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A public choice framework for climate adaptation – barriers to efficient adaptation and lessons learned from German flood disasters

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Abstract. In this paper, we propose a comprehensive Public Choice framework to identify and categorize barriers to efficient public climate adaptation. Specifically, we distinguish three dimensions of public adaptation: extent, structure (form and timing) and organisation (vertical and horizontal). Within each of these dimensions, we investigate how the self-interest of voters, pressure groups, bureaucrats and politicians may bias adaptation decisions. Thus, we indicate specific barriers to efficient public adaptation. Based on this framework, we illustrate how Germany's response to major flood disasters reflects the incentive structure of concerned stakeholders and their political interaction. The ad-hoc character of some public adaptation measures implies a clear bias from the efficient benchmark. In conclusion, we argue that the propositions of Public Choice theory shed some light on how empirical public adaptation processes unfold.

JEL Classification. D78, Q54, Q58
Keywords. Adaptation, barriers, climate change, climate policy, efficiency, public choice

1 Introduction

In August 2002, severe floods in Central Europe caused 21 deaths and up to 10bn € damage in Germany alone (DKKV 2003, Deutsche Rück 2004). The subsequent public disaster relief efforts are widely seen as an important reason why the incumbent German government of Chancellor Schröder did not lose that year's general election (e.g., Bechtel and Hainmueller 2011). Incidentally, in 2013 a major flood disaster again occurred within months of a general election and again the full emergency machinery was set into motion, including an 8bn € reconstruction fund (BMI 2013). In contrast, flood events in 2006 and 2010, which entailed lower and more regionally concentrated damages were less mediatised and were not met with major public relief. This example illustrates that the characteristics of public adaptation measures – i.e. measures that are initiated and implemented by governments to offset the impacts of climate change (McCarthy et al. 2001, p. 982)[1] –, such as flood risk management, are heavily affected by political considerations.[2] Similar experiences have been reported for a variety of public adaptation measures worldwide (e.g., disaster relief in the US, see Congleton 2006; Shughart II 2006; Eisensee and Strömberg 2007).

Against this background, our paper contributes to a growing debate on barriers to and drivers of public adaptation (Klein et al. 2014). This debate has been fuelled by numerous case studies, a strong strand of which relates to flood management (see, e.g., Næss et al. 2005; Penning-Rowsell et al. 2006; Storbjörk 2007; Schanze et al. 2008; Goulden et al. 2009; Falaleeva et al. 2011; Lebel et al. 2011; Müller 2012; Runhaar et al. 2012). Moreover, several attempts have been undertaken to develop frameworks to organize and classify barriers to adaptation (e.g., Moser and Ekstrom 2010; Biesbroek et al. 2011; Eisenack and Stecker 2012; Klein et al. 2014; Lehmann et al. 2015). Both case studies as well as frameworks point towards the importance of institutional and actor-specific barriers. However, research on understanding the causal relationships underlying these barriers is still limited (Biesbroek et al. 2013; Eisenack et al. 2014; Biesbroek et al. 2015). In fact, the research focus needs "to change from the inventory questions of 'if' and 'which' barriers to adaptation exist towards more analytical questions as to 'why' and 'how' these barriers emerge" (Biesbroek et al. 2013, p. 1128). In particular, more actor-centered research on barriers to adaptation is needed (Eisenack et al. 2014).

Economic contributions to the topic have mainly focused on optimal public adaptation from a normative point of view. Basically, this entails issues like assessing the costs and benefits of adaptation and determining the efficient degree and timing of adaptation based on optimisation models (for discussions, see Agrawala et al. 2011; Watkiss et al. 2015). Yet, in order to understand real-world drivers of and barriers to efficient public adaptation, Public Choice theory provides an important additional perspective by focusing on the implications of self-interest driven behaviour of actors. Fundamental questions read 'Which societal groups are involved in the political process?', 'What kind of interests do they pursue?', 'How does policy affect these interests?' and 'How do these groups interact and take influence on the political process?' So far, Public Choice based research on adaptation is scarce. Some case studies consider interest groups' specific preferences for different adaptation options (Mortsch and Mills 1996; de Loë and Kreutzwiser 2000); Michaelowa (2001) applies Public Choice theory to climate adaptation and Schwarze and Wagner (2007) analyse the politico-

[1] We understand "public adaptation" as being largely synonymous with "planned adaptation", to which recent assessment reports of the Intergovernmental Panel on Climate Change refer (e.g., Klein et al. 2014).

[2] We are aware that flood management is oftentimes considered a policy field that only partly overlaps with public adaptation. This is expressed, for example, in the EU Directive 2007/60/EC on the assessment and management of flood risks.

economic reasons for the refusal of compulsory flood insurance. Yet, to date, there is no comprehensive framework that analyses adaptation from a Public Choice perspective.

This paper aims at filling the above gaps by developing a framework for understanding deviations between the empirically observed and the efficient design of public adaptation measures. We structure and analyse public adaptation along the three dimensions of extent, structure (form and timing) and organization (horizontal and vertical). For each of these dimensions, we outline how the self-interest driven behaviour of policy-makers, voters, interest groups and bureaucrats affects decisions. As an illustration of how this framework may be helpful to understand actual adaptation processes, we review the experiences from several severe flood events in Germany. Indeed, we find that Public Choice presumptions well explain the empirical evidence of flood risk management in Germany. Obviously, our analysis does not imply that a Public Choice approach alone is sufficient to understand barriers to public adaptation. Instead, we aim to explore to what extent observed deviations from efficient public adaptation are in line with predictions of Public Choice theory.

The rest of this paper is organised as follows. At the outset of Section 2, the basic Public Choice framework is introduced (Section 2.1). Building upon this framework, the related barriers to efficient public adaptation are investigated with respect to extent (Section 2.2), structure (Section 2.3) and organisation (Section 2.4). In Section 3, we illustrate the results from this analysis via the example of German flood risk management. Finally, Section 4 offers conclusions and discusses scope for further research.

2 A Public Choice framework for studying barriers to efficient public adaptation

In the following, we outline different dimensions of public adaptation and introduce the respective premises of Public Choice theory. Acknowledging these premises, in turn, should let us expect numerous biases – differences between efficient and politically preferred public adaptation decisions.

2.1 Conceptual basics of public adaptation

2.1.1 Three dimensions of public adaptation

Public adaptation can be characterised by three dimensions: its extent, its structure and its organisation. First, consider the **extent** of public adaptation, as exemplified by the issue of emergency relief.[3] Public authorities have to decide on the extent of emergency relief to be provided in case of (catastrophic) extreme weather events. In many European countries, such schemes of governmental emergency relief co-exist with market based insurance against natural hazards (Raschky et al. 2013; Porrini and Schwarze 2014). Since public and private adaptation might be substitutes, governmental relief programs may crowd out private insurance (so-called 'charity hazard', see Browne and Hoyt (2000)). Specifically, the prospect of (costless) public aid may lead to moral hazard on the part of private actors which refrain from buying insurances or investing in preventive measures. Consequently, the profitability of offering hazard-related insurances decreases and forces some providers

[3] We are aware that some authors exclude disaster relief from the very definition of adaptation but we do not follow this view for two reasons. First, disaster relief represents a public form of insurance (without explicit premium payments) and insurance is generally seen as a form of adaptation. Second, even if disaster relief were excluded from a narrow definition of adaptation, due to the numerous behavior-related interactions between precaution on the one hand and relief as well as recovery efforts on the other hand, the latter need to be part of our analysis of *barriers to efficient adaptation.*

to leave the market. Thus, the remaining companies are forced to raise premiums for covering costs, which in turn induces a downshift in demand and hence an even lower supply and higher prices. This kind of vicious circle is known as 'disaster syndrome' (Kunreuther and Pauly 2004).

