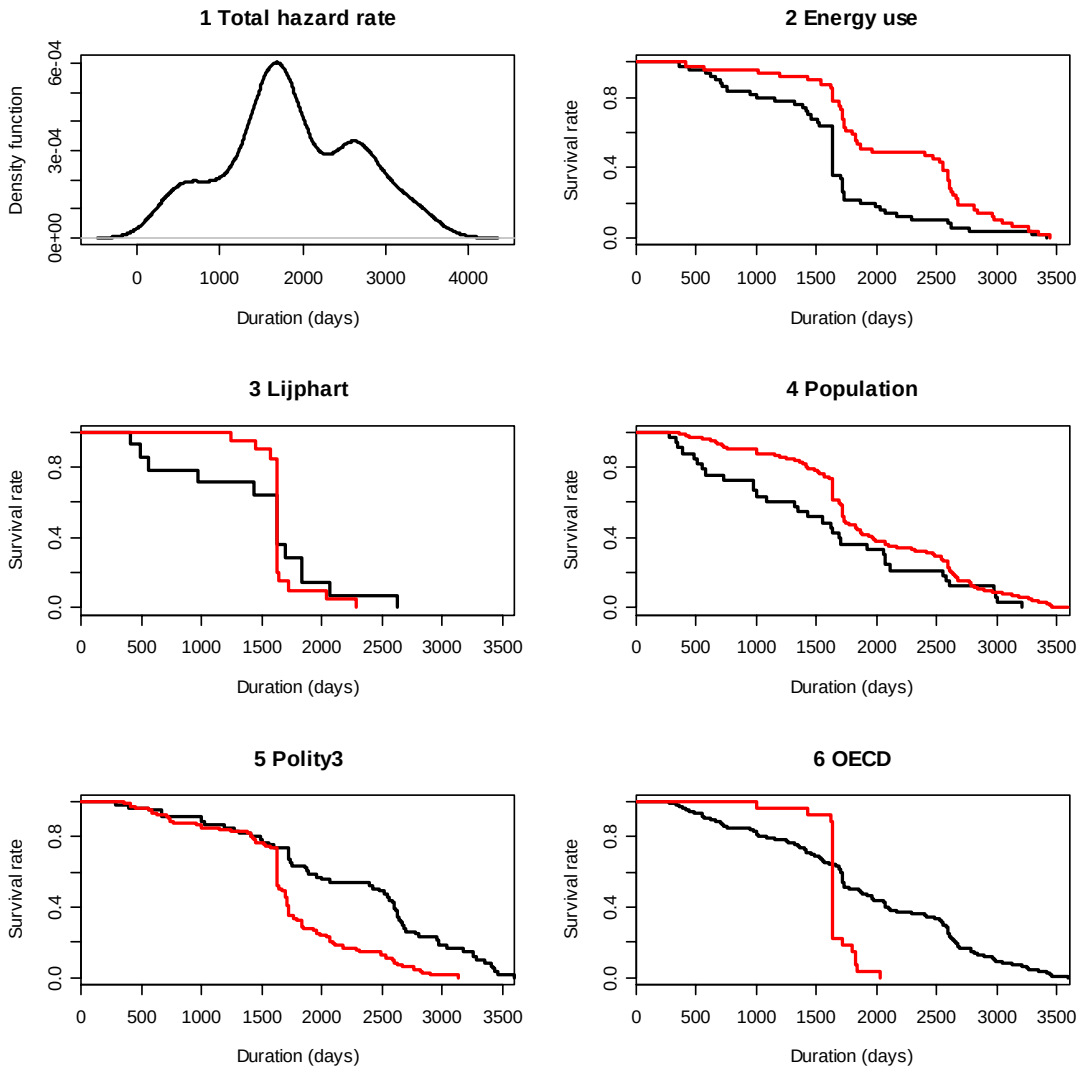

Figure 1: Results of the survival analysis

The fifth part of the figure shows the Polity III index, again dichotomized at the median value. This index captures whether a country is rather democratic or rather autocratic. During the first half of the process, democratic (red curve) and autocratic countries (black curve) perform identically, but then the democratic countries appear to have reached a certain critical mass, and many democracies adopt at the same time or shortly afterwards. The process is then slowed down again. This pattern is strongly consistent over all democracy measures we have tested: the Polity III index, the Vanhanen Index of electoral participation and party competition, the Failed States Index, the Human Development Index of the World Bank, the Worldwide Governance Indicators of the World Bank about voice and equality, fighting corruption, government efficiency, political stability, regulatory quality and the rule of law, as well as the Freedomhouse Index of political rights and civil liberties. The finding generally suggests that the more stable, participatory and effective a political system is, the more likely it is that the Kyoto protocol will be ratified rapidly, particularly after the initial spin-off after about 1,550 days.

