Rational adaptation to increasing flood risk? Institutional drivers of and barriers to risk-based flood management in Germany and Britain[1]

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Introduction

How do developed societies adapt to the increasing flooding? Which role do instruments associated with the concept of risk play in this adaptation? In which ways does the role of risk instruments in flood management vary between countries? How can the nature of and variation in flood regimes in different countries be explained?

Over the last two decades, questions about how societies in Europe deal with flooding have attracted increasing public and political attention. The European Commission has counted more than 100 severe flood events for the period between 1998 and 2004 in Europe. As flooding is associated with (extreme) weather events and climatic processes, it is expected to become an even greater problem in the future. The experience and prospect of a more frequent occurrence of severe flood events has challenged notions of engineered control and safety that dominated flood management in the 20th century. Given the limitations of flood defences, recently emerging programmes and regulations concerning flooding looked beyond the management of water within their natural confines, including the management of land and financial damages. As safety can no longer be taken for granted, efforts are made to anticipate the consequences of future flood events and undertake interventions in accordance to the anticipated consequences.

Risk – conventionally defined as the product of probability and consequences of potential, harmful events – promises to "bring the future into the present and make it calculable" (Rose 2002:214) and therefore offers "an incisive and compelling approach to decision-making" (Stirling 2003:33) in relation to future disasters. Based on quantitative risk assessments, it is possible to undertake interventions and allocate resources in a targeted, proportionate, and objective manner (Jones 1996; EA 2005). Given this 'rational' appeal of risk instruments and risk-based flood management, instruments associated with risk can be expected to increasingly inform anticipatory measures concerning flooding, especially in advanced industrialised societies with substantial analytical capacities. This expectation is vindicated by the recent EU Directive on the assessment and management of flood risk, promoting the use of risk assessment instruments as a basis for management decision (EC 2007).

However, as this paper will demonstrate for the cases of Britain and Germany, the use of risk instruments varies between countries and across different dimensions of the emerging flood management regimes. This paper argues that variation in institutional context can explain the variation in the degree to which flood management is being adopted by actors responsible for flood management. More specifically, following arguments of Moran, Power and others (Power 1997; Hood 1999; Moran 2003), the patterns of adoption in Britain can best be understood in the context of the rise of the unique British regulatory state, characterised by an increasingly formalised, auditable style of regulation. Germany's pattern of a limited adoption of risk-based flood management reflects the incompatibility of risk

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instruments with institutional structures that comprises norms such as solidarity, safety and protection; a legal rule-based, hierarchical public administration and a regionally fragmented flood management regime.

The next section will give a brief overview of flooding as a policy challenge and the emerging flood management approaches. Following this, three key dimensions of the two countries' emerging regimes, namely regulation, financing, and infrastructure, will be described, in particular in respect to their use of risk instruments. A third section proposes a neo-institutionalist explanation for the particular nature of and role of risk in the emerging flood management regimes in Britain and Germany. The final section will draw broader conclusion on the potential role, limitations and problems of risk-based governance of future, environmental disasters.

The emerging approach to flood management

Flooding can be defined as "temporary covering of land by water as a result of surface waters escaping from the normal confines or as a result of heavy precipitation" (Kron 2003:2). Recent figures of the reinsurer Munich Re suggest that this natural peril has become an increasingly important challenge to societies: The global average annual losses from flooding in the 1990s have become a multiple of the values in the previous decades, in line with other natural disasters (Kron 2003).

Some of this increase in frequency is argued to be a result of global warming induced changing precipitation patterns (Bronstert 2003). Other authors blame human activities such as the sealing of soil surface, the conversion of meadowland into arable land and the construction of dykes and roads that interfere with the natural water storage properties of vegetation, ground, and soil, for the greater number and severity of floods (LAWA 1995). Whilst human activities are only a contributing factor to the occurrence of the natural hazard flooding, they are crucial in respect to the damage floods cause. It has been argued that the rising economic damage caused by flooding is a result of factors such as increasing affluence, a more flood-prone evolution of economic structures and activities, changing land-use, and urbanisation (Mitchell 2003).

Often in response to particular disasters, actors involved in managing flooding reviewed their approaches (Johnson, Tunstall et al. 2005; Lange and Garrelts 2006). Traditionally, flood management was dominated by engineered structural defences that ensured that water from rivers and the sea was kept away from land and values (Scrase and Sheate 2005). The underlying idea was one of technical control of natural processes such as flooding. Since the 1980s and 1990s, this infrastructure-based approach was increasingly questioned, partly as a result of its failures and inadequate design standards as revealed by recent flood events and its costliness, especially in the context of a changing climate. For instance, the Rhine floods of 1993 and 1995 served as a wake-up call for flood managers in Germany and the Netherlands, as the defences protecting Cologne's old city centre were overtopped (1993) and a likely dike failure led to mass evacuations in the Netherlands (1995). Flood defences were also criticised because of their aggravation of flooding by narrowing river channels; their adverse implications for wildlife and environment; and their implications on the behaviour of the population that felt safe behind defences.

The new approach to flooding emerged in the 1990s and 2000s across Europe, with an early version sketched out by Germany's *Lander* Working Group Water (LAWA 1995) and the transnational International Commission for the Protection of the Rhine (ICPR 1998). This approach shifts the emphasis from security infrastructure to broader bundles of measures with objectives other than simply containing the water in its 'normal' confines. On the contrary, it aims at 'making space for water' (DEFRA 2005). This implies, for one, that natural capacity

for water retention, e.g. by (re)locating dikes further away from the river, is improved in order to reduce the speed and height of flood waves.