Second, the **structure** of public adaptation relates to timing and form of adaptation measures. With respect to **timing**, Smit et al. (1999) differentiate between anticipatory[4] measures that aim at alleviating adverse impacts of climate change ex ante, i.e. before these occur, and reactive measures, that are implemented ex post, i.e. as response to a specific damage. Within ex-post measures in response to catastrophic events, one may further distinguish between relief, made in the immediate aftermath of a catastrophe and recovery measures such as reconstruction (Dari-Mattiacci and Faure 2015). The second structural attribute concerns the **form** of adaptation. In this respect, adaptation is either of technical nature, i.e., directed at changing physical infrastructures, or of societal nature, i.e. "enhancing the resilience of a society through planning or provision of (non-infrastructure) options to cope with climatic stresses" (Michaelowa 2001, p. 5).

Third, the **organization** of public adaptation refers to political interactions across policy fields and across political levels. One may speak of **vertical** ('which political level?') and **horizontal organisation** ('which policy field?') (Mickwitz et al. 2009). On both (sub-)dimensions, responsibilities of the different actors have to be allocated and their respective activities need to be coordinated. Regarding vertical organisation, the eventual decisions on adaptation measures often reside with local actors, though their decisions are usually embedded into a regulatory framework set by higher levels of governance (Measham et al. 2011, p. 894). In other words, adaptation is characterized by multi-level governance. This may promote activities at lower levels by assigning an explicit mandate, providing information or transferring resources. However, regional and national laws and regulations, such as fiscal transfer systems or national insurance schemes, may also produce adverse incentives for local decision-makers and result in maladaptation (Amundsen et al. 2010; Corfee-Morlot et al. 2011; Eisenack and Stecker 2012). Horizontally, public adaptation may be understood as a new policy field which requires new institutions. Alternatively, it may be mainstreamed, i.e. integrated into existing sectoral procedures and responsibilities of decision-making (UNDP/UNEP 2011). Empirical studies point out that mainstreaming is usually called for but only casually implemented (e.g., in disaster management, see Beck et al. 2009; Mickwitz et al. 2009).

2.1.2 Actors involved in public adaptation

Which actor groups are typically involved in representative democracies' decision-making and which (self-) interests do they pursue (for a broad overview see Michaelowa 2001)? Figure 1 sketches the main stakeholders of public adaptation and their interactions.

On the one hand, there are actors supplying public adaption. They involve **politicians**, whose main interest is to maximise votes. Consequently, their behaviour is strongly oriented towards both the median voter's preferences and their term of office. Therefore, the electoral cycle often transforms into an "political budget cycle" where proximity of an election induces a "consumption binge" to curry favour with voters (Rogoff 1990). Upon political decisions, the public adaptation measures are implemented and monitored by **bureaucracies**. However, bureaucrats may also be interested in "salary, perquisites of the office, public reputation, power, patronage and output of the bureau"

[4] In the flood risk management literature, the term preventive is common. In order to emphasize the dimension of time, we use the terms anticipatory/reactive here.

(Niskanen 1971, p. 38). In other words, bureaucracies may strive for budget maximisation which induces excess public adaptation (type I barrier). Then again, bureaucracies may also increase their rents by producing any given output level at a higher cost. They may artificially increase their production costs by on-the-job consumption or excess staff (so-called slack maximisation, e.g., Wyckoff (1990)). As a consequence, an inefficiently low output level (type II barrier) ensues, possibly aggravated by risk-averse bureaucrats (Mueller 2003, p. 368 ff.).On the other hand, there is a set of actors affecting the demand for public adaptation. **Voters** long for government action that keeps potential residual damages associated with climate change at the lowest possible level without incurring any extra costs. This also implies that voters exposed to flood risk differ from non- or less-exposed voters in this respect. Also, different voter groups benefit from different adaptation measures. Consider two forms of flood protection: farmers may reject the conversion of agricultural land into river retention areas while homeowners may object to the construction of levees close to their homes. In addition, public adaptation is affected by **interest groups** (see, e.g., Stigler 1971; Krueger 1974). These include the providers of adaptation services both in terms of infrastructure and insurance. Construction companies and other providers of technical infrastructure favour technical adaptation measures. Insurance companies lobby for a broad set of anticipatory measures that may help to limit the extent of damages. Moreover, non-governmental organizations (NGOs), engage in lobbying. For instance, development NGOs will push the adaptation needs in developing countries while environmental NGOs point to concerns of nature preservation which might be undermined by specific adaptation projects. Interests groups may express their interest through public campaigns which increase or decrease political support. Finally, **media** play a crucial role in agenda-setting (e.g., Eisensee and Strömberg 2007) and influencing the voters' demand for adaptation by reporting on negative impacts or potential threats due to climate change. A basic interest of media consists in raising attention to increase the number of recipients and income from advertising.

In the following, we scrutinise how these various actors and interest groups affect decision-making regarding the extent, structure and organization of public adaptation.

