PUBLIC PRIORITIES AND PUBLIC GOODS:

THE DRIVERS AND RESPONSES TO TRANSITIONS IN

FLOOD RISK MANAGEMENT

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Public priorities and public goods: the drivers and responses to transitions in flood risk management

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Abstract: This thesis examines the role of the public in Flood Risk Management (FRM) service provision at a time when the perceptions of the distribution of benefits provided by FRM interventions are in flux, and the role the public should play in FRM highly contested among stakeholders. Two schemes have marked the revised role of the public in FRM – Partnership Funding and Flood Re – both of which challenge existing judgments of the excludability and rivalry of benefits delivered by FRM interventions. The Partnership Funding scheme allocates capital for FRM projects proportionately to the public benefits they provide, allowing communities to top-up grants through local contributions. In comparison, by increasing accessibility to affordable insurance through cross-subsidies and pricing signals, Flood Re highlights a growing recognition that the distribution of gains as a result of widespread insurance uptake is greater than the benefits received by the policyholder alone. Following the identification of these schemes, we tested their social feasibility, examining both the scale and distribution of benefits. Due to the different stages of implementation of each scheme at the time of writing this thesis, two distinct methods were developed. The Partnership Funding Chapter used field data to examine how public-private funding of flood defences has changed service provision and the public acceptance of this transition. Whereas the Flood Re chapter used computer-based experiments to hypothesize how Flood Re may make the

purchase of insurance a more or less attractive investment for different types of consumer. We found that Partnership Funding enabled more FRM projects to go ahead, raised public awareness of flood risk, and improved collaboration between stakeholders, but encouraged lower-cost projects, which, in the longer term, could transfer the expense of managing residual risk to the householder. In comparison, Flood Re provided peace of mind to householders struggling to afford rises in insurance premiums, but disproportionately benefited those who annually purchased insurance. Combining this proposed inequity in Flood Re with increasing residual risks, we identify a gap in service provision for the public who cannot afford household mitigation measures. We propose that loss mitigation and flood defence should become increasingly collaborative in line with the complexities of flooding within a community. We seek a move away from the information asymmetry which currently exists between insurance providers and policyholders, and yet simultaneously call for local authorities to recognise the capacity of the public to participate in FRM, and sustain resilience in the face of rising flood risk.

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1. Introduction

1.1. Flood Risk Management as a public or a private good

Flood Risk Management in England is currently undergoing significant changes, and, as a result, it is unclear whether the benefits of flood risk management should be seen as public or private. Flood Risk Management has traditionally been considered as a public good, providing benefits which are both non-excludable and non-rival[1]. Yet, a shift towards cost sharing of flood defences and a growing emphasis on managing flood risk at a household and community level has undermined this *status quo*, and raised questions of how public funds should be used to support the primary beneficiaries of flood risk management. Whether flood risk management services are seen as providing a public good or otherwise is important as such categorizations determine who is responsible for the provision of Flood Risk Management services, how the public can and should be engaged in the Flood Risk Management process, and, consequently, the form of interventions which

[1] Non-excludability "means that once a good has been created, it is impossible to prevent other people from gaining access to it" (Blakely *et al.*, 2005, p.4). Non-rivalry "means that one person's use of an idea [or resource] does not preclude another person using it at the same time (Blakely *et al.*, 2005, p.3).

would most effectively deliver the public or private benefits of Flood Risk Management. However, many barriers stand in the way of defining flood risk as a public good, including England's heterogeneous social, political and physical landscapes, diverse flood sources, magnitudes and characteristics, and, importantly, 'saturation points' which limit management options in terms of funding, space, and culture.

These barriers, alongside increasing moves towards devolution, mean that the scales at which public goods are delivered may be negotiable, or at least adaptable. Thus, imposing a national level management strategy of the scale traditionally associated with public goods (Samuelson, 1954) may prove impossible, resulting in an increasing share of Flood Risk Management interventions falling under the umbrella of "club goods" (see Table 1.1). The task of defining Flood Risk Management as a public good is further complicated as the sources of flood risk grow in variability, driven by climate change, the exacerbation of 'surface water flooding', increasing population pressure, and the increasing value and vulnerability of assets located on the flood plain. Thus, the concept of Flood Risk Management as a public or private issue is not static or clear, raising questions of the best scales of management for these forms of flooding, and how these align with current moves towards the devolution of responsibility and decision-making.