On the other hand, 'making space for water' acknowledges the limitations of defences, and implies that the land near rivers should be kept free from property and values. As a result, the traditional infrastructure approach is complemented by endeavours to regulate land-use near rivers with the aim of reducing the potential damage from flooding. Acknowledging the limitations of defences also implies the need to compensate damages and reinstate the damaged properties in the aftermath of flood events, with the aim of mitigating the impact of flooding on the financial position of its victims. In short, while architecture mostly focused on reducing the hazard of flooding, the complementary measures of regulation and financing address the exposure and vulnerability of values that are at risk of flooding.

As prospective flood events are expected to be beyond affordable technical control, emerging flood management approaches promote measures and instruments to gain a better understanding of future flood events and their consequences. As Germany's *Lander* Working Group Water notes, "only knowledge about the threats makes a targeted precautionary flood management possible" (LAWA 2004:15).

Instruments associated with the assessment and management of risk promise to provide the required 'knowledge' for anticipatory interventions concerning the different aspects of flood management. The traditional risk approach, drawing on and used in a wide range of 'hard science' disciplines, means that risk analysts and managers "anticipate potential physical harm to human beings or ecosystems, average these events over time and space, and use relative frequencies (observed or modelled) as a means to specify probabilities" (Renn 1992:59). The basic idea behind risk-based management is that interventions and resources to control potential threats to values and life are organized in accordance to the probability and magnitude of future events (Rothstein, Irving et al. 2006).

Risk instruments promise to match the specific needs for information of flood managers: For instance, based on precipitation and flood flow models, flood maps calculate and display the extent, depth and speed of inundation for potential flood events of different probabilities, allowing predictions of which areas, values and defence systems are potentially affected by disasters. These instruments have become increasingly available to flood managers: According to a flood expert of the reinsurance industry, thanks to the availability of new data gathering methods (laser scanning, electronic gauges) and increased computing power, "analytical capacities in assessing current and predicting the course of future flood events have radically improved" (Munich Re 2009 – personal communication).

Given the predictive nature of risk information and the improved data availability, risk assessment and management instruments emerge as a 'rational' foundation for the management of future flood events. The central role of risk in flood management is vindicated by the recent EU Directive which promotes risk maps as an "effective tool for information" that can serve as a "basis for priority setting and further [...] decisions regarding flood risk management" (EC 2007:12).

In sum, a new approach to flood management has emerged in the 1980s and 1990s that replaces the traditionally strong bias favouring engineered flood defences with a broader mix of measures, taking into account the management of land and the material consequences of flooding, as well as using assessments of probabilities and consequences of potential flood events as a basis for anticipatory flood management interventions. The next section elaborates on the three dimensions of flood management regimes and the role that risk instruments can play within them.

Risk and the three dimensions of flood management regimes

The regimes that emerge in societies to adapt to the increased occurrence of severe flood events include three dimensions[3], namely regulation, financing and security infrastructure. Within these dimensions, risk can play an instrumental role to 'rationalise' the measures in accordance to probabilities and consequences of potential, harmful events. Figure 1 illustrates the dimensions of flood management and the role of risk therein.

Figure 1: Dimensions of flood management

Dimensions of flood management	Interventions / Measures	Potential role of risk instruments
Regulation	Restrictions on land use near rivers	Target interventions by risk-based differentiation of restrictions
Financing	Compensation of damage; pricing of financial risk transfers	Determine financing needs; price access to compensation according to risk levels
Security infrastructure	Investments into flood defences	Prioritising and differentiating investments in view of risk levels

Regulation suggests the setting of rules that impose restrictions to certain human activities, with the aim of preventing human behaviour that aggravates frequency of and damage from flooding. Most importantly, regulation is concerned with shaping settlement and construction within areas exposed to flooding. Restricting development on floodplains has become a central element of the emerging flood regimes, in recognition of the fact that the increasing damage figures largely result from the economic development of floodplains. Risk instruments can help identify different areas that are to be inundated in the event of a flood with varying probability. On this basis, regulations can be devised that restrict the economic development of areas in a targeted manner proportionate to risk levels.

Financing suggests that damages from flooding are recompensed after the event, with the aim of reducing the financial vulnerability of property owners. Another aim of financing regimes can be to economic financial incentives to property owners to mitigate the consequences of flooding. There are two basic modes of disaster financing: Ex-post financing implies that funds are only mobilised after the event while ex-ante financing suggests that reserves are built prior to the event. The most important mechanism for ex-ante financing is insurance whilst ex-post financing is usually provided as government disaster compensation. Ex-ante financing is particularly relevant to achieve a behavioural change of property owners because it allows for an ex-ante setting of contractual conditions under which the after-the-event compensation becomes available, including the setting of a price (e.g. insurance premium) for and the extent of the financial risk transfer (e.g. insurance deductible). Risk instruments are expedient to anticipate future financing needs and price insurance cover in accordance to different levels of risk.