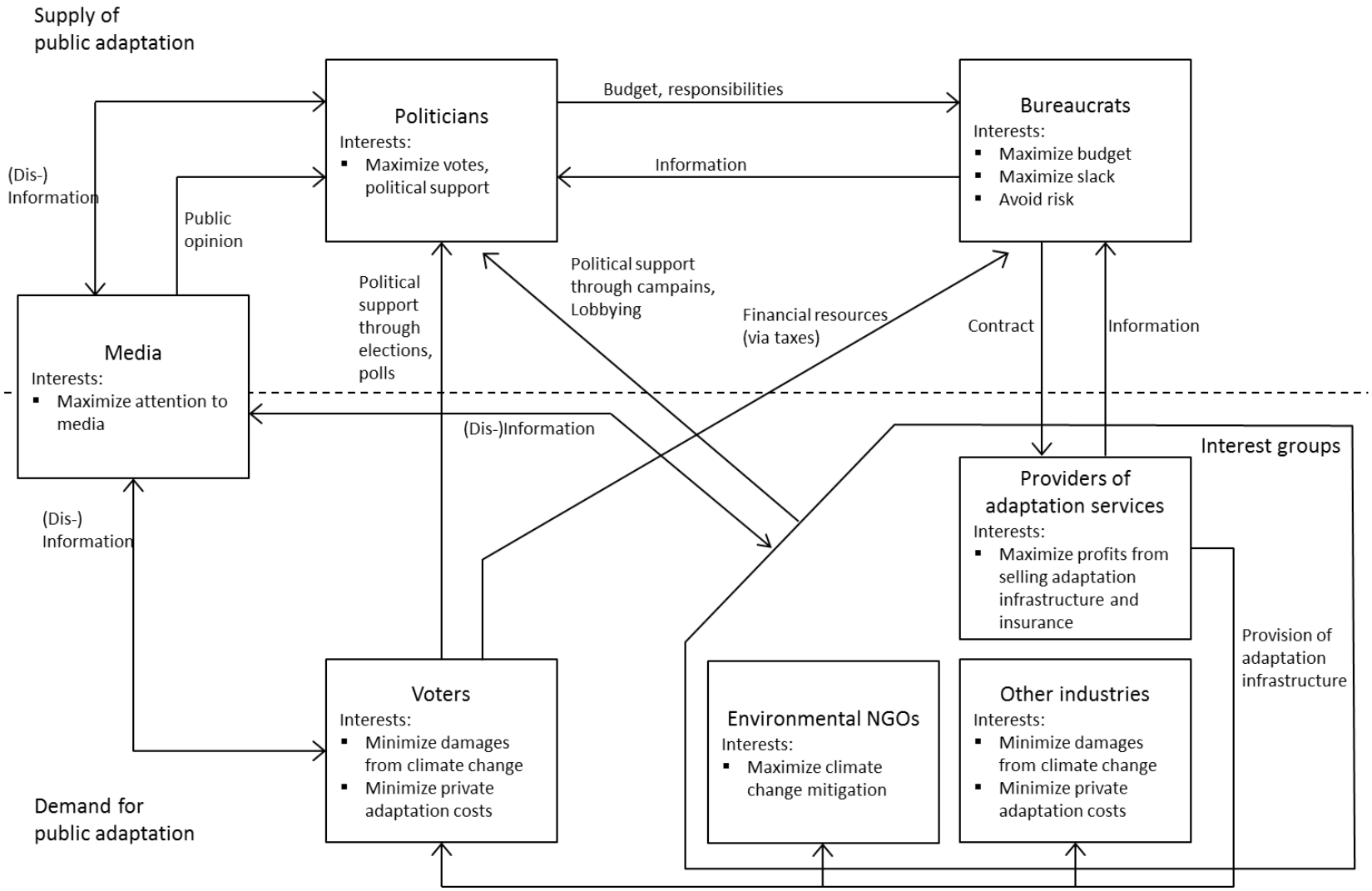

Figure 1: Overview of actors driving public adaptation, their interests as well as relationships between actors

2.2 The extent of public adaptation

a) Normative analysis: Recommendations given by economic theory

Economic theory clearly states that government intervention in the adaptation process is only appropriate in case of market failure. Moreover, societal, non-efficiency-related goals which are not transported by the market mechanism, such as ecological goals or distributive justice basically provide legitimisation for government intervention as well. However, these non-economic grounds go beyond the scope of our paper, which covers efficient public adaptation and related barriers.[5] In the following, we will assume that some form of classical market failure occurs (e.g., external effects as diverse as basic research on drought resistant crops or levee building) so public adaptation is, in principle justified. Furthermore, the behaviour of private actors is frequently subject to bounded rationality (e.g. for cultural ideals or norms) and temporal inconsistencies (such as inertia, procrastination or strategic ignorance), leading to inefficient autonomous private adaptation (Carrillo and Mariotti 2000; Osberghaus et al. 2010b; Gifford 2011; Eisenack 2013). Against this background, which extent of public adaptation is efficient? Economic theory calls for equating the social marginal benefits and costs in order to achieve optimal adaptation, which is certainly challenging in practice due to the diverse uncertainties involved (Meyer et al. 2015; Watkiss et al. 2015).

b) Public choice predictions for actual adaption outcomes

Public Choice barriers may either cause unnecessary government intervention or lead to inefficiently low public adaptation. In other words, over- (marginal costs exceed marginal benefits of adaptation, type I barrier) or underinvestment (marginal benefits exceed marginal costs, type II barrier) may occur. Does the self-interest of stakeholders induce barriers of type I or type II? There is no general answer to this question. Rather, as will be seen in the following, some actors may even induce barriers of both types.

According to the fundamental hypothesis of Downs (1957), the self-interest of politicians translates into vote maximising behaviour. At first glance, this endeavour should induce politicians to meet the voters' needs and hence foster the optimal adaptation outcome. However, vote maximisation creates incentives for politicians to manipulate cost-benefit assessments of public adaptation measures. Consequently, the political cost-benefit analysis does not necessarily reflect the true social costs and benefits (Blankart 2011, p. 494 ff.). Consider, for instance, levee construction. In terms of benefits, politicians do not only account for the social benefit, i.e. the (expected) amount of avoided damages, but additionally assess the expenditures for the construction and maintenance of the levee since these yield profits for local enterprises and stimulate private demand, which fosters the probability for being re-elected. With respect to the costs-side, the levee's political opportunity costs are to be factored in. These public means committed to the levee cannot be used to serve the demands of other interest groups. Additionally, any tax increases to finance the levee would diminish voter support. The respective loss of votes overstates the costs within the political cost benefit analysis compared to the social optimum. On balance, the additional components stemming from the politicians' vote-maximising behaviour on the benefit side lead to an excess (type I barrier), while those on the cost side lead to a lack of public adaptation (type II barrier). Such distortions are aggravated if benefits and costs materialize at different political levels.

[5] For more details see Gawel and Heuson (2011).

Furthermore, **voters' preferences** constituting the demand for public adaptation not necessarily transport the true social benefits. They hinge crucially on **private households'** awareness of adaptation need and options. This is aggravated by the fact that adaptation measures are often not easy to define and delimit from measures belonging to other public fields of action ("which part of flood risk management policy is due to climate change?"). For the general public it is thus difficult to state a clear preference for adaptation at all (Heuson et al. 2012). Combined with the highly uncertain and often long-term impacts and the associated bounded rationality of individuals in terms of temporal inconsistencies, such as hyperbolic discounting leading e.g. to inertia (Cimato and Mullan 2010), the general public's preferences are likely to underrepresent the true social benefit of public adaptation (type II barrier). However, climate change related extreme weather events and resulting damages clearly lead to a stronger emphasis on public adaptation on the part of the voters after such events (Bryant et al. 2000). The voters' demand might additionally be boosted by the **media**, which have – except for catastrophic events causing a high public attention and increasing sales – a limited interest in reporting on adaptation-related issues (Michaelowa 2001). Moreover, as Eisensee and Strömberg (2007) show, even catastrophes compete with other newsworthy events for scarce media attention; since public emergency relief is positively correlated with media coverage (ibid.), there is possibly a temporary excess of demand for public adaptation (type I barrier) in the aftermath of highly publicized catastrophic events, which however shrinks over time – until a new event occurs.