The clarification of the public nature of the wide-ranging Flood Risk Management interventions available supports decision makers in efficiently aligning public expenditure with public expectations, and informs the scales at which public Flood Risk Management initiatives are least controversially and most effectively delivered. Central to this analysis is the assumption that the delivery of the good being provided (in this case flood risk reduction) is fundamentally affected by the public's capacity and acceptance

of their increased involvement in flood risk management service provision, and that the changing scene towards private goods in this field has important implications for the process of stakeholder engagement and public participation. In this regard we have the advantage of researching the situation in a country where there is a long tradition of stakeholder engagement in flood risk management, enshrined in legislation originated in 1930, which gave stakeholder-based regional committees substantial responsibilities and powers in this area (Tunstall *et al.*, 2004; Penning-Rowsell and Johnson, 2015). This is in contrast to the situation in many European countries where stakeholder engagement in flood risk management is at an embryonic stage, lagging behind engagement with issues concerned with the Water Framework Directive (see, for example, Newig *et al.*, 2014).

This thesis analyses the position of Flood Risk Management as an evolving public good. Examining the influence of the gulf between public goods and public priorities we seek to understand how:

- The public influence and respond to the goods provided by flood risk management;
- Policy instruments aim to adjust the distribution of contributions and benefits of flood risk management services across society;
- Flood risk management schemes are reliant upon public acceptance and consumer response;
- The public should be involved in the design and delivery of flood risk management services.

Reflecting this, each chapter of this thesis gives a background to the public involvement required for a policy tool to be effective, the efficiency and equity of these instruments in achieving their desired aims, whether the public can be relied upon to fulfill their

role in supporting the flood risk management scheme, and implications of misalignment between public priorities and public goods.

1.2. Key definitions and assumptions: public goods vs. public priorities

The theoretical groundings of public goods are multiple, and the consideration of Flood Risk Management as a public good needs to be scrutinized with a knowledge of how the definition of public good varies between disciplines. Within the literature, two definitions of public good preside: a definition established by economists, and a definition proposed by social scientists frustrated with the limitations of the former interpretation. Encompassing these views of public good, we have some sympathy with Karlsson's broader definition of a public good as one which fulfills three criteria: "culpability, capacity and concern"[2] (Karlsson, 2007, p.103), a theme which shall be introduced following the definition of public goods and public priorities.

Economists refer to public goods as a product that one individual can consume without reducing its availability to another individual and from which no one is excluded. Public goods are thus referred to as "non-rival" and "non-excludable". The classic example of a non-rival good is a newspaper, which can be read by several individuals without it being itself consumed, and the example of a non-excludable good is a lighthouse which benefits all those at sea, none of whom can be excluded from enjoying the safe passages that the lighthouse may indicate. In other spheres national defense, sewer systems, ocean fish

[2]Culpability is the level of responsibility for a fault or wrong-doing, capacity is the ability or power of a person to do or understand something, and concern is the interest or involvement a person has in an issue.

stocks, public parks and basic television and radio broadcasts could all be considered public goods (see Table 1.1)

A variation on this categorization acknowledges, first, that some public goods may also become subject to restrictions on access, rather than free to all so that the park may become designated as private, or television broadcasts might be subject to payments of subscriptions or some other exclusion mechanism. These goods are not 'consumed' by those who make these payments, so are non-rivalrous, and the term "club goods" has been used here. Secondly, it is recognised that some public goods may become "used up" if over-exploited, and hence lose their true public good character over time, such as fish stocks that become exhausted or coal reserves that become depleted: these are termed "common goods" or "common pool resources" (Cowen, 2007).

The goods provided by the Government go beyond those which are purely public, and in order to describe these goods some social scientists have proposed the use of the term 'public priorities', which is broader than the concept of 'public goods' in that the notion of public priorities reflect prevailing social values within a given society which are then expressed through the services that should be provided by non-market mechanisms (Duneulin and Townsend, 2007). That individuals could acquire these goods or services through the market is not of importance. As such, the goods are referred to as 'public priority goods' or as a 'public need'. In this thesis, we will borrow this terminology in order to ensure clarity between public goods defined by the public and those defined by economists.