Security infrastructure implies the undertaking of measures that shape the physical environment, with the aim of controlling the flood hazard. This includes the construction of dikes, embankments, weirs and other engineering interventions into the physical environment. While the emerging 'making space for water' approach relies less on this type of intervention, such interventions continue to be an essential part of flood management because a significant amount of values is protected by them. However, the resources needed to protect all values exceed those available for flood management, especially in view of

[3] It is important to note that there is a fourth dimension, information, that aims at reducing exposure and vulnerability by allowing the population and emergency responders to prepare for the onset of a flood disaster. Flood warning regimes – as key part of information – were left out because they belong to immediate response measures rather than long-term adaptation to flooding, as achieved through defences, regulation, and (ex-ante) financing.

climate change. Risk instruments can serve as an important tool to prioritise investments. Investments into defences that protect the greatest risks, i.e. the product of probability and consequences, emerge as the most rational approach within flood defences.

As this brief discussion of three dimensions of adaptation regimes to flooding shows, risk instruments offer opportunities for more 'rational' interventions in dimensions with different types of interventions and objectives. They enable flood managers to target their land use restrictions at particularly vulnerable and exposed properties and stretches of land. They allow damage financiers to price access to compensation according to risk, thereby making risk-taking unattractive and risk pooling more efficient. They make it possible to allocate investment resources to those areas where defences are most needed because of a high probability of flooding and/or the assets protected.

This 'rationality' of risk instruments appears seems to provide a case for its universal application to deal with future environmental change. But is this really the case? Suggestions of 'objectivity', 'rationality' and 'universalism' call for comparative analyses. The next section reviews emerging flood management regimes in Britain and Germany.

Comparing flood management in Germany and Britain

Germany and Britain have been chosen as countries that have been affected severely by flood events in the 1990s and 2000s to which they responded by reviewing and changing their approaches to flood management, adopting programmes named 'Making Space for Water' (DEFRA 2005) and 'Room for Rivers' (Bundesregierung 2005a). Part of these new programmes are the regulation of land use in specific areas near rivers, as well as the promotion of commercial insurance-based schemes of disaster financing. In both countries, policy documents highlight the importance of 'knowledge about threats' (LAWA 2004) and 'risk information' (DEFRA 2005) as prerequisites for improving flood management which has in turn led to substantial effort to model, map and assess the consequences and probability of different flood events.

These similarities suggest the emergence of similarly configured flood regimes with a central role of risk instruments in both countries. However, as the following discussion of regulation, infrastructure and financing in Britain and Germany shows, the differences between the emerging flood management regimes and the role of risk instruments within them are significant. As will be argued later, this can be explained by the different institutional context in which actors involved in flood management operate in the two countries.

The following, brief descriptions present each domain's key information tool(s), the regulatory heart, as well as the most important measures and interventions to exercise control over flooding.

Regulation of land-use

Since 1947's Town and Country Planning Act, local planning authorities (LPAs) have formally been at the centre of Britain's planning regime. In their autonomous decision-making on planning issues, they have only been constrained by non-binding central government guidance through so-called Circulars.

Flood issues played a limited role in the planning on local level, partly because the issue was not taken seriously, partly because of competing planning objectives and interests. Moreover, central government guidance (Circular 31 from 1947) on flooding was mostly concerned with ensuring that planning would not interfere with drainage and flood management infrastructure planning. It was only the Circular 30 from 1992 that recommended to local planners to take into account flooding when designing development plans and deciding on planning application for flood plains, as well as to seek advice, first,

from the National Rivers Agency, later, by its successor, the Environment Agency. Still, even in the late 1990s, the Environment Agency had – in response to the demands of the Select Committee of Agriculture's (SCA) request to report on the impact of its technical flooding advice on planning decisions by LPAs – found that in about one out of five cases, its advice was ignored by local planners. As the Institute of Civil Engineers states in the SCA's report, the "biggest single issue" in current flood defence policy was "the need to take coastal defence issues fully into account in the development planning process" (quoted in SCA 1998:para 87).

Eventually, the flood events of Easter 1998 and autumn 2000 accelerated changes in Britain's planning regime and led to the rise of risk instruments. In 2001, the Planning Policy Guidance 25 (PPG25) on Development and Flood Risk was published to replace the ineffective Circular 30/92. The regulatory core of PPG25 (and its 2007 successor, the Planning Policy Statement 25, PPS25) is a risk-based Sequential Test (ST). Distinguishing between four risk zones and different vulnerability classifications, the ST advises local planners to systematically attempt locating developments (taking into account their vulnerability) in lower risk areas before considering higher risk zones.

As key input to this regulatory core, PPG and PPS25 emphasise the crucial importance of risk assessments and maps at all stages of the planning process. The starting point for the application of the Sequential Test is the Environment Agency's nation-wide Flood Map that replaced previous local and regional surveys (the so-called Section 105 surveys) and is the result of a major mapping project initiated after the Easter 1998 floods. This is complemented by the LPA's more comprehensive, local Strategic Flood Risk Assessments (SFRAs).

Given the widely-suggested neglect of flood issues by LPAs, ensuring that land use is steered away from flood risk areas is mostly concerned with controlling local planning decisions. To this end, an Order was issued in 2006 that turned the Environment Agency (EA) into a statutory Consultee for all planning applications *in flood risk areas and of a certain size*, as well as facilitates call-ins by the Secretary of State to make a final decision on a particular project. Since 1998/1999, following the SCA report, the compliance of LPAs with national policies is monitored through the so-called High-Level Target 5 (HLT 5) reporting (including compliance to EA advice; production of SFRAs) by the EA to responsible central government ministries.

Like in Britain, Germany's local authorities (LPAs) hold the responsibility for planning decisions, the so-called *Planungshoheit*. However, at the same time, local plans and decisions are bound by state and Federal level legislation and superordinate, regional plans.