Private **companies providing adaptation infrastructure** and technologies increase profits with rising sales and thus push for a level of public adaptation above the optimum (type I barrier). Finally, the goals of **NGOs** might be affected by public adaptation. For instance, **environmental groups** typically consider adaptation as distraction from mitigation which offers – contrary to adaptation – a comprehensive protection against the adverse impacts of climate change. Thus, these groups advocate the public sector to abstain from adaptation measures – or only support measures which generate environmental co-benefits, such as the re-establishment of natural retention areas – which possibly creates type II barriers (Michaelowa 2001). The influence on the extent of public adaptation emanating from **other NGOs** is less clear-cut. Typically, these groups prefer public measures in specific sectors or fields of action, such as health- or development-related measures, which makes it hard to appraise there influence on total public adaptation efforts.[6]

Which of the (interest) groups is likely to prevail? According to political-support-approaches going back to Stigler (1971) and Peltzman (1976), policy makers choose the level of public adaptation such that the political support of the various groups in terms of votes is maximised (so called political-economic equilibrium). This implies trading off losses and gains in support arising from opposed goals of the various groups. As pointed out by Olson (1971), the respective group's influence crucially depends on its capability in getting organised. Thus, the unorganised group of private households as well as small firms that are not part of the adaptation industry probably play a minor role in influencing the extent of public adaptation due to the very large group size and a lack of clear and strong preferences. Environmental and other NGOs often lack a strong financial basis and homogenous preferences among their group members with respect to public adaptation. Consequently, they won't considerably influence the political-economic equilibrium either. The opposite applies for providers of adaptation infrastructure and large firms of other industries. They exhibit a rather small group size, financial strength and thus have access to media. Moreover, they pursue a clear homogenous goal which is maximising sales of adaptation infrastructure or passing on adaptation costs to

[6] This issue touches upon Section 2.3 which deals with the efficient structure of public adaptation.

the public, respectively. As a result, there is a tendency for the type I barriers to be dominating on the **demand side**.

On the **supply side,** government outputs, such as public adaptation measures or instruments, are implemented, controlled or regulated by **bureaucracies** (Mueller 2003, p. 359). As described above, there are three types of self-interest on the part of bureaucrats that may give rise to a distorted outcome, budget maximisation, slack maximisation and risk-aversion. Note that the bureaucrats' ability to manipulate the output level in each of the three cases requires an informational advantage regarding the cost of adaptation and the impossibility to monitor the bureaucrats without (considerable) costs on the part of the government, respectively. In this regard, adaptation offers special scope for enforcing the bureaucrats' self-interests. Adaptation measures are typically kind of fuzzy and hard to delimit from measures related to other political fields of action. Moreover, there is neither a public budget which is especially dedicated for purposes of adaptation, nor do clear-cut success metrics exist for evaluating the adaptation output. All these characteristics help the bureaucrats to disguise their true costs and efforts in terms of adaptation. To sum up, the supply-side is subject to incentives for both increasing and decreasing public adaptation.

2.3 The structure of public adaptation

a) Normative analysis: Recommendations given by economic theory

In terms of **timing**, there is the following trade-off to be considered between anticipatory and reactive measures. From a simple microeconomic perspective, an adaptation investment should be postponed as long as the benefits of postponement (avoided investment costs) are greater than the associated costs (higher climate change damages). This rule suggests that anticipatory adaptation is more likely to be relevant for "long-lived investments, measures with a long lead time, and measures where subsequent retrofitting would be expensive" (Fankhauser et al. 1999, p. 71). Moreover, anticipatory action is obligatory if climate change involves irreversible effects or damages. To sum up, public adaptation covers a balanced mix of anticipatory and reactive measures (Mendelsohn 2000).

In terms of the efficient adaptation **form**, given the heterogeneous and context-dependant character of adaptation, again, like in case of timing, most probably a balanced mix of measures may be warranted. For instance, it might be reasonable to adress heat stress with a broad range of measures starting with irrigation systems right through to basic research on drought-resistant crops.

b) Public choice predictions for actual adaption outcomes

First, the discrepancy between political and social cost benefit assessments (Blankart 2011, p. 494 ff.) may induce distorted adaptation, regardless of any influence of the demand or supply side. With respect to timing, one major source of distortion is given by the **politicians'** limited time-horizon. Due to their focus on being (re-)elected, they tend to excessively discount costs and benefits that accrue beyond their term of office.[7] Even within the electoral cycle, the political benefits of implementing adaptation measures are not evenly distributed over time: the attention cycle or political "budget cycle" (Rogoff 1990) implies that the political payoff from a measure increases when an election is approaching. Furthermore, in the immediate aftermath of a catastrophe vanishing political

[7] There is an ongoing heavy dispute on which of these rates to apply to cost benefit assessments supporting policy decisions, especially concerning climate change (Blankart 2011, p. 491).

opposition against crisis-related policies may provide politicians the opportunity to present themselves as successful crisis manager (Fidrmuc and Tichit 2013). Consequently, the timing of public adaptation may be biased in favour of reactive measures, since these promise immediate and rather certain political benefits (public attention, media notice etc.). Moreover, reactive measures, such as emergency relief, can be pointedly used for boosting the chances of being re-elected, as demonstrated in Section 2.2. Within ex-post measures, it has been argued that immediate disaster relief is much less prone to type I barrier than long-term recovery measures because relief and ex-ante precaution are complements while recovery aid may substitute for precaution: immediate relief reduces the social cost of a flood disaster while recovery aid just redistributes the cost of rebuilding from the concerned individuals to the state. Hence, "[r]elief is less likely than recovery to generate over-supply by the government and over-reliance by victims" (Dari-Mattiacci and Faure 2015, p. 180). On the contrary, anticipatory adaptation usually involves immediate costs but uncertain and remote benefits and hence diminishes the chances of being re-elected.

Concerning the form of adaption, there is no such obvious bias emerging from the political cost benefit assessment at first sight. However, elected representatives may be inclined to follow voters' preference for technical over societal adaptation measures due to the formers' visibility, (possibly deceptive sense of) security, relatively fast implementation (e.g., as compared to long-term renaturation of river basins) and fiscal illusion on the part of the voters (Michaelowa 2001).

The self-interest of **bureaucracies** may play out in different ways. Budget maximisation and slack maximisation suggests that bureaucrats go for anticipatory measures because they increase budget in the near future while reactive measures only involve uncertain increases in budget – both with respect to occurrence and point of time. Also, the international launch of adaptation strategies constitutes a window of opportunity for overstating the need for (anticipatory) adaptation.[8] As such windows are temporarily, bureaucracies have a strong incentive to make use of it right away. However, budget maximisation and slack maximisation are not tied to specific forms of adaptation (Michaelowa 2001). On the one hand, technical adaptation measures typically involve high budgets. On the other hand, societal adaptation is similarly attractive when it can be differentiated in many single measures. If bureaucrats are risk averse, they will favour reactive measures since these grant largely certain benefits while the benefit of anticipatory measures depends on highly uncertain climate change impacts; on the cost side, anticipatory and reactive measures do not differ remarkably concerning risk. In terms of the adaptation form, there is no unambiguous trend suggesting that technical or societal measures generally are associated with significantly different risks in terms of costs and benefits. To sum up, the supply side is subject to incentives for both fostering anticipatory and reactive measures. However, considering that the strive for attaining budget as early as possible concerns both budget and slack maximisation, this aspect probably outweighs the comparative advantage of reactive measures in generating (slightly) lower risk in terms of benefits. Hence, bureaucracy presumably tends to distort the outcome of public adaptation towards anticipatory measures.

What type of structure-bias can be expected from the demand side? As stated above, unorganised **voters**, i.e. private households generally tend to show weak preferences for (public) adaptation due to unawareness with respect to the availability and necessity of adaptation and temporal inconsistencies (Section 2.1). Consequently, their call for public adaptation significantly rises in the aftermath of extreme weather or catastrophic events (Bryant et al. 2000). This clearly suggests that voters push

[8] For an overview of respective efforts within the European Union see (PEER 2009).

for reactive instead of anticipatory measures. Additionally, the voters' influence is likely to bias the mix of public adaptation towards technical measures since these are more strongly perceived compared to societal ones (Michaelowa 2001) – especially when it comes to removing damages after catastrophic events. An exception in this regard may be given by direct financial compensation for obvious reasons. This trend is likely to be reinforced by the **media**. In terms of climate change, their focus is mainly on such events as these cause considerable public attention and hence promise to increase sales. Thus, news coverage similarly concentrates on the related – visible and hence technical (or societal, direct financial) – public responses.