Bridging the rigidity of public goods and the broadness of public priorities is Karlsson's overview which delegates public goods by public "culpability, capacity and concern" (Karlsson, 2007, p.103), which combine under the umbrella of "responsibility". Thus, the

	Non-excludable
Rivalrous	**Common Goods** *Classic:* Classic: Fish stocks, non-renewable energy. *Flood Risk Management:* Emergency sandbags, flood plain protection
Non-rival	**Public Goods** *Classic:* Classic: Free television channels, national defense. *Flood Risk Management:* Flood warning systems, subsidized 'affordable' insurance.
	Excludable
Rivalrous	**Private Goods** *Classic:* Classic: Food Parking spaces, property *Flood Risk Management:* Household property level protection, individual insurance policies.
Non-rival	**Club Goods** *Classic:* Cinemas, private parks, pay-to-view television. *Flood Risk Management:* Community level/funded flood defences, community flood warden schemes.

Table 1.1.: The excludability and rivalry of generic goods and flood risk management goods

presence of responsibility becomes an indicator of a market failure, and, so, even if a good is excludable and rival, if public responsibility is lacking due to diminished culpability, capacity and / or concern, the good becomes public in nature. Ballet *et al.* (2013) expand Karlsson's triad of responsibility. First, Ballet *et al.* (2013) discuss culpability, identifying three issues which determine delegation of culpability; whether the actions of one party can be directly linked to an event which took place, if all stakeholders had access to information which would enable them to manage their impact on a situation, and finally, the ability of stakeholders to shift blame on to others, for example blaming the experts who informed them or blaming the institutions with shaped the direction of their research. Capacity looks at the ability of a stakeholder to solve the issue, even if they are not responsible for its emergence. The concept of 'concern' relates to moral responsibility, with the implication that even if a stakeholder does not cause an even they should be concerned about what might happen to others. Ballet *et al.* (2013) go as far to argue that "Governments bear moral responsibility for doing nothing" (p.128). Throughout this thesis "public goods", "public need" and Karlsson's (2007) overview are used to contextualise the provision of different Flood Risk Management services.

The provision of both "public goods" and "public priority goods" may originate from either a public authority, the State or a private organisation. Public goods, such as a newspaper may be provided by a private publishing house, and a lighthouse could be provided by a private landowner. Similarly a "public priority good" might be something that the public perceives as should be provided by a state authority but this does not necessarily mean that this is a public good as classically defined; the state might provide a particular good for a sub-section of society, and exclude others from its benefits (e.g. social housing). The state might also provide something which is consumed by the

public, and, therefore, is used up by the first consumer (for example, an injection against influenza). We need to differentiate between public goods and those provided by the state in a way that is careful and commensurate with conventional definitions.

The concept of boundaries further complicates the delegation of Flood Risk Management as either a public or private good. This is in part due to the typical spatial extent of forms of flooding and how these align with different levels of governance, and also as a result of the scales at which different Flood Risk Management interventions are designed to function (e.g. flood forecasting/warning may be regional and catchment-based, or even international, whereas spatial planning of floodplains is largely local). Therefore, we must consider where the boundaries of public goods and public priority goods should sit if they do not align with national borders but delimit smaller scale activities and interventions. As a theory, the concept of public good is traditionally associated with the nation state (Tiebout, 1956; Miller, 2009). However, the geography of that state, the distribution of populations and physical features which influence flood risk mean that the borders of a country may inhibit the efficiency of delivering a public good even if positive externalities, such as public well-being and economic stability, are inhibited when that public good is redefined as a private issue (Hayek, 1945).

A social science definition of public priority goods allows for a flexible and dynamic approach to a public good, which offers a strong argument for determining what services might be provided centrally, regardless of characteristics of non-rivalry and non-excludability. Yet, a sole focus on public priority goods can be criticized when assessing its merits in light of broader definitions of a public good. Specifically, when referring back to Karlsson's notion of "culpability, capacity and concern" (Karlsson, 2007, p.103) it is clear that a reliance on only social values is problematic, as, despite the existence of

a public concern, the management strategies required in response to public demand may be impossible to implement in terms of responsibility delegation and resource acquisition.