Historically, the regulation of land use concerning flooding was largely ineffective because restrictions on floodplain development could only be imposed if a development implied danger for others. As individual construction projects have a negligible impact, the construction of buildings in flood risk areas was undertaken at the owner's own peril. In the aftermath of the Rhine floods from 1993 and 1995, however, the Federal framework legislation on water management (*Wasserhaushaltsgesetz*, WHG) and spatial planning (*Raumordnungsgesetz*, ROG) were amended in order to emphasise a general, precautionary obligation to prevent flooding, especially through the restoration and preservation of natural floodplains (WHG 1996 revision, §31). However, the *Lander* (Germany's 16 Federal states) – in charge of flood management and the transformation of Federal framework legislation into *Landes* legislation – were slow to implement the Federal rules which led – accelerated by the Elbe 2002 flood disaster – to the introduction of the Flood Control Act from 2005 (*Hochwasserschutzgesetz*, HWSG).

The regulatory core of the HWSG are the so-called Inundation Areas (*Ueberschwemmungsgebiete*, USGs) that are defined as areas that are inundated with a 1% annual chance and where significant damages can be expected (WHG 2005 revision, §32). This excludes areas behind flood defences that are usually designed to a minimal standard of 1% annual chance. In these areas, local plans are – unless nine stringent, qualitatively defined conditions are met – not permitted to identify areas for new development. The HWSG also introduces the spatial category of flood-prone areas (*ueberschwemmungsgefaehrdete Gebiete*, ugG). However, these areas, even if displayed on flood maps, do not carry substantial regulatory meaning.

One contributing factor to the ineffectiveness of previous regulations of USGs was that flood managers had done little to systematically identify USGs. In fact, existing Prussian USGs from the early 20th century were removed from spatial plans because they were inaccurate and therefore often ignored in the planning system. With the advent of new regulations, however, mapping was stepped up by the responsible water authorities in the *Lander*, especially concerning the USGs. The maps also identify the flood-prone areas even though their regulatory consequences in the planning regime are limited (e.g. one Land (North-Rhine Westphalia) imposes a general precautionary principle on developments in these areas, another (Saxony) has yet to formally integrate flood-prone areas into their planning documents for fear of compensation claims by property owners in these areas).

The main concern with regard to implementing development control in Germany was the transformation of Federal law into *Lander* legislation. Once legislation is in place, the discretion of local authorities is limited. There is the 'hierarchical chain' (Spatial Planning Ministry North Rhine-Westphalia 2009 – interview) between the plans, including the Landes to the regional to the local plans. Local plans and amendments have to be approved by regional planners whose regional plan in turn needs to comply to the *Landes* plans. This hierarchy is enforced through two mechanisms: On the one hand, regional planners have a supervisory role (the so-called *Fachaufsicht*) to ensure that local planners and plans comply with regional regulations and plans. On the other hand, if local planners fail to produce local plans and decisions that take into account the legal and planning regulations from *Landes* and regional governments, their plans and decisions can be annulled by the public law courts (*Verwaltungsgerichte*) following the complaint of an individual or a private organisation.

Figure 2 compares the extent to which flood risk instruments inform the two countries' planning regimes.

Figure 2: Risk in the planning regimes

	Britain	**Germany**
Information	Flood map and SFRAs with three zones with different levels of risk (measured in probability)	Regional plans, based on flood maps, identifying flood areas (measured in probability)
Goals / standards	Sequential Test which allocates developments with different vulnerabilities to zones with different probabilities	Ban (with very few exceptions) on new developments in USGs at 'unacceptable' risk (>1% annual chance).
Implementation	Degree of monitoring/control of LPAs varies with risk	Control rule-based (hierarchical approval; judicial review)

In short, with SFRAs, the Flood Map and the Sequential Test, risk instruments have assumed a key role in reorganising Britain's planning regime following flood events in the late 1990s. In Germany, risk mapping is used to define specific areas of which only one partially probabilistically defined spatial category (USGs) matters for the regulation of and interventions into planning practices.

Financing of disasters

Britain's financing regime largely relies on the insurance industry for compensating damages, i.e. financial compensation becomes available to an insurance holder after an event based on a contract between commercial insurer and insurance policy holder that requires ex-ante payment of premiums by the insured and – potentially – defines further conditions for pay-outs, such as a deductible or specific risk reduction measures required from the insured.

Britain's insurance markets for flood risk took off in the early 1960s when the industry struck an informal gentlemen's agreement with the government. In this, the industry committed to offer universal and affordable flood cover in exchange for 'sufficient' investment into flood defences by the government. In combination with the incorporation of flood cover into standard all-risk property and content insurance products, this commitment of the insurers led to a remarkable market density: Britain's insurance policies cover more than 90% of properties and 75% of home content.

However, the flipside of the universal coverage at uniform and low premium rates were major losses the industry suffered during the floods of 1998 and 2000. These losses served as a 'wake-up' call to the industry, triggering the renegotiation of the gentlemen's agreement with the government between 2000 and 2003. The new agreement, expressed publicly in the Association of British Insurers' (ABI) so-called Statement of Principles (SOP) (ABI 2002), created a new regulatory core of Britain's disaster financing regime. In contrast to the 1960s agreement, it sets a 1.3% annual chance as threshold of commitment for insuring currently insured properties (i.e. anything less protected/more exposed is not certain to obtain cover) and defines obligations for the government to comply to (e.g. on defence investments, risk assessments, land-use regulation) if insurance cover is to be continued.