As far as **interest groups** are concerned, the **providers of adaptation infrastructure** obviously lobby for technical measures. Furthermore, the providers have a clear incentive to push for anticipatory measures since these promise a larger net present value of profits. **Small companies of other industries**, similarly to private households (Section 2.1), basically show a low interest in adaptation and thus prefer reactive, technical measures or direct financial compensation. On the contrary, **large companies** are more sensitive concerning the risks associated with climate change and thus probably lobby for early, anticipative measures in order to rule out any detrimental effects ensuing losses and reduced competitiveness from the beginning. In terms of adaptation form, there is no compelling reason for preferring technical or societal measures as long as they redound to the firms' advantage. **Environmental NGO's** tend to dismiss adaptation for being a distraction from the – in their eyes – more promising option of mitigation. Also, since technical adaptation usually conflicts with goals of nature preservation, environmental NGOs have a clear preference for societal measures, particularly restoration of natural flood plains.

Following the line of argument in Section 2.1, which builds upon Olson's (1971) theory on interest groups, it can be argued that the providers of adaptation infrastructure and large firms from other sectors are likely to exert the strongest influence on the policy maker. Consequently, the overall demand-side influence on the structure of public adaptation presumably leads to a bias towards anticipatory and technical measures.

Table 1: Structure of public adaptation – overview of stakeholder incentives

	Timing		**Form**	
	anticipatory	reactive	technical	societal
Drivers	• Bureaucratic budget maximisation and slack maximisation • Adaptation industry's profit maximisation	• Bureaucratic risk aversion • Political discounting	• Federalism • Adaptation industry's profit maximisation • Voters' perception of security	• Environmental NGOs push for mitigation and natural adaptation

Aggregating all stakeholder interests with respect to the form of adaptation (cf. Table 1) suggests that preferences for technical adaptation may dominate. Concerning timing, the political sector faces pressure towards anticipatory measures from both the supply and demand side, while it prefers reactive measures. Whether policy makers defer to this pressure depends on the strength of their preferences for reactive action, i.e. on how strong they discount future benefits of anticipatory measures.

2.4 The organisation of public adaptation

a) Normative analysis: Recommendations given by economic theory

The economic discussion of **vertical organisation** is primarily associated with the theories of fiscal federalism. Traditional approaches strongly favour a **decentralisation** of government. Firstly, local decision-makers typically have better information about heterogeneous local conditions and preferences than actors at higher levels (Hayek 1939; Oates 1999, p. 1123). In contrast, national governments tend to implement one-size-fits-all policies which neglect local priorities. Secondly, decentralised governance may promote interjurisdictional competition (Tiebout 1956). This may eventually help to match policies perfectly to community preferences and may prevent inefficient expansion of government (Brennan and Buchanan 1980). At the same time, a certain degree of centralisation may generate economies of scale in the provision of public goods, e.g. regarding the necessary information (Hansjürgens 1996, p. 79; Inman and Rubinfeld 1997, p. 84; Bardhan 2002, p. 191). Furthermore, capacity constraints may impair proper assessment at the local level: climate change assessments are particularly science-heavy (Moser and Ekstrom 2010, p. 22029) whereas local governments face institutional and budgetary restrictions (Crabbé and Robin 2006; Koch et al. 2007; Measham et al. 2011, p. 894; Eisenack and Stecker 2012). As a result, national governments set adaptation goals and framework regulations, financially supporting their implementation by lower levels (Urwin and Jordan 2008; Amundsen et al. 2010, p. 277). Overall, administrative responsibility should correspond to the scale of the public good or externality: local (national) public goods should be provided by the local (national) level (Musgrave 1959; Olson 1969; Oates 1972). For instance, flood management should be coordinated at the scale of a river basin.

Concerning **horizontal organisation**, **mainstreaming** is often advocated. Firstly, adaptation closely relates to numerous other policy fields (UNDP/UNEP 2011). Therefore, seizing the specific information available within these fields seems preferable. Secondly, mainstreaming facilitates the identification of co-benefits and synergies with existing policy measures and administrative process which may reduce the cost of public adaptation (Füssel and Klein 2004; Füssel 2007). Obviously, mainstreaming requires additional resources for coordination across sectors, so existing inter-sector mechanisms should be acknowledged (UNDP/UNEP 2011). A lead authority should disseminate and exchange information across sectors to realise economies of scale (Hunt and Watkiss 2011).

b) Public choice predictions for actual adaption outcomes

From a Public Choice perspective, several reasons for excessive centralization have been emphasized as a general tendency of vertical organisation (Vaubel 1994). Firstly, **politicians and bureaucrats of the central government** aim at increasing their voter base, power and budget by concentrating government functions at their level. For higher-level politicians, the incentive to centralise may be particularly strong when local adaptation decisions would be taken by politicians of other, rival parties. In this case, benefits from public adaption would be associated with the rival party and might negatively affect the election results of governing party at the central level. This is particularly likely for local decisions taken in densely populated districts with a large share in total votes, such as the national capital. Secondly, **politicians and bureaucrats of lower-level governments** may also find it preferable to shift (some) responsibilities to the higher level. Regions with ambitious environmental programs may lobby for policy harmonisation through federal legislation in order to avoid competitive disadvantages with other regions. In a similar manner, local governments may promote the centralized provision of public goods as a means of inter-region income redistribution (e.g., if the income

of the median voter in the region is below the federal average). Importantly, given a certain degree of centralisation, politically unpopular decisions may be pinned on the central government. In fact, local actors can hardly justify adaptation measures in the presence of competing planning interests without a clear mandate from a higher authority (Koch et al. 2007; Amundsen et al. 2010; Corfee-Morlot et al. 2011; Measham et al. 2011). Finally, centralisation may also be promoted by those local politicians and bureaucrats who hope to be promoted to the higher level in the future. Obviously, these considerations of politicians and bureaucrats of lower-level governments compete with the basic interest of maintaining and extending a certain degree of regulatory power. Thirdly, **interest groups** with nationally homogeneous interests may try to foster centralisation as a means of improving their bargaining position: centralisation increases information costs for the government whereas the interest groups' transaction costs of rent-seeking decrease. Finally, centralisation may be favourable to those **voters** who supply factors of production in the federal capital and therefore benefit directly from an expansion of the central government. On the contrary, unorganised voters and private households, respectively, do not have a specific interest in terms of vertical organisation.