The last plot draws an even clearer picture: OECD countries were extreme laggards before most of them ratified the protocol simultaneously. In fact, OECD membership accounts for much of the variance in the previous plot. This suggests the role of the OECD as an in-

strument that facilitates common framing and tackling of the problem, culminating in belief and policy congruence of the member countries.

This part of the analysis has provided some clues of how political systems cope with long-term risks. Important factors preventing governments from becoming active seem to be domestic political pressure, consensual institutions and a lack of decision-making capacity, a low magnitude of the problem for the country at risk, and finally a lack of political openness to have a public debate about the problem. However, purely economic factors like GDP per capita do not exert a strong effect.

4.1.3 What leads some countries to change their policies to a stronger extent than others?

The ratification dates of the Kyoto protocol are only one indicator of fighting against climate change. In fact, this does not say anything about how countries change their emission rates and why some countries show incremental policy change and others radical change. In order to assess this variance, we will look at the absolute per capita change in CO2 emissions between 1990 and 2004. Some countries decrease their emissions while others increase them. For a prediction of this change, a log transformation of the values is necessary. This is, however, not possible for the decreasing emission levels, since the logarithm of negative values is not defined. Instead, we discard the direction of the change and concentrate on predicting the magnitude of emission change, i.e. the absolute values. What drives polities to introduce radical versus incremental policy change?

Figure 2 gives an overview of the distributions and associations of this dependent variable ("CO2 change") as well as some selected independent variables. The lower triangle consists of row- and column-wise scatter-plots with loess smoothers (without correction for outliers), the upper triangle shows the correlation coefficients, and the diagonal cells include the variable names and the histograms. "CO2 p.c." refers to the total amount of CO2 emissions per capita in 1990, which is the baseline year before the change. "VH Part." is the electoral participation component of the Vanhanen democracy index 2000, "Failed S." is the Failed States Index 2007, WWGI stands for the regulatory quality index of the World Bank's Worldwide Governance Indicators 2007, "GDP p.c." is the gross domestic product per capita in 2004, and "% Ind." refers to the share of the secondary (industrial) sector. The assumption is that the cross-sectional variance is much higher than longitudinal changes within the countries; therefore we can rely on indices from different years as rough measures.

We can see three things in this scatterplot matrix: First, the magnitude of change is strongly correlated with the total level of emissions of a country. The explanation is straightforward: If country A has an emission level of 5 and country B an emission level of 20, it will be easier for country B to have a change of 5 than for country A. In other words, larger values also have a larger variance. Second, absolute CO2 change per capita is correlated with a number of democracy and economic variables. The impact of these factors is examined below. Third, the dependent variables show a high degree of overlap among each other, which is a sign of collinearity of the dependent variables. In a regression analysis, it is therefore advisable to look at the Variance Inflation Factor (VIF) to test whether the collinearity is too strong.