The importance of correctly identifying public goods within Flood Risk Management is particularly poignant when dealing with the notion of capacity. First, there may be a misalignment between the costs of the services expected and the willingness of the public to pay for a service which they perceive necessary to match their ideology of the 'public good'. Second, capital intensive flood defences are often preferred by flood risk communities (Geaves and Penning-Rowsell, 2014), but are not always appropriate as an isolated form of flood defence, being shown to reduce awareness when not combined with additional information, and, therefore, increase vulnerability to large-scale floods with long return periods. As such, we examine not only the financial capacity of the public to manage flood risk, but also the behavioural capacity to ensure all aspects of risks are appropriately managed.

Despite a general public demand, public contribution is frequently an issue in the provision of public goods, manifesting itself as the free-rider problem. This problem says that a rational person will not contribute to the provision of a public good because the good is non-excludable. Herein lies a key problem for stakeholder engagement and public participation. We are assuming here that stakeholder engagement and public participation in decision-making concerning Flood Risk Management is likely to lead to better decisions and is to be encouraged. We contend that the critical purpose of this stakeholder engagement is to build and maintain the conditions under which collaborative approaches between those at risk and those responsible for Flood Risk Management will be achieved (Geaves and Penning-Rowsell, 2014). This requires that only a limited range of public resources are selected to contribute to the provision of flood risk management services

and that individuals at risk accept some form of loss in one choice (e.g. loss of time and/or potentially capital), in the expectation that they will make gains in subsequent choices (e.g. a new flood defence).

In this respect we see stakeholder engagement as the process by which an organisation or interested party attempts to involve people who may be affected by decisions made by itself or another or can influence the implementation of these decisions. As such, this engagement is much more than simply the participation of members of the public, important though this may be, but more the development of social relationships in the pursuit of some ideal, including the resolution of conflict or delegation of blame. Given that it involves a range of individuals or organisations, the process of negotiation for the individual stakeholder should be seen as part of a social process rather than individualistic bargaining, thus "widening the negotiation space for the individual stakeholder" (Green and Penning-Rowsell, 2010, 373), through dialogue and cooperation, from a focus on short-term narrow self-interest towards an attention to wider considerations. For the individual stakeholder, this may mean a change in focus from this self-interest associated with the rational economic person (Frank, 2006), to the possibility of trading off this interest against either their long-term narrow self-interest or for some wider interest (Green and Penning-Rowsell, 2010, 373). Such a change could come about from the reconsideration of the diverse outputs of Flood Risk Management interventions as either public or private goods, and the resultant incentives or barriers to individuals joining cooperative arrangements leading to consensual solutions.

In summary, by utilising the frameworks of both public goods and public priority goods, we not only better understand the direct impacts of the Flood Risk Management interventions, but also the externalities, which may be of equal benefit to society. We

begin to understand how both interpretations of a public good hold their merits – one in terms provision of non- or missing-market goods, the other in regards to democratic authenticity - and, as such, any study which wishes to clarify the position of Flood Risk Management as a public, club or private good must account for several interpretations of those terms. Finally, in regards to public engagement, we hope to identify how the use of alternate interpretations of public goods and public priority goods drives the emergence and form of public engagement in Flood Risk Management, how public activities influence the provision of flood risk management services, and the associated distribution of contributions and benefits from flood risk management measures.

1.3. Flood Risk Management measures

In the UK there exists a diverse portfolio of measures designed to prevent the build-up of flood risk, protect against that risk, or prepare for risks if they cannot be prevented or in any other way reduced. All of these measures are now used in the UK, both singly and – more usually - in combination (Defra, 2005), with recent moves away from an over-reliance on engineering measures for flood defence, towards non-structural measures such as spatial planning for flood risk areas (Pardoe *et al.*, 2011), near-universal flood insurance to compensate flood victims for financial losses (Penning-Rowsell and Johnson, 2015), and property level protection promoted where major flood defences are inappropriate or unaffordable. An emphasis recently has been on greater local community involvement in funding such interventions rather than a reliance on government investment (Defra, 2013; Geaves and Penning-Rowsell, 2014; Penning-Rowsell and Johnson, 2015). In this section we also indicate whether these measures are "non-rival", or "non-excludable", following the classic and basic economic definitions of public good as

discussed above. We now give examples where possible of the nature and character of the public good, or variations on public good characteristics as shown in the Flood Risk Management field.