Regarding the **horizontal organisation** of public adaptation, **voters** and therefore also **politicians** are likely to prefer mainstreaming because it may reduce or at least conceal the cost of adaptation. What is more, mainstreaming facilitates the identification of links to other policy objectives which have a higher political priority (Yohe 2001, p. 251; Measham et al. 2011; UNDP/UNEP 2011). The case is less clear-cut for public **bureaucracies**. If bureaucrats in the different policy fields are assumed to be budget maximisers which compete for adaptation funds, there may be an incentive to integrate adaptation issues into sectoral policies and procedures. In turn, if bureaucrats are rather understood as slack maximisers, which try to reduce efforts for a given budget, there is an incentive to reject the integration of adaptation measures (or only implement it symbolically) and rather shift the responsibility to other policy fields, most notably environmental departments. Which approach eventually dominates, depends on the likelihood to obtain additional budgets for public adaptation. Beck et al. (2011, p. 5) point out, for example, that no extra budget is provided for implementing the action plan of Germany's adaptation strategy. Rather, adaptation measures shall be funded from existing sectoral budgets through mainstreaming. Based on Public Choice reasoning, however, this provision may in fact be interpreted as an impediment to mainstreaming. Table 2 summarizes the incentive structure of all stakeholders as regards vertical/horizontal organization.

Table 2: Organization of public adaptation – overview of stakeholder incentives

	Vertical		**Horizontal**	
	centralised	decentralised	mainstreaming	no mainstreaming
Drivers	• Lower level bureaucratic risk aversion • Higher level bureaucratic budget maximisation • Interest groups: decrease lobbying costs • Central government: max. voter base and power • Lower level government: shift responsibilities for unpopular decisions	• Lower level government: secure decision-making power	• Government on all levels: conceal adaptation costs • Bureaucracy on all levels: budget maximisation • Interest groups: min. cost burden of public adaptation	• Bureaucracy on all levels: slack maximisation

3 Lessons learnt from German flood disasters

In the following, we demonstrate how the conceptual framework outlined above sheds some light on a specific empirical example of public adaptation – flood risk management in Germany.In order to illustrate how the experience of public adaptation to flood risks may be traced back to the Public Choice framework, we proceed in three steps. First, we provide an overview on the public adaptation options that could/should be implemented to mitigate flood risks (Section 3.1). Second, we summarize the empirically observed adaptation measures in response to flood disasters in Germany (Section 3.2). Third, we argue that the empirical evidence hints at barriers to efficient public adaptation which are well in line with the above framework (Section 3.3).

3.1 Public adaptation to flood events

Adaptation to the climate-change induced increase in flood risk may occur in a variety of ways, none of which could eradicate all flood risk by itself. In other words, there is no 'silver bullet' to flood risk management. As indicated in our conceptual framework, an efficient mix of adaptation measures would have to meet three requirements.

First, regarding the **extent** of public adaptation measures, social marginal costs would need to equal social marginal benefits. Since 100% public protection against flood risk is neither efficient (crowding-out of private precaution) nor feasible in the first place, private efforts necessarily need to complement public adaptation. Such private precautionary measures may include defensive measures (e.g. building houses on stilts or keeping mobile protective walls ready) and "yield/secure"-measures such as using water-resistant construction materials and relocating valuable items to higher floors (cf. Kreibich et al. 2005). Moreover, private precaution may consist of disaster insurance. In order to evade the 'disaster syndrome' (cf. Section 2.1), a mandatory natural disaster insurance (possibly subsidized) has been advocated so as to evade the cycle of adverse selection (Schwarze and Wagner 2007).

Second, the **structure** of adaptation should reflect a "balanced mix" of technical and societal[9] as well as reactive and anticipatory measures. Figure 2 illustrates exemplary public adaptation measures for various combinations of form and timing. For instance, technical flood protection includes the construction and maintenance of permanent levees or mobile flood walls as well as artificial retention basins in the upstream parts of a river. Restoring natural prevention is required because natural floodplains to a large extent have disappeared in the course of man-made river regulation (BMU and BfN 2009); accordingly, a main strategy to increase retention areas via recreating natural floodplains is based on the relocation of levees. Overall, an efficient approach towards *anticipatory* flood risk management cannot rely on a single kind of measure since the marginal opportunity costs of specific measures possibly increase with their extent. This still leaves the question how to trade-off preventive efforts with *reactive* flood risk management. One could argue that the incidence of disastrous floods follows from the failure of preventive adaptation in the first place. Then again, the expectation of ex-post compensation, such as disaster relief in the immediate aftermath of a flood catastrophe and long-term recovery aid greatly affect the incentives for ex-ante precaution (cf. Dari-Mattiacci and Faure 2015, Shugarth II 2006). And as we see below, disaster relief and recovery aid form an important part of the actual public response to flood risk in Germany.

[9] We are aware that the flood risk management literature mostly refers to this distinction as structural/non-structural but in our view the word pair technical/societal more directly expresses what is meant.

Third, the **organization** of flood risk management faces a considerable challenge: the protection from flood risks constitutes a public good but the spatial distribution of affected stakeholders may not coincide with the political constituencies. In order to internalize all spill-over effects (no pun intended), responsibilities within the public provision of flood protection need to be allocated so as to match the spatial range of public adaptation measures with political representation. Also, vertical organization of flood risk management should take the benefits of both decentralization and centralization into account: locals possess important knowledge over case-specific details while policy coordination across governance levels may yield economies of scale. In particular, coordinated river basin management over all affected countries, states and municipalities would be required to efficiently manage flood risk. What is more, integration within existing emergency relief structures in other policy fields would be preferable so as to enable cost-efficient implementation of reactive adaptation measures (horizontal organization).

Overall, the mix of adaptation measures to mitigate flood risks should be balanced according to the context-specific setting (DKKV 2003; 2013; Meyer et al. 2013). For instance, Meyer et al. (2013) propose that anticipatory flood risk management should comprise the four pillars of i) technical flood protection, ii) natural protection, iii) private precaution and iv) mandatory insurance.

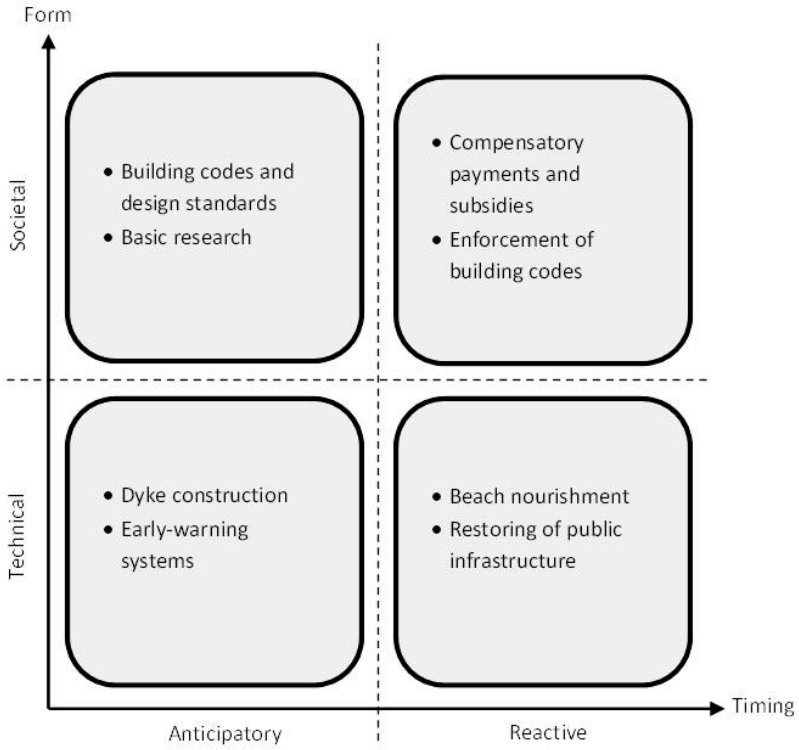

Figure 2: Public adaptation to flood risk

3.2 Empirical evidence: extreme floods and adaptation measures in Germany 1997-2013

Since 1997, Germany has witnessed a number of extreme flood events (see Table 3). In particular, in the Elbe catchment, covering large parts of Northern Czech Republic and Eastern Germany, two extreme flood events occurred within only 11 years, with discharge levels in parts of the main river and some of its tributaries which, statistically, would have to be expected only every 100 years or even less frequently (DKKV 2013). Damages caused by the Elbe and Danube flood in August 2002 were