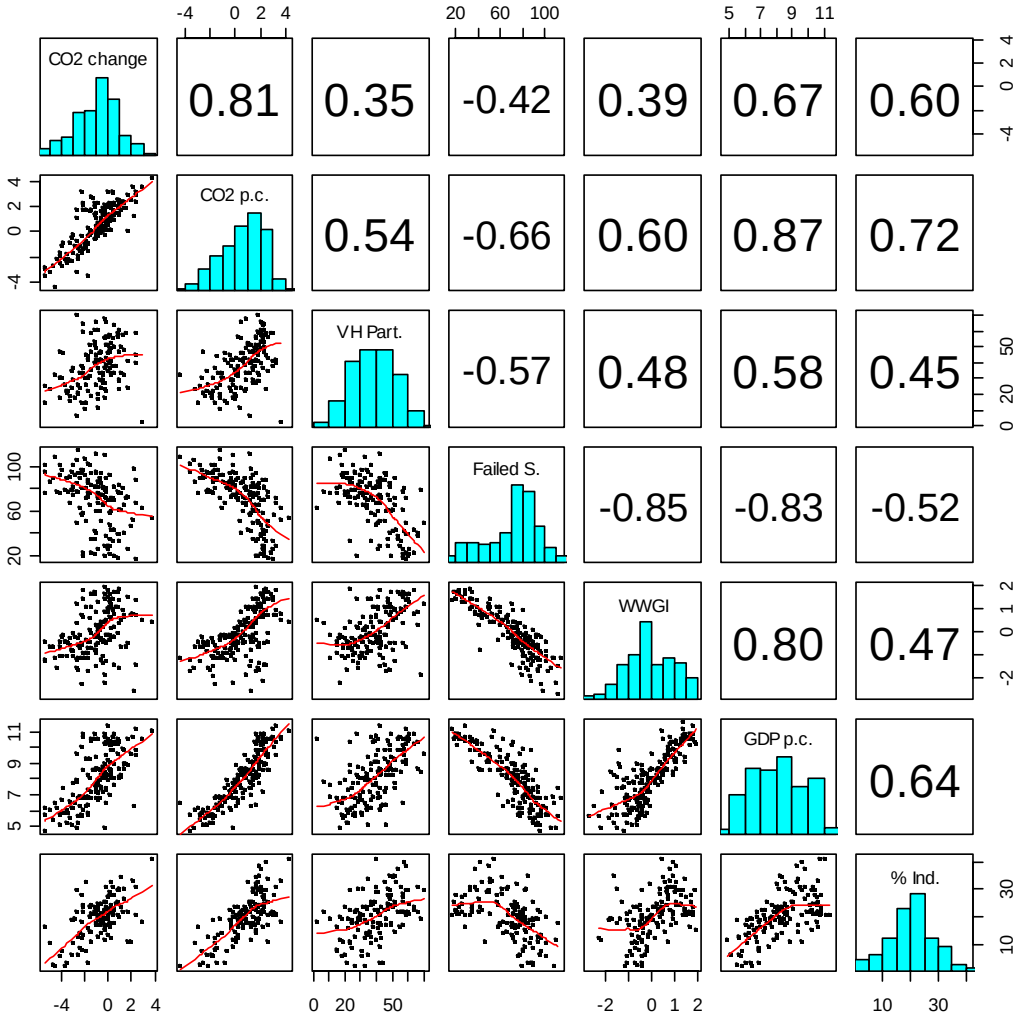

Figure 2: Associations between the variables

Table 1 presents the results of several linear models. Due to the multi-colinearity issue, models 1 to 6 include only two independent variables each: The absolute emission level, which is necessary to hold the effect of large baseline values constant (see above), and one measure of democracy or economy in each model. We can clearly see that both have an effect: The more democratic a country is (and the better the participation of the people and the regulatory quality of the governments is), the stronger is the magnitude of change in emissions (models 1 to 4). This effect is consistent over almost all measures of democracy we have tested (for a list, see previous section). The Human Development Index of the World Bank, which incorporates economic, technological, health-related and political factors, shows a highly significant effect (model 5), just like GDP per capita alone (model 7). The effect of GDP per capita might be attributed to post-materialist values or fewer competing risks (no civil wars or health problems).

Table 1: Results of the linear models

	Dependent variable: Magnitude of change in CO2 emissions from 1990 to 2004 (log)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Failed States Index	-0.014*							
	(0.006)							
Vanhanen: Participation		0.025**						
		(0.009)						
World Wide Governance			0.313*					-0.734***
Indicators: Regulatory quali-			(0.143)					(0.170)
ty								
World Wide Governance				0.400**				
Indicators: Government ef-				(0.134)				
fectiveness								
Human Development Index					5.825***			
					(0.741)			
Share of secondary sector						0.104***		
(industry)						(0.018)		
GDP per capita (log)							0.640***	1.001***
							(0.084)	(0.116)
CO2 emissions per capita in	0.129***	0.151***	0.131***	0.120***	0.047*	0.072**	0.028	0.018
1990 (log)	(0.025)	(0.029)	(0.025))	(0.023)	(0.023)	(0.022)	(0.025)	(0.024)
Adj. R^2	0.29	0.27	0.27	0.29	0.46	0.40	0.45	0.50
df	147	130	157	160	149	120	159	156

It is, however, not rooted in lower political pressure of organized industry interests due to the lower amount of heavy industry because this is already held constant in the absolute emission level variable. Unless we look at the micro or meso level within the countries, it is hardly possible to distinguish between the possible mechanisms.