1.3.1. Avoidance of flood risk environments

In the context of Flood Risk Management, spatial planning is designed to restrict the development of "urban" land uses in areas liable to flood risk (or areas contributing to flood risk), on the assumption that this restricts the future build-up of flood damages and reserves space for the river to flood on to its natural floodplain or the sea to encroach landwards in storm and tidal surge events. In the United Kingdom (UK), now devolved to National Governments, this has been the subject of many government guidance Circulars (Tunstall *et al.*, 2004) and, more recently, with a National Planning Policy Framework designed to restrict such development, although there are exceptions. In general, we believe that this has been a successful policy, pursued since 1947, in that the majority of UK's major floodplains have been reserved in this way and no longer appear to be the locus of the most serious damaging flood events (see Chatterton *et al.*, 2010). However, it should also be noted that despite the success of land-use planning, the Adaptation Sub-Committee Report on the number of properties located in areas at risk of flooding and coastal erosion in England (Hopkin *et al.*, 2015) shows a faster rate of incremental urbanisation in flood plains than in comparison to non-flood plains.

We judge that the regulation of the private use of land as a Flood Risk Management measure, with its outputs as described above, is a good example of a classical public good. Land itself is excludable and rival, yet the regulated reservation of land for the river and its flood water are not "used up", and can repeatedly function as a Flood

Risk Management intervention – even if they are privately owned - to store water to protect the community. All parts of the UK have the ability to use the available spatial planning system and its measures to restrict development into floodplain areas, and in that respect the "good" is non-excludable. Although tighter restrictions of development in areas outside of the greenbelt may promote the development of the flood plain in urban areas, as the good of affordable and accessible property is prioritised over the goods provided by space for flood water within an urban area. Moreover, each planning decision is taken on its own merits, and there is always the possibility that future decisions may compromise the reservation of floodplains in the way that is currently intended.

As far as managed realignment is concerned, this is rare in the UK, with the exceptions of some experiments on the coast and in tidal estuaries where nature conservation areas have been created by the withdrawal of dikes or levees, with the objective of shortening the line of defence or not defending areas of rough agricultural land which would not warrant further investment through flood protection measures (Myatt-Bell *et al.*, 2002; Ledoux *et al.*, 2005). Again the resource created – room for the sea - is non-rival, but the provision of realignment can be compromised in future if, for example, sea levels rise such that the newly located dikes are again threatened and risk is increased. Also, in terms of its non-excludability, managed realignment is expensive, and might be restricted to areas of relatively high value, either for human occupation or nature conservation purposes. Thus this measure is not readily available in these locations to all who might benefit from it, making it less of a public good than might otherwise be the case.

In summary, measures which affect the land use, and reserve "room for the rivers" (Rohde *et al.* 2006), are generally public goods (because all at-risk areas can benefit by this room creating flood risk reductions and that facility is not "used up"), and

command widespread and favourable public backing in stakeholder engagement and public participation processes. The spatial planning system in the UK is on the whole supported by the public (Marshall and Glasson, 2007) so that, although decisions may be disputed, the results of planning decisions tend to be uncontested and "stick". Despite this, many authorities if given the choice would permit more construction on flood plains, and as such regulation is necessary. It is the non-excludability character of this particular Flood Risk Management measure that commands support, in that everyone, everywhere, is treated more or less the same. This equality of treatment is what the public in general finds beneficial and therefore supports through its engagement in the decision-making process and its participation in the governance arrangements into which this is embedded. There are exceptions to this, particularly in areas with high land values, where the "escalator effect" means that development follows flood protection, and spatial planning decisions are made on the basis that such areas are "safe" (Parker, 1995); this a process and outcome that the public in general finds disquieting and many Flood Risk Management professionals find profoundly unsatisfactory.

1.3.2. Reduction of hazard probability & magnitude

The second category of Flood Risk Management measures are those designed to protect property and lives from flooding by minimizing the probability and/or magnitude of a flood event. These measures, of course, have been the traditional approach to Flood Risk Management, involving engineering structures, but more recently have been extended to making individual buildings more flood resistant, and with "soft engineering" schemes such as Sustainable Urban Drainage Systems, and beach nourishment at the coast.