As noted, one condition to continue coverage is the collection and provision to the insurers of risk information. In 2004, the government made available to the insurers the National Flood Risk Assessment (NaFRA). While NaFRA has a number of purposes (such as steering flood defence investments), it does reflect in important ways the insurers' needs. In contrast to the Flood Map and SFRAs used for planning, the threshold between high and moderate risk zones stands at 1.3% annual chance. However, as NaFRA and earlier government risk instruments did not always match the insurers' needs perfectly and individual insurers recognised the competitive benefits of their own instruments, major insurers such as Aviva and Royal Sun Alliance engaged in flood mapping themselves.

In conjunction with the abandonment of the implicit price regulation through the gentlemen's agreement, the availability of improved risk instruments offer insurers opportunities to price insurance cover in accordance to risk levels. However, a recent study (Lowe, Barnett et al. 2008) of the pricing of 25 insurers shows, that the price difference between on and off floodplain insurance cover is minimal (6£ per annum if the insured seeks the cheapest products). The same study reports that risk instruments, in particular probabilistic flood models by major risk management companies such as RMS, assume a greater significance for the calculation of overall portfolio exposure in order to ensure that sufficient reserves and adequate premium pricing.

Germany's disaster financing regime also formally relies on insurance-provided compensation in the aftermath of flood disasters. Commercial insurers offer flood cover since the early 1990s when the market previously organised by regional monopolies was deregulated in response to EU regulation. However, in contrast to Britain's almost universal coverage of households and small businesses with flood policies, insurance coverage in Germany – with the exception of Eastern German Lander and Baden-Wurttemberg where flood insurance was compulsory – is below 10%. Consequently, while insurers contribute Germany's disaster financing, most of the financial risk from flooding is retained by

individuals and businesses or – as experienced most notably in the case of the Elbe 2002 floods – transferred to the government.

In contrast to Britain, Germany's disaster financing lacks a regulatory core that defines responsibilities of insurers, different levels of government and individuals. Rather, the responsibility of the government for disaster relief and compensation is mostly determined by ad-hoc political decisions and negotiations between different levels of government. One example is the 2002 floods that saw the establishment of a '*Sondervermoegen*' (special fund outside normal budget) of €6.5 billion, jointly financed by Federal and state governments. This significant investment has to be viewed in its political context, the imminent Federal Election in September 2002. While the political context determines public disaster financing, insurance-based financing is largely determined by economic factors, such as a company's reserves, portfolio exposure, and competition.

Another important variable is the influence of the industry-wide flood mapping standard ZUERS, a joint project of the industry launched by the Association of German Insurers (GdV) after the 1997. This tool has become industry standard, differentiating between four probabilistically defined risk zones. Zone 4, with a 10% annual chance of flooding, is assumed to be uninsurable even though this standard is not explicit, binding or – in view of the high threshold of 10% for uninsurability – particularly constraining for insurers. The government – in contrast – does not undertake risk assessments specifically aimed at 'rationalising' its or the insurers' disaster financing. Ex-post financing requires damage assessments and is often guided by principles of solidarity and distributive justice rather than levels of risk(-taking) (Klimaszewski-Blettner and Richter 2007).

Given the limited role of risk instruments in ex-post governmental financing, the impact of risk instruments on the actual financing measures is limited. ZUERS is widely used among insurers as one important input to determine the premium but insurance-based financing accounted for 15% and – at most – 40% of the total economic damage.

Figure 3 compares the extent to which flood risk instruments inform the two countries' disaster financing regimes.

Figure 3: Risk in the disaster financing regimes

	Britain	**Germany**
Information	Government's NaFRA and individual risk maps by insurers, with three or more risk categories	Industry-wide ZUERS with four risk categories for private disaster financing; no risk information for ex-post government financing.
Goals / standards	SOP *defines* availability and access to insurance on the basis of NaFRA high-risk category (*1.3%).*	ZUERS high-risk category *shapes* threshold of insurability (*10%*); no specific public compensation rules
Implementation	Risk levels with limited impact on pricing of risk transfers	ZUERS considered by underwriters, along with other criteria; no role for risk in ex-post disaster financing by government

In short, NaFRA, mapping projects by insurers and the SOP standard reflect an important role of risk in Britain's disaster financing. However, the SOP standard, compelling insurers to provide insurance if a specific protection/safety level is exceeded, constrains insurers' ability to take individual decisions which probability level is appropriate for them. Moreover, the effects of different risk levels on pricing is limited. As Germany's disaster

damaged are largely financed ex-post by governments, the insurers' risk instrument ZUERS has a limited impact on the overall financing of disaster damages in Germany.

Protective infrastructure

Historically, Britain's flood defence regime was organised in a fragmented and decentralised manner. Investments were undertaken on the local and regional level, with a plethora of actors, i.e. the Regional and Local Defence Committee (RFDC/LFDC) of the Environment Agency, Internal Drainage Boards, Local Authorities, and riparian owners being involved – to different degrees – of proposing, deciding constructing, maintaining and funding flood defences. This system was strongly criticised in the aftermath of the 1998 and 2000 floods (Bye and Horner 1998).

The aforementioned NaFRA is not only a key information source for the insurance industry but also guides investments into flood defences. NaFRA reveals the level of protection granted by defences to particular areas by identifying the probability of flooding taking into account the effects of defence systems.