A highly significant association is also present in model 6, the share of the secondary sector. Countries with much industry tend to produce more extreme changes in their level of emissions than agriculture- or service-oriented economies when the total level of emissions is held constant. This finding is somewhat puzzling and deserves further investigation.

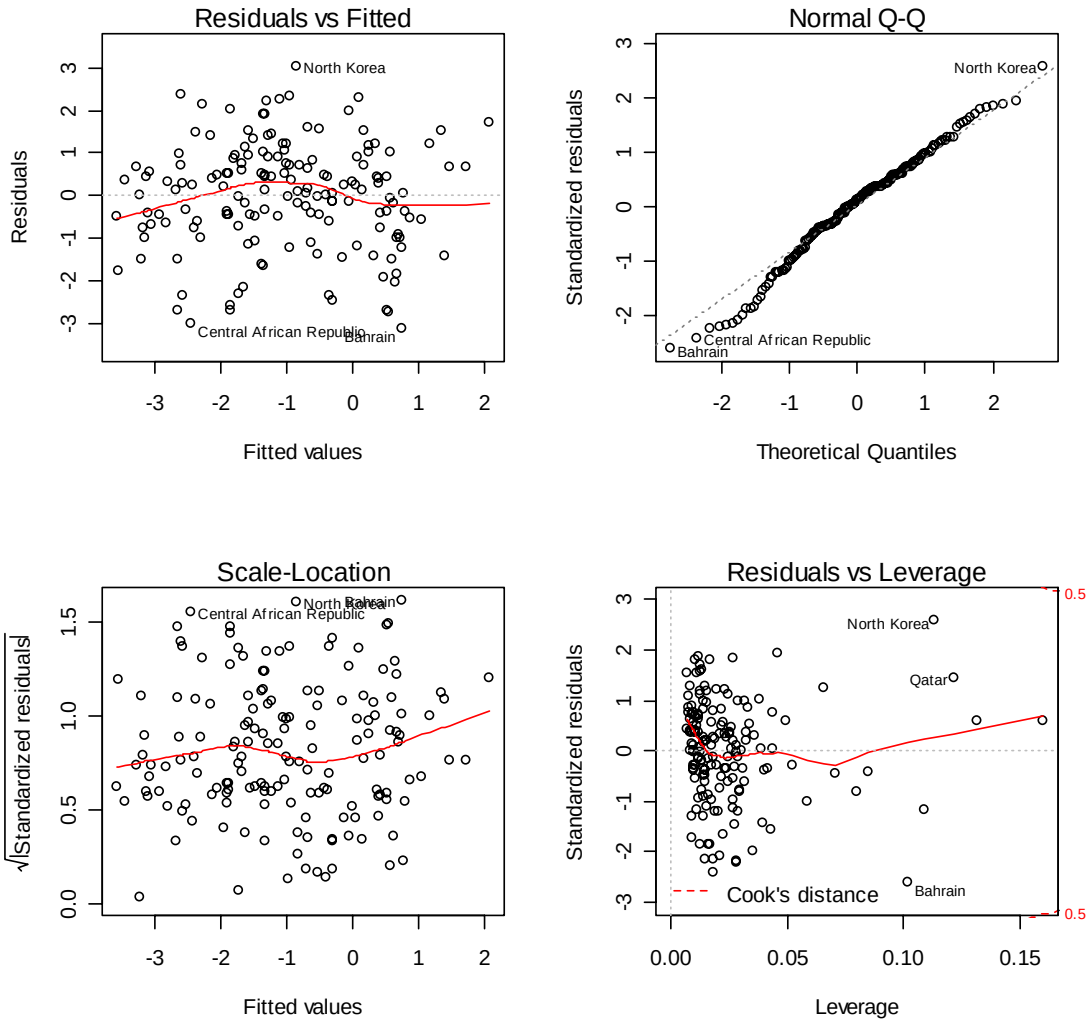

Figure 3: Regression diagnostics of model 8

If economic and political factors are combined (model 8), 50% of the variance can be explained. Both factors are highly significant, but the total level of emissions, that has to be held constant, is not significant anymore. The Variance Inflation Factor shows scores far below 5.0, so collinearity is at least not a serious problem in this combination of factors. The regression diagnostics depicted in figure 3 provide evidence that the model is properly specified. Only small residuals deviate slightly from a normal distribution, as shown by the normal Q-Q plot.