The outputs from these Flood Risk Management measures are, again, in general public

goods in that the areas protected can be protected for the lifetime of the measure, assuming maintenance regimes and the replacement of flood defence assets continues, and therefore the benefits are not "used up". As with the lighthouse example, anyone living in the area protected by engineering works or provided with flood resistant housing can benefit from that protection, even if they have not sought it. The whole community can benefit from ring dike embankments surrounding their properties or major investment such as the Thames Barrier or, again in England, from the Jubilee River protecting Maidenhead, Windsor and Eton (Adams *et al.*, 2004). No one is excluded from this benefit if they live within boundaries of the benefit area, re-emphasising the importance of boundaries to the delineation of public goods.

However this again raises the question of the free-rider problem. Those living within the protected area have no choice but to be protected if a scheme is implemented. Yet, in the past those individual beneficiaries also have no incentive to contribute towards its cost or its subsequent maintenance, in the knowledge that others, whether that includes the Government or otherwise, are likely to continue their existing contributions. This, in turn, makes the public participation and engagement process less than ideal, in that those who do not seek to benefit from such works, but will benefit when they are implemented, have little incentive to engage in the promotion of the kind of Flood Risk Management measures that have this character.

The position of these Flood Risk Management measures as a public good can change if flood risk increases. This occurs when the return period of an intervention is reduced, such that a 1-in-100 year flood is re-calibrated, perhaps due to climate change, increased run-off or some other mechanism. The defence standards might decline, and therefore the capacity of those measures to protect the area once protected to a standard that was

perceived as satisfactory will also decline. This means that the 'good' becomes "rival", using the economists' terminology, or it ceases to be of use, and therefore ceases to be non-rival - though it should be noted that the defence still does yield some benefit, even if it is of a lower standard than in original designs. Importantly, this illustrates that there is the potential for a public good to become saturated even if the intervention and public behaviour remains the same. Such situations will need to be identified in order to reduce conflict between stakeholders and amicably revise the social contract in regards to the acceptable, and possible, level of public service provision.

In the case of flood resistant properties, the good provided is private, regardless of any potential positive externalities. The increasing accessibility to devices to protect the public at household level must be considered beneficial, and when taken up illustrates an awareness of the homeowner of flood risk with the increased potential for the spread of awareness through social networks. Yet, the exclusionary nature of this scale of intervention should be recognised in order to prevent property level protection being considered as an equal alternative to community scale interventions.

The cost of property level protection is, on average, some £4922 per domestic property for temporary seals to doorways and the like (Merrett, 2012), with limited state-funded grant schemes available, meaning that the poorest of a community are priced out of this market-led form of flood protection. Such exclusion may be acceptable to a community if there are low levels of altruism or the damage to a citizen's unprotected property is not significant enough to influence the community's ability to function socially or economically. However, reliance upon property level protection as an alternative to other measures fails when we challenge the assumption that a community is merely a conglomeration of properties. We know this assumption is false, and that in order to

function economically, politically, and socially, community assets must be protected in addition to isolated properties, something which is not possible with a sole reliance upon property level protection.

In response to a perceived infringement upon a public good by reliance upon private initiatives, the larger community-level schemes, either fully funded by residents or in partnership with authorities, have been growing in popularity. In effect, these schemes are providing a club good as the benefits are exclusionary by the spatial scale of protection; all residents and property within the boundaries of the intervention are protected regardless of the extent to which they have contributed to the establishment and maintenance of the scheme. For areas where the flood problem occurs at a significantly smaller scale, and within a predictable area, such targeted delivery of a public good can be seen as beneficial. These benefits may be of particular support for low-value properties which would otherwise not attract wider funding.

The growing use of in-community level interventions is one indicator of a pivotal change which is occurring in respect to engineered Flood Risk Management schemes in England. This move devolves and diversifies the sources of capital for Flood Risk Management schemes, and is embodied in the Partnership Funding initiative (Defra, 2013) which encourages, or even requires, local communities to contribute significant capital towards the funding of flood risk reduction measures. Thus, Flood Risk Management policy in England rests on a hinge point where it is unclear whether Flood Risk Management should be delivered as a public good or re-delegated as the private issue of property owners. This lack of clarity in the position of community schemes as a public or private good is further complicated as, for the local community, part of the scheme they are promoting is in fact a private good, paid for by their own contributions, although the

scheme itself provides public goods in that those not contributing can also benefit.