most severe, with 21 deaths and about 10bn € financial damage in Germany. Public relief efforts were sizeable. In contrast, when in 2006 the river Elbe also flooded parts of the most affected areas from the 2002 flood in South Eastern Saxony (the overall damage was rather low compared to 2002) no substantial government funds were handed out. In 2013 another extreme flood caused large financial damages at around 6.7 bn € and 8 casualties - because most of the new levees, which were built after 2002, held and the respective cities were not flooded. Furthermore, a recovery aid fund for up to 8 bn € was installed.

Table 3: Extreme flood events, damages and public disaster relief in Germany since 1997
Source: compiled by the authors, based on Bundestag (1997), DKKV (2003), Deutsche Rück (2004; 2006; 2010), BMI (2013), SäSK (2011)

Flood year and most affected major rivers	Damage (estimate in bn € for the whole of Germany)	Public disaster relief and recovery aid (estimate in bn € for the whole of Germany)
1997 Oder flood	0.3-0.6	0.5
1999 Donau flood	0.5	no information / no significant public aid
2002 Elbe and Donau flood	10	7.1
2006 Elbe flood	0.1	no information / no significant public aid
2010 Oder flood	0.9	no information / no significant public aid
2013 Elbe and Donau flood	6.7	8

As regards the three dimensions of public adaptation, the following picture of flood risk management in Germany emerges:

First, as Table 3 makes abundantly clear, the **extent** of reactive public adaptation in the form of relief and recovery efforts is very large. This becomes all the more obvious when we compare the extent of actual public funds to the legal provisions set up to distribute the responsibilities of flood risk management between individuals and the government. The "Federal Water Act" stipulates that all individuals have a general duty of care to implement "reasonable" precautionary measures to mitigate flood risk for themselves or their property (Wasserhaushaltsgesetz (WHG) – Federal Water Act 2009, § 5(2)). Furthermore, laws on the regional level (*Bundesländer*) exempt the regional governments from any duty to provide 100% protection against floods – for instance, the Bavarian "immediate assistance guidelines" restrict emergency relief measures to hardship cases. However, Table 3 rather tells a story of ad-hoc public disaster relief and recovery aid. Emergency relief – *if provided at all* – is full. This uncertainty whether public aid is granted at all should induce individuals to engage in private precautionary efforts and limit crowding out.[10] Indeed, overall insurance density against ele-

[10] Raschky et al. (2013) argue that such a limited relief is more effective when the grant as such is uncertain compared to an uncertain degree of coverage (as is the case in Austria). Moreover, the emergency relief should be restricted to the most essential needs, such that the incentives for private actors to invest in precautionary

mentary risks in Germany has been steadily rising, suggesting an increase of private risk consciousness: in 2012, insurance density reached 32 percent, against 19 percent ten years earlier (BMI 2013). Moreover, Osberghaus (2015) finds little empirical evidence for crowding-out of private mitigation measures by insurance. Yet, this leaves still over a million "uninsurable" buildings in areas that are statistically flooded every ten years (Meyer et al. 2013). Basically, there are two main options to deal with settlements in flood-prone areas, which have no chance of receiving insurance cover on the free market: either the government credibly commits to not providing emergency relief in their case (as advocated by Shughart II (2006), for instance) or one sets up a mandatory insurance scheme (for an overview of the discussion see Schwarze and Wagner (2007)). Even though the topic has been repeatedly brought forward in public debates, for instance by several politicians in the wake of the 2013 flood, no such scheme has been implemented so far (Jahberg 2014).

Second, as regards the **structure** of flood risk management, technical measures remain very popular. In the wake of the 2002 flood, for instance, large investments in technical measures were carried out: in Saxony alone, 530 million € were spent, mostly on concrete walls and levees to insulate cities from the Elbe and its tributaries. By 2020, technical adaptation measures worth up to 1bn € shall be built in Saxony (Meyer et al. 2013). One reason behind these pronounced technical efforts is that only a fraction of the original retention areas now provide flood protection. For instance, 86% of the former 6.172 ha. natural plains along the Elbe have disappeared (UBA 2011, p. 22). Their recovery is prone to conflicts because of the trade-offs with surrender of agricultural land or even settlements. In consequence, although it is widely acknowledged that natural floodplains provide an important and partly non-substitutable form of flood protection, the numbers show a clear picture: the total natural retention area recuperated via levee relocation projects along the Elbe so far amounts to 700 ha (Meyer et al. 2013) – compared to the original 6.172 ha., this appears as a non-negligible but limited contribution. In fact, only three out of 49 originally planned projects had been realized in the State of Saxony by 2013 (SMUL 2014).

Third, the vertical **organization** of flood risk management in Germany puts the main responsibility with the states. Thus, the *Bundesländer* set up plans for managing anticipatory and reactive adaptation measures. For instance, the state of Saxony has implemented a risk management scheme that includes a ranking of technical measures to be built in the future (Schanze et al. 2008). Nevertheless, the federal government enters the scene whenever a highly media-covered flood event occurs (see below). As regards the Elbe, one of the most concerned rivers in the 2002 and 2013 floods, a main challenge consists in coordinating risk management both within Germany on regional and communal governance levels and between Germany and the Czech Republic.

In the following, we argue that the observed pattern of flood risk management in Germany displays politico-economic biases in line with the conceptual framework elaborated in Section 2. To that end, we investigate how extent, structure and organization of flood risk management in Germany may deviate from a hypothetical efficient mix of adaptation.

measures are kept as strong as possible, and be distributed among those affected according to the needs, so as to maximise the benefit of a given amount of relief (Osberghaus et al. 2010a).