As in the survival analysis, we have tested Tsebelis' veto player data and Lijphart's executive-parties dimension, but this time no effect can be detected. It seems that the pace of becoming active is related to the capacity of a government to decide effectively, but that the magnitude of change is not related to it. Domestic political configurations deserve closer attention in future research.

This cross-sectional analysis has corroborated the result of the survival analysis that democracy matters. The capacity of polities to have public debates about upcoming long-term risks affects their climate policy behavior. The results also leave us with some new puzzles: Why does democracy determine the magnitude of policy change, but not the direction of change? Why are domestic institutional factors irrelevant in this respect? And particularly, what exactly happens inside the black box of the nation state? We argue that it is necessary to examine the emerging debate and the role and integration of certain actors within the polities in order to understand the variance in climate policy between the polities.

4.1.4 Drawbacks and implications

Research on the micro level is often criticized for not looking at between-country variation, while macro-comparative research is frequently attacked for ignoring what actually happens inside countries. On these grounds, our macro approach to the problem of societal long-term risks can only provide hints on where thorough consideratio is needed. Aside from this general issue, there are a number of problems associated with our macro-comparative analysis requiring discussion:

Multicollinearity: The independent variables not only explain the dependent variables, they also explain each other. In particular, it is useless to include measures both of democracy and economy. The latter two effects are inseparable, i.e. we are facing the well-known problem of whether democracy causes wealth via liberalism or whether wealth causes democratic institutions (Norris 2008). In the cross-sectional analysis above, a separate model was therefore estimated for every indicator, showing that a democratic and economic effect is indeed at work. The way to go from here is to develop testable theoretical implications from the theory, i.e. what would also be true if the capacity of political systems for public debate was responsible for the reaction of countries?

Dependence between the observations: In inferential statistics, observations are assumed to be independent from each other. Yet this independence is not necessarily given when looking at political systems: According to neorealist hegemonic stability theory, great powers have the ability to create and enforce international norms, i.e. they will impose constraints on the actions of smaller countries. Additionally, developed countries offer other countries development assistance and expect their compliance in the international arena (e.g. the "adaptation fund" initiated at the Bali summit or the "forest carbon partnership" offered by the German government and the World Bank). Russia's ratification of the Kyoto protocol in November 2004 was tied to the issue of Russian WTO accession as a package deal. Once such incentives are offered to less wealthy and less democratic countries, the variance between countries cannot be reliably explained anymore on the grounds of democratic and economic mechanisms in a simple cross-sectional design. It might be possible to solve this problem of autocorrelation, which is also known as Galton's problem, by identifying and incorporating the underlying mechanisms of diffusion. This would, however, require some addtional effort.

Operationalization: A potential problem is the operationalization of some variables: Emissions are not the direct output of climate policy-making, they are rather an impact variable, resting on the assumption that state action fully determines the behavior of emission originators. Varying success of policy instruments like emission trading is not taken into account. As for the independent variables, we cannot ascertain whether GDP per capita, for instance, has an effect on voters' values, i.e. post-materialism, and on the possibility to assert these values in a participatory political system (since democracy and wealth are correlated), or whether it is just a proxy for development, i.e. fewer competing societal risks promote a higher priority of climate change in governmental policy-making. This leads to the problem of multicollinearity again, which is essentially a theoretical rather than a methodological problem.

Endogeneity: As is the case with most social science theories, causality is not purely unidirectional. Development promotes emission change, but emissions may also affect whether a country develops or not.

Competing risks: In addition to climate change, countries are exposed to a variety of societal and economic short- and long-term challenges. Some of these have a global scope like environmental issues and some do not or hardly exceed state boundaries, e.g. civil wars, economic decline or demographic change. The role of these competing risks in causing governments to act has largely been neglected: Governments face tradeoffs when anticipating and fighting risks, i.e. they will only see the most pressing problems and neglect others. If a government has to suppress upcoming ethnic tensions, for instance, it will assign a very low priority to climate change, given the time, staff and budget constraint. This further complicates the comparability of observations.