What is apparent, however, is that the Partnership Funding initiative has encouraged public engagement in decisions about all aspects of flood risk reduction, not just funding but also scheme design (Geaves and Penning-Rowsell, 2014). Whether the policy itself initiated the process of public engagement is investigated in more depth in Chapter 4. Yet, current policy does encourage property owners to participate and has utilised the resources of the large number of "flood action groups" keen to have significant influence on the risk reduction policies of the organisations responsible for Flood Risk Management in their area. Previous research has shown that the nature of this engagement varies between "contractual" relationships between these groups and authorities and "cooperative" arrangements whereby these groups work together with the authorities to promote risk reduction in a mutually reinforcing process (Geaves and Penning-Rowsell, 2014). In terms of the degree of engagement, the "cooperative" initiatives maximize this participation, whereas the "contractual" arrangements tended to focus on initial processes of interaction in order to secure their contract, followed by a less engaged process of monitoring progress by the Flood Risk Management authority rather than active participation in scheme implementation.

In summary, physical measures to protect lives and property vary in their categorization as public goods. Interestingly, Partnership Funding has meant that many Flood Risk Management schemes, previously considered as 'pure' public goods, are now "club goods", made excludable by their geographic scale and by the distribution of culpability for their implementation and maintenance across a region. The trend of large-scale, capital intensive schemes increasingly displaying traits of "club goods" is exacerbated as those areas with the pre-existing resources to form pressure groups to rally for the

funds for defences draw disproportionate attention to their cause. Whereas, in deprived areas, in circumstances where there is a demand for flood defences, often there is not the knowledge of local governance processes or contacts to facilitate access to appropriate resources (Geaves and Penning Rowsell, 2014). Household and community level protection, though falling under the bracket of "private goods" and "club goods", increasingly offer a fair (Johnson *et al.*, 2007) alternative to earlier Flood Risk Management strategies. However, yet again, the access to these resources is constrained by the availability of funds. As such, Flood Risk Management increasingly witnesses the semi-privatization of previously considered "public goods", with this privatization reflecting the limited distribution of benefits across society.

1.3.3. Improvements to public preparedness

In the last several decades there has been much greater emphasis within Flood Risk Management to ensure that citizens are aware of the flood risk they may face, to warn them of events before they strike, and to enhance recovery after hazardous and damaging floods.

This is in part in recognition of the fact that we cannot protect ourselves by engineering works to an infinite design standard, and that there will be residual flooding which may become increasingly unpredictable in its geographic distribution and timing. The latter applies particularly to what is now in the UK termed "surface water flooding" (Pitt, 2008) which has a pattern related to individual localised pluvial/rainstorm events, the geography of which is determined by fine-scale local conditions. Although the UK now has flood risk maps[3] for this "surface water flooding" they show that the locations of

[3]Flood Maps have been published on the web by the Environment Agency since 2004, though indicative

such events are widespread, small in scale, and related to relatively small low-lying areas where rainwater can accumulate. These areas are not nearly as predictable as the large floodplains of England's major rivers, and hence it is even more important that the public is aware that they may be at risk wherever they may live.

The types of preparedness measures are numerous and generally are "non-rival" in that they theoretically cannot be used up: the risk awareness raising through public education, or the flood warning available to one member of a flood risk community, are both equally still available to others, and both considered to be 'pure' public goods (Samuelson, 1954). Generally, flood forecasts and warnings are provided for the whole population, and no one is excluded. Yet, the form of flooding does pose some excludability issues, as forecasting and warning are not effective for surface water flooding. The same non-rivalry applies to emergency response, where the efforts involved generally do not discriminate between different parts of the population but embrace interventions that are designed to help everyone. This is partly because these services are almost universally provided by the state, rather than by private enterprise, but also because emergency services generally are available free of charge for the whole population at risk (e.g. fire; police; ambulances), not just those who will benefit most from such measures.