NaFRA serves as basis for the regulatory core of the infrastructure regime, namely standards and goals set for the outcomes from flood investments by central government. These are defined in Defra's so-called Outcome Measures (OM). OM-2 defines the objective of moving 145,000 households to a lower NaFRA probability category between 2008 and 2011 through investments into projects funded by central government's Flood Defence Grants in Aid (FDGiA); 45,000 households of the total number should be moved from the high probability category (>1.3% annual chance) to moderate or lower risk areas, underlining the importance of NaFRA for goal- and standard-setting. Moreover, nation-wide prioritisation of investment into defences is also shaped by the expected benefit-cost-ratio (BCR), as stipulated by OM-1. OM-1 sets the aggregate, nation-wide benefit-cost-ratio for flood defence spending at 5:1 whereby individual projects have to achieve a BCR significantly better than 1:1. The benefits in this calculation in turn are calculated on the basis of NaFRA.

Actual investment and construction of security infrastructure is guided by BCR and – on the basis of NaFRA – endeavours to accomplish the protection of additional households as effectively as possible. The importance of OM, BCR and NaFRA is further reinforced by the fact that funding for defences is increasingly centralised: Since 2004, central government provides the FDGiA that now account for about 95% of flood defence investments (DEFRA 2009).

Germany's flood defence regime is very fragmented. This is primarily a result of the responsibility of the Lander for flood management, combined with individual, joint initiatives between Lander and Federal level.

Driven by specific events along rivers, endeavours to systematically assess the performance and state of flood defences remained geographically limited. One of the earliest assessments, for instance, was undertaken by the International Commission for the Protection of the Rhine (ICPR) in 1997 (ICPR 1997a), revealing large variety between safety standards along the same river. More systematic data gathering – beyond specific catchments – was undertaken in Saxony in the aftermath of the 2002 floods where Flood Protection Concepts (*Hochwasserschutzkonzepte*) include an analysis of historical flood events, existing defence structures and defence needs for all catchment areas.

Most *Lander's* investment programmes subscribe to a minimum safety standard of 1% annual chance of flooding (LAWA 2006:17). This standard has historically been used by water managers in Germany to determine the so-called BHQ (*Bemessungshochwasser*) as a standard for defence construction.

While Lander have widely endorsed the 1% standard, there is no consistent regulation on how to prioritise investments. In 2005, LAWA developed non-binding guidance for the conduct of benefit-cost-analyses (LAWA 2005). Their impact on investment decisions varies between the different Lander. Saxony has developed the most systematic approach to prioritising investments through the so-called '*SMS-Modell*' which takes into account as benefits a mix of damage potential, flood management contributions, special requirements for high vulnerability objects, and other factors (Socher, Sieber et al. 2006). Bavaria undertakes cost comparisons between different projects to achieve the goal of a 1% protection standard. In North Rhine-Westphalia (NRW), cost-benefit calculations inform primarily individual project approvals while Land-wide prioritisation is based on 'historically grown knowledge' (interview with NRW's Environment Agency 2009) on how best to control floods and retain water. The impact of BCAs on the funds provided by the GAK (Joint Task Agriculture and Coastal Protection), a joint Federal-Lander financing instrument, is completely unrelated to any performance criteria or risk assessments. The allocation of funds is shaped by the so-called '*Koenigsberger Schluessel'*, originally devised for the allocation of Federal funds for higher education between Lander, based on population figures.

Funding originates from different sources. Saxony's overhaul of flood management infrastructure was at times supported by funds from 17 different sources (Interview with Saxony's State Reservoir Agency 2008). Rather than systematically informed by risk assessments and BCR, the availability of funding is often determined by the political context/ negotiations, such as the occurrence of a major flood (Saxony's well-funded investment programme) and the GAK political compromise between Lander.

Figure 4 compares the extent to which flood risk instruments inform the two countries' security infrastructure regimes.

Figure 4: Risk in the infrastructure regimes

	Britain	**Germany**
Information	NaFRA's data on defences and benefits from defending	Lander and catchment-specific evalutions of existing safety standards in probabilistic terms
Goals / standards	Outcome measures define risk reduction objectives in NaFRA categories	Widely endorsed minimum safety standard, distinguishing between acceptable (events with a <1% chance) and non-acceptable (>1%) risks.
Implementation	Central government funding (95% of all investments) is allocated on the basis of NaFRA, combined with BCA	Funding from a wide range of sources, often ad-hoc post-disaster arrangements or politically negotiated

In short, Britain's flood defence regime is strongly shaped by risk instruments. NaFRA is used to define and measure the goals of defence investments, and influences the allocation of the majority of funding. Germany's defence regime makes limited use of risk instruments: Funding sources are fragmented and allocated in an ad-hoc and/or politically negotiated manner, used to achieve at least the minimum protection standard of 1% annual chance of flooding. A systematic assessment of existing defences and their capabilities is often initiated only in the aftermath of major flood events and is limited to specific catchments or Lander.

Based on the discussions of the three management dimensions, the image of the two countries' regimes that emerges is one of a much stronger impact of risk instruments in Britain than in Germany. How can this variation be explained? Why did the actors involved in the design of the emerging flood regimes choose one type of intervention, measure and

principle over another? The next section seeks to shed light on the differences from a neo-institutionalist perspective.