Selection of the risk: Climate change is only one societal long-term risk. If one tries to infer more abstract mechanisms from this single case, one might face an extreme small-n problem. In other words, we cannot be sure that our theory and our findings equally apply to other creeping catastrophes. In the following subsection, we will therefore discuss our point using a second societal long-term risk: demographic change.

In this section, we have summed up six major drawbacks of our macro approach that are hard or even impossible to fix using a purely macro-comparative research strategy. We therefore advocate looking at individual countries in more details. The final section of this paper will elaborate on this proposal.

4.2 The case of demographic change

In modern industrial countries like Germany or Japan, the average life expectancy has been monotonically growing over the course of the last decades (Oeppen & Vaupel 2002). At the same time, societal value change and pressures resulting from globalization and economic competition have led to decreasing net reproduction rates of these societies. These developments are expected to have severe and increasing implications for existing welfare systems such as the pension system, health insurance, long-term health care or family-related social policy: While more elderly people require medical treatment or health care, there are fewer net insurance tax payers. Similarly, public spending on monthly old-age pensions must be increased to cover the growing number of annuitants, while at the same time there are fewer pension tax payers to cover

the growing costs. Since the problem pressure steadily grows over several decades, this is a case of “creeping normalcy” referred to in section 1.

This multitude of interacting mechanisms supplies evidence that the distinction between causes, consequences and the actual problem definition are not clear-cut. Although many will identify declining fertility (due to the increasing use of contraceptives, societal value change or chemical exposure) as a creeping risk, it is rather the main cause of the pressures that current social security systems experience. Other causes of this problem are presumably a lack of working immigrants, the missing empowerment of labor market reserves, a lack of economic reforms, increasing life expectancy or the short-term orientation of policy-making conditioned by institutions such as short legislative periods. The problem that needs to be tackled, however, is the unfavorable ratio between the benefits annuitants receive and the money that tax payers have to pay for them. At the same time, a variety of solution concepts exist, each solution concept being related to one perceived cause.

We argue that a comparative assessment between countries is hardly possible for three reasons:

1. As demonstrated above, the problem, its causes and its solutions are multidimensional and complex. In the case of climate change, the problem was only one-dimensional, i.e. good policy versus bad policy or lower versus higher emission levels or environmental versus industrial interests. It was therefore relatively easy to find output measures as dependent variables. In the case of demographic change, this is more complicated: The multiple cleavage lines include, but are not limited to, socialist versus liberalist social policy, left- versus right-wing immigration policy (and possible implications of immigration for integration and social freedom), or gender equality (as featured in the empowerment of labor market reserves) versus fertility subsidies (pro-active family policy). These issues depend on ideologically informed judgments and are partly complex (interdependent) at the same time. It is hardly possible to assemble a variety of these policies into an aggregate measure of demographic risk policy which can be used as a dependent variable in a regression analysis.
2. While climate change is a global risk affecting more or less all countries in the world to the same extent and at the same time, demographic change exhibits a greater deal of variability. According to the Demographic Transition Model (Thompson 1929), countries undergo demographic change in four steps from a pre-industrial society with high birth rates and high death rates to a stable stage with low birth and death rates. An extension of this model adds a fifth stage with sub-replacement fertility rates, culminating in the risk of pressures on the social security systems. This dynamic model implies cross-sectional as well as longitudinal variation in the magnitude of the problem. Cross-sectional regression models with countries as observations would therefore be a misspecification.
3. The Demographic Transition Model convincingly shows that the four or five transition stages are caused by industrial development at each point in time. The hypotheses discussing how states cope with creeping risks include political and economic variables as well. If we analyze only highly developed countries because they are in the fourth or fifth transition stage and experience the problem, we might have a selection bias. This would preclude any variance in

the independent variables because democracy and wealth are both highly correlated with the selection mechanism of industrial development.

For these three reasons, we argue that case studies can provide more accurate insights into domestic processes. Even in the less complex case of climate change, results from macro-comparative analyses turn out to be limited and merely produce clues that "democracy matters". In the case of demographic change, the option of replicating this kind of macro analysis is precluded from the beginning.