3.3 Applying the public choice framework: evidence for biases

The previous discussion has revealed that the **extent of adaptation** – in terms of emergency relief and recovery aid provided – has been varying with flood events in Germany. The uncertain relief has probably not been purposefully chosen for limiting the crowding-out effect, but it rather has derived from the respective incumbent governments' incentive to adjust the amount of support to the level of media attention and on whether elections are due or not. One might speak of two different modes of policy-making here, the normal non-crisis mode and the crisis mode (e.g., Alesina and Drazen 1991; Drazen and Easterly 2001; Fidrmuc and Tichit 2013): from this perspective, flood catastrophes represent a prime example of the crisis mode in that they are characterized by strong public pressure for immediate and visible political responses (even if only symbolic, Edelman (1964)) and by extraordinary leeway for politicians to take advantage of the attention cycle; normal budget constraints (opportunity costs) are temporarily suspended due to public acceptance of extra expenditures which enables "consumption binges" (Rogoff 1990). As a consequence, damages are likely to be overcompensated (type I barrier) – even more so in election years, when the political budget cycle draws to an end (Citlak and Wagner 2001, type I barrier). This can be seen from the flood in Germany in 2002 which helped chancellor Schröder to be re-elected the same year. Specifically, Bechtel and Hainmueller (2011, p. 851) argue that the flood relief programs (a 7.1bn € recovery fund was set up) increased the incumbent party's vote share in affected areas by 7 percent in the 2002 federal elections; what is more, the targeted recovery aid not only delivered short-term rewards but also yielded longer lasting effects: about a quarter of the short term reward carried over to the next general election in 2005 where the incumbent party's vote share in affected areas was still 2 percent higher than it would have been without flood relief. Only at the end of the subsequent election cycle, in 2009, the 2002 flood response has shown no more discernible effect on voter behaviour (ibid.). In comparison with the 2002 flood, the overall damages in 2006 were far lower and the event also received less attention in national media. Furthermore, the flood occurred at the beginning of the election cycle, so the federal government's incentive to intervene was low. In 2013 another extreme flooding occurred within months before a general election. While there are not yet any detailed analyses on the 2013 relief's electoral impact comparable to the analyses for 2002, the extent of the damages and the event's timing at the end of the electoral cycle made full and imminent relief efforts a political necessity for the incumbent government. Note that the 2013 flood recovery fund (*Sondervermögen "Aufbauhilfe"*) explicitly comprises more money than the official sum of damages (BMI 2013, see Table 4). In conclusion, the actual extent of public disaster relief and recovery in Germany seems to be heavily determined by the level of media attention and political expediency (e.g., Eisensee and Strömberg 2007). This is not to belittle the regional efforts to consistently hedge flood risks through anticipatory measures – yet, the politico-economic characteristics of the overall public response to flood risks remain.

As regards the **structure of adaptation**, the above framework also helps to explain the observed bias for technical measures. The many large-scale technical preventive measures possibly inhibited the sufficient implementation of complementary societal measures: empirical studies demonstrated that the reinforced or newly built levees convey a sense of certainty for most individuals (Kuhlicke and Steinführer 2007, p. 101). Not only is this sense of certainty deceptive, but also does it prompt individuals to move into supposedly "safe" zones. In the long run, this may lead to spiralling costs, higher even than without any technical measures. Moreover, technical protection reduces the expected damage from an individual point of view and reduces the incentive to carry out private precautionary measures (Meyer et al. 2012). In terms of timing, flood risk management has been criticized for not

sufficiently emphasizing preventive measures like restoration of natural floodplains in the respective legal provisions (Reese 2011).

As regards the **organization of adaptation**, Germany's federally organized system may pose some challenges for implementing efficient flood risk management. Indeed, for the 2002 flood, communication between authorities on different government levels and from different regions seems to have been problematic; however, due to this experience responsibilities have been centralized on the level of the states, the overall perception being that coordination has improved since then (DKKV 2013). Concerning mandatory insurance, distributional conflicts between federal and state administrations, have been identified as one important reason inhibiting its introduction in Germany (Schwarze and Wagner 2007); also, the insurance industry lobbies against such proposals (Jahberg 2014). To be sure, the transnational character of river basins intensifies the challenge of horizontal organization. For instance, although the EU's relevant directive 2007/60/EC requires transnational coordination, the handling of retention areas next to Prague during the 2013 Elbe flood has been criticized by downstream municipalities, both in Germany and the Czech Republic (Schmidt 2013).

In sum, some of the characteristics of existing flood-related policies in Germany well align with the premises of Public Choice theory: the **extent** of flood disaster relief is driven by media coverage and influenced by the electoral cycle, the **structure** of flood risk management shows a bias towards technical measures and the **organization** of flood risk management faces the pitfalls of coordinated action across regional and national boundaries. Overall, the main bias of the observed pattern of flood disaster relief is its ad-hoc nature. This is not to say that all flood risk management is arbitrary. For example, there exist consistent long-term strategies for the spatial allocation of technical measures on state level. However, due to the ad-hoc nature of disaster relief, not all non-protected areas necessarily receive sufficient disaster relief. Media attention and flood events' timing within electoral cycles are crucial variables in explaining why disaster relief is granted or not.[11] These biases, in turn, feed back into and possibly distort private precautionary and public anticipatory efforts. In other words, overall adaptation output is co-determined by the perceived severity of recurring crises.

4 Conclusions

This paper provides a Public Choice framework for public adaptation to climate change. Specifically, we distinguish three dimensions of adaptation: extent (investment level/effort), structure (timing – preventive vs. reactive measures; form – technical vs. societal measures) and organisation (horizontal and vertical). Within each of these dimensions, Public Choice expects actual adaptation measures to deviate from the efficient benchmark. This not only concerns public adaptation as such, but also related private adaptation measures "insofar as government rules determine private rates of return at the margin" (Congleton 2006, p. 23). Overall, stakeholders' self-interest biases adaptation towards centralization of decisions, as well as to technical and to reactive measures.

[11] Experiences after the Hurricane Katrina struck Louisiana in summer 2005 can be traced back to politico-economic incentives in a similar way. For instance, 'glory seeking' prevented efficient disaster management: policy makers confiscated private organisations' supplies in order to achieve more recognition (and finally votes) on their own behalf (Sobel and Leeson 2006). Furthermore, numerous coordination problems between different levels of government yielded confusion and led to suboptimal relief efforts (Congleton 2006).

The experience of German flood disasters from 1997-2013 reveals a trend toward ad-hoc recovery efforts, mainly driven by the level of media attention. While the legal provisions clearly stipulate that individuals bear the main responsibility for flood risk precaution and should only receive immediate emergency relief, these guidelines have been repeatedly ignored if political expediency required so. Given the public pressure in the aftermath of catastrophic events, politicians striving after re-election cannot credibly commit ex ante to restrict public aid to the most essential needs. This, however, would be necessary to sufficiently induce private actors to engage in self-prevention. Thus, the German flood responses revealed an ad-hoc approach where the extent and timing of disastrous events within the electoral cycle also affected the extent of recovery aid; this ad-hoc nature of nature of recovery aid exacerbates the challenge of consistent overall flood risk management. In effect, this leaves a small part of potentially affected population completely unprotected as their location is deemed uninsurable and no technical measures are in place. On the contrary, sizeable flood-prone areas lack the proper incentives for private precautionary efforts because levees and dams convey a deceptive sense of safety.

In conclusion, normative economic analyses of public adaptation need to confront the inconvenient truth that actual public adaptation does not always and not in all areas proceed as advised. The question how to deal with this fact in devising policy recommendations possibly points towards adaptation of research frameworks. Instead of decrying "monumental governmental failure" and praising the virtues of private action, both in individual precaution and the provision of public goods (Shughart II 2006, p. 49), economic analyses might be better advised to conceive of the interest-based nature of policy formulation as inevitable restrictions – politico-economic restrictions that cannot be assumed away but that should form the basis of any meaningful policy analysis. This also implies investigating whether what at first glance may appear as "irrational" protest against some supposedly efficient adaptation measure might just reflect hidden costs that have not been taken into account yet. Consider the difficulties of erecting flood protection walls in some German cities with baroque townscapes. While news reports after the 2013 flood blamed delays in the implementation of measures on local protests (Locke 2013), the latter can also be interpreted as rational efforts to reveal the full extent of some measure's opportunity cost (i.e., historic townscape impaired by flood wall).

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