Risk in flood management: Explaining variation between Britain and Germany

Neo-institutionalist approaches embed actors into a particular a context structured by political and economic institutions. Institutions can be defined as "the formal and informal procedures, routines, norms and conventions in the organizational structure of the polity and political economy" (Hall and Taylor 1996:942). As such, institutions shape actors' preferences, the outcome of their interactions and/or cognitive templates in relation to the adoption of specific policy programmes and institutional configurations[4].

Such approaches are particularly useful in the context of cross-country comparisons of responses to similar policy challenges (such as the occurrence of a series of devastating flood events) for which explanatory approaches focusing on public opinion (e.g. the demand for governmental compensation payments) or interest group pressure (e.g. pressure by developers to avoid overly restrictive regulation of floodplain land use) would predict similar choices because they illustrate how available policy options are narrowed down by institutional constraints and/or shaped by instruments and institutions already in place.

Britain: Risk-based flood management in the context of the rise of Britain's regulatory state

A number of scholars have observed the rise of a unique regulatory state in Britain (see Power 1997; Hood, James et al. 1998; Moran 2003). While more generic accounts of the regulatory state usually describe the shift from state ownership to control through regulation, often by independent regulators (see Majone 1994), the British regulatory state emphasises a particular type of regulation, namely through 'standardization, central control, and synoptic legibility to the centre' (Scott 1998:219).

The rise of increasingly formalised, standardised and centralised regulation is explained by changes in the organisation of the state and state-society relations, in particular the increasing relational distance (e.g. independent regulators, privatised industries) and socio-cultural change (e.g. declining deference/public trust vis-a-vis elites, weakened shared social norms within administration); formalisation and standardisation offers opportunities for better control and greater accountability to restore public trust (Levi-Faur and Gilad 2004). The emerging regulatory state replaces Britain's 'club government' (Moran 2003) which was characterised by informal, co-operative relations between regulators and regulatees based on informal club rules and mutual trust. However, this 'club government' found – according to Moran – an end in the late 1970s when economic decline and challenges of the legitimacy of 'club government' triggered a phase of 'hyper innovation' in Britain.

The emerging regime of flood management in Britain can best be understood as part of this reorganisation of governance, whereby risk instruments are chosen as instruments to increase control and accountability within government. Deviations from this 'rationalisation' drive reflect path dependencies and institutional and political barriers, mirroring the messiness of transformation described by Moran.

The need to improve central government control over land use and infrastructure was reinforced by the recognition in the aftermath of the 1998 and 2000 flood events that local and/or fragmented actors responsible in both fields underperformed. The problem of 'inappropriate' development was flagged by the SCA's report (SCA 1998), while the review

[4] Note that Hall and Taylor distinguish between three types of new institutionalisms, namely calculus (rational choice), cultural (sociological), and historical institutionalism. They propose to take into account all three types under the umbrella of historical institutionalism because it is open to combinations of the analysis of preferences and strategic interactions, as well as changes of cognitive templates throughout time and space.

report by Peter Bye and Michael Horner (Bye and Horner 1998) after 1998 took issue with the fragmented nature of flood defences, investments and maintenance.

In the absence of comprehensive direct control mechanisms over autonomous local planning, increasingly detailed, quantitatively defined central government policies and guidance, PPS25, and centralised reporting mechanisms, HLT 5 reporting, restrict the discretion of local planners. Sequential Test and Flood Maps offer effective means of "structuring the thinking of planners", as well as the implementation because "planners like tools... give them a tool and they use it" (Interview with UK government's Planning Ministry).

Similarly, defence investments and managed were fragmented in Britain's flood management regime, including the production of local flood surveys by local or regional river and water authorities, as well as defence construction and maintenance managed by local and regional river authorities, internal drainage boards and local authorities and partly funded through local levies. The production of NaFRA as consistent, nation-wide basis for prioritisation of investment and identification of investment needs reflected, on the one hand, the too variable and often unknown standards of defence across Britain, and, on the other hand, an increase of central government funding that "implied a much stronger accountability to Ministers and the Parliament" (Interview with Regional Flood Defence Committee York).

In the domains discussed above, standardisation of risk information and risk-based management tools have improved legibility and control of local actors' interventions from the perspective of central government. In the domain of Britain's disaster financing, it is central government itself that is held accountable for its flood management measures by the insurance industry and the insurance-seeking/holding public.

Thanks to the public SOP, the performance of the state can be compared with the probabilistic insurability threshold (and other requirements). While this suggests special importance of risk instruments in disaster financing, their impact on access to compensation – as a potentially important economic incentive to avoid risk-taking – is limited. This can best be understood as a historical legacy from the gentlemen's agreement. As prices used to be informally fixed at an 'affordable' level, public and political expectations prevent the charging of a full economic premium for 'reputational reasons' (interview with the leading insurer Aviva). Moreover, as Britain's market has – due to the agreement and subsequent standardisation of the product – turned into a large and profitable market, stiff competition keeps the premium rates low (Clark, Priest et al. 2002).

In short, risk instruments – while offering important instrumental benefits for flood managers – are particularly compatible with Britain's rising regulatory state, by offering standardised, quantitative tools to control actors in charge of enforcing and implementing flood management measures. Such technical instruments – as Porter (1995) argues – provide legitimacy and objectivity that are necessary to control distant actors such as local authorities and planners from a central government viewpoint, as well as central government, as seen by the insurance industry.