The next and final section of this paper will summarize our findings, briefly describe how case studies can contribute to our analysis and illustrate how these case studies can be embedded in an overall research strategy.

5 Conclusion

As set out above, the analyses of this paper have produced a number of results. The findings, however, do not allow for a definite answer to the questions posed in the second and third parts of this paper. After summarizing the results, we will therefore discuss their practical implications for further research designs. The survival analysis and the cross-sectional models have generated six findings:

1. Democracy clearly matters. It is measured in terms of stability, participation and effectiveness of political systems. The more democratic a country is, the faster it will react to problems and the more radical the policy change will be. We interpret this as the capacity of governments to have public debates and to include various interests and opinions. Nonetheless it should be noted that the link between the variables employed and the theoretical construct is rather loose. Consequently, we advocate case studies that can properly identify the links between democracy and political action.
2. The decision-making capacity of governments seems to affect the pace of governmental action, but not the magnitude of change. Decision-making capacity is measured in terms of Lijphart's executive versus consensual dimension as well as the energy efficiency of countries. The reason is that being inefficient is a sign of industrial lobbying or benefits of the electorate connected to the inefficiency. We propose taking a closer look at the conflicting interest groups and cleavages in specific countries in order to assess whether strong industrial interest lobbying really is responsible for energy inefficiency (due to lower production costs) and for the a governments' rapid decision-making ability(Fisher 2006). At the same time, an explanation for the zero-correlation between decision-making capacity and the magnitude of change should be developed.
3. International or supranational organizations such as the OECD or EU serve as forums for policy coordination and collective risk processing. The largely simultaneous Kyoto protocol ratification of all OECD member countries shows that risk processing is not restricted to the national public discourse but entails international negotiations as a form of swarm intelligence. Closer attention should particularly be paid to the way in which national concepts are introduced to the international arena and how international perceptions rebound on the national level.

4. Being at risk makes polities respond faster but not more intensively. Very small countries like Antigua and Barbuda or Fiji are among the first adopters of the protocol, but their magnitude of change is low, even if controlled for total emissions. This might be due to their low democracy scores, as discussed above.
5. Economic well-being as measured by GDP per capita plays an ambiguous role. There is a clear effect, but from a purely macro perspective we cannot distinguish whether this is due to: the correlation with democracy; the wealthy voters who have post-materialist attitudes and promote green policy, or; the fact that wealthy countries usually have fewer competing societal risks and can prioritize less urgent matters like climate change. An explanation has to take into account that the effect appears when examining the magnitude of change, but not the pace of policy action.
6. Democracy and economy as defined above can only be used to predict the magnitude of emission change, but not the direction of change. This is a theoretical puzzle that might be addressed in case studies of specific countries.

In conclusion, we have found substantial evidence that democracy matters. Yet a coherent framework as well as a qualitative foundation of the mechanisms is lacking. We propose case studies of selected countries in order to refine the hypothesized mechanisms and generate more easily testable implications for a comparative analysis on the aggregate level. This is in compliance with Lieberman's approach of a nested analysis (Lieberman 2005): After conducting a preliminary large-n analysis, one should go down to the level of "on- and off-the-line" individual cases, refine the model, develop implications and then test them again on the macro level in a large-n analysis. Such case studies may concentrate on some of the following aspects, which cannot be included in a pure macro-comparative analysis:

- What role does policy coordination between the countries play from the perspective of national states?
- Is wealth related to post-materialist values or fewer competing risks?
- What is the role of specific institutions like the parliament, the executive government, direct participation of the electorate, or the integration of scientific consulting, social movements, interest groups and the media in agenda-setting and policy-making?
- How does the public discourse about risk evolve, and what organizations have an interest in promoting a given position? Can this be aggregated to an across-country pattern?
- What different interest or discourse configurations can we identify in the countries? Policy network analysis might be a valuable tool for the investigation of this question. Do certain configurations or the intensity of cleavage lines affect the policy outcome if compared on a macro scale?

On an abstract level, this paper has outlined several approaches to the problem of how polities react to long-term societal risks and tested some of these conjectures. The empirical analysis supported the conjectures but raised additional research questions and revealed weaknesses that only new research strategies can answer. The conclusion, finally, outlined very briefly what such strategies may be.

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