Germany: Risk-based flood management in a fragmented welfare state with a Weberian bureaucracy

In contrast to Britain where risk instruments serve not only an purely functional but also a political purpose, risk-based management is less compatible with Germany's institutional context. The basic principles that govern Germany' public policy are found in the *'Grundgesetz'* (Basic Law), Germany's constitution that was established under the impression of World War II and the Third Reich. The Basic Law defines Germany as a *'Rechtsstaat'* (state institutions and interventions are bound by law), a *'Sozialstaat'* (state institutions safeguard the individual from the mishaps of life), and *'Bundesstaat'* (in addition

to the Federal level, the Lander are sovereign). These abstract principles and their reflection in public policies and administration have a substantial impact on Germany's flood management regime, as well as the specific role of risk instruments therein.

While risk instruments serve as control instruments in Britain, this political function is largely redundant in Germany. Reflecting the '*Rechtsstaat*' and the Weberian tradition of a hierarchical, rules-based public administration, administrative actors such as local planners execute their functions on a legislative basis judicially and hierarchically overseen by superordinate authorities and administrative courts. The limited discretion of local actors such as local planners becomes particularly apparent in the USGs where new developments are almost completely banned as a result of the legislation of the HWSG from 2005.

While the '*Rechtsstaat*' reduces the political need for risk instruments, it also reduces the degree to which they can be applied. The spatial category of flood-prone areas, for instance, has a limited relevance in Germany's planning regime because local planners fear interventions by administrative courts because their precautionary interventions into land use behind dikes may be interpreted as "violation of individual property rights, potentially triggering compensation claims" (interview with local planner in Saxony). As one expert notes, "in the interactions between lawyers and experts, the lawyers refuse to step back from the binary conceptualisations of at-risk and not-at-risk" (interview with the Environment Agency NRW). This contrasts with Britain's more pragmatic, less codified approach that allows for a more extensive, gradual approach to risk-based land use regulation.

The '*Sozialstaat*' – in combination with norms of solidarity as reflected in the massive private donations in the aftermath of flood events in 1997 and 2002 – undermines Germany's insurance market because the prospect of the 'near certainty of government emergency aid' (Schwarze and Wagner 2004) suppresses demand for insurance products. As an official in Saxony's Environment Ministry perceives it, "there is a general duty for safeguarding of existence ('*Daseinsvorsorge*') of state institutions vis-a-vis the population" (interview with Saxony's Environment Ministry). Risk instruments, however, have no significant role in ex-post public disaster financing systems.

Finally, the fragmented nature of the German '*Bundesstaat*' undermines one important driver for greater accountability, namely a uniform source of funding investments into flood management. The fragmented, ad-hoc and/or politically negotiated nature of flood management funding reflect the varying responsibilities at different levels of government. This fragmentation in turn raises the transaction costs of introducing systematic, risk-based control of expenses.

In short, risk instruments – even though available in the form of ZUERS and the Lander's diverse flood mapping projects – have a marginal role in Germany's flood regime because drivers of their adoption – associated with the rise of Britain's regulatory state – are not present in Germany, and important institutional barriers – associated with basic principles of Germany's statehood – restrain their adoption.

Conclusions

The past decades with an increasing number of severe natural disasters and louder warning about climate change have taught developed societies such as Germany and Britain that an adaptation strategy to environmental disasters such as flooding based on engineered structures that control natural processes no longer offers safety. Rather, a strategy has been adopted that recognises the defences' limitations and makes provisions to manage the consequences of flooding behind the defences and after damage was suffered.

As defences no longer offer the certainty of safety, predictive knowledge on future events has become increasingly important in flood management regimes. Risk instruments in governance offer an insight into the consequences and probability of future flood events,

allowing for more targeted, differentiating, and anticipatory interventions into socio-economic and natural processes and structures based on a quantitative and seemingly objective, scientific basis. While appearing as a rational response for managing future harm, its adoption in Germany and Britain varies strongly. In Britain, most aspects of flood management are informed by different levels of risk while Germany's flood regime makes limited use of risk assessments and management tools.

This paper proposes an explanation that takes into account the institutional context within which actors involved in flood management operate. In Britain, the adoption of risk-based flood management matches well with a general endorsement of a highly innovative, high-modern regulatory state in policy-making, i.e. actors operate in a context that values centralisation, quantification, standardisation and economic efficiency. Risk instruments providing objective assessment and rational management tools offer a good fit. In Germany, the institutional context stresses a different set of norms and principles which are less reconcilable with the application of risk instruments. Solidarity and the state's obligation to safeguard the individuals' existence (the '*Sozialstaat*'), legal codification and hierarchically-organised public administrations (the '*Rechtsstaat*' combined with a Weberian bureaucracy), political negotiations, and strongly institutionalised territorial fragmentation (the '*Bundesstaat*') stand in conflict with the implications of risk instruments, i.e. differential treatment and quantitative, objective standardisation.

The implication of the notable variation between countries in the role of risk in adapting the future environmental challenges is that attempts (such as the EU Flood Directive) that promote more uniform, risk-based model of adaptation may be contested and/or impeded by certain institutional barriers. Moreover, it indicates that risk instruments do not only serve functional purposes, helping address a specific adaptation problem, but also political purposes, namely a centralisation of control and potentially an increase in accountability through greater transparency in the form of performance measures expressed in quantitative risk terms. It finally highlights that there may be alternative instruments and principles to respond to increasingly frequent and severe natural disaster, namely those that emphasise the role of the state and the principle of solidarity.

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