However, in exceptional circumstances rivalry can occur within the provision of emergency services. When demand for these goods overwhelms the resources available, for that moment in time the "capacity" (Karlsson, 2008, p.103) to deliver that public good is reached. A further limitation to defining preparedness measures as 'pure' public goods is the accessibility to the media by which information is distributed concerning flood events and general flood awareness education. Of note here are the results of the Ox-

floodplain maps were developed by the National Rivers Authority since 1994.

ford Internet Survey Report (Dutton *et al.*, 2013) which showed that almost 100 per cent of those in the UK with high incomes used the internet, while only 58 per cent of the population classed as poor had access. These vulnerable sectors of society are restricted from benefiting from the full range of flood forecasting and warning options. The information may be available through public hubs, such as libraries, but such individuals may not have the knowledge, awareness or timely access to fully exploit these resources. In essence, preparedness measures are almost universally public goods, but can become rival if demand exceeds infrastructural capacity, or excludable if access is limited by an inability to connect with mainstream modes of media, such as the internet. This can lead to lower than desirable levels of participation in the take-up of these measures and their associated benefits.

The character of preparedness measures as public goods can also reduce public participation and understanding. For example, even though flood forecasting and warning systems are received by members of the public, they are poorly understood with little engagement in their delivery outside research institutions, professional bodies, and those communities which frequently need to manage flooding and therefore have maximum awareness levels. Generally the public has nevertheless come to react favorably to flood warnings but the exception comes where the service is deemed to have "failed" those affected, for example when warning systems deliver messages after the flood event has occurred; then there is a public disquiet. Meanwhile the public's general level of engagement in the proactive design of such systems, for example by helping to tailor the Environment Agency's arrangements to match local circumstances, remains rudimentary.

1.3.4. Encouragement of household loss mitigation

As with preparedness measures, loss mitigation is able to provide a final level of protection in the eventuality that other Flood Risk Management measures fail. Insurance is traditionally used to deliver manageable losses by distributing the costs of potential damage over time with the addition of transaction costs. The UK's insurance industry is the largest in Europe (ABI, 2012), with the function of insurance surpassing that of distributing losses over time; insurance is used to promote a stable economic environment for investment and development (Kunreuther and Pauly, 2014), and to deliver an efficient scale of management (Hayek, 1945) to overcome losses which cannot be prevented. The latter is of particular concern in England with 35,000 homes being at risk from surface water flooding, and 1.6 million properties at risk from groundwater flooding (ABI, 2015), with neither of these risks being easily manageable by large-scale structural defences. As such, insurance should not only be considered as a method of distributing losses over time, but also as a household level, nationwide flood mitigation strategy. Yet, there are a number of characteristics of insurance policies and pools which makes widespread availability and accessibility difficult to achieve.

Insurance policies are excludable by price – if someone cannot afford insurance they cannot purchase insurance – and rivalry exists within the insurance pool in the case too many claims are received simultaneously. For insurers, the latter is of concern with a £3 billion of payouts made by insurers in 2007 for 185,000 flood damage claims (ABI, 2015). This unusual quantity of simultaneous claims was dealt with effectively by insurance companies (Pitt, 2008), but has increased concern that insurers are being asked to take on risky clients whose claims are typically conglomerate due to the nature of flooding, increasing the risk of potential insolvency. Such a concern is only set to

rise for insurance companies in January 2016 with the implementation of Solvency II; a Directive which is aimed at informing the amount of capital that EU insurance companies must hold to reduce the risk of insolvency (Persaud, 2015). In partnership with the UK Government, the solution has been to create an insurance pool which is cross-subsidized by low flood risk policyholders, and in the case that claims exceed a certain level of flood event, money is withdrawn from this pool, with responsibility of flood events larger than that of a 1 in 200 year event being placed on central government.

For householders, and the State which represents them, excludability as a result of high insurance costs is of great concern (ABI, 2015). Frequently, policyholders who have been flooded have seen their premiums rise to five figure sums with excesses to match. This is of particular detriment to both mortgage providers and purchasers who often have no choice but to purchase insurance as part of their mortgage agreement. As such, there is significant pressure from these stakeholders for an agreement between the State and insurers to transform insurance into a non-excludable, non-rival good – at least until infrastructure can be put in place to reduce risk, and, resultantly, lower premiums

However, the development of an insurance scheme has been convoluted by an inefficient insurance market, leading to a lack of public engagement in the industry. In England, flood insurance is available from private insurance companies and everyone in the UK can buy from insurance companies the requisite flood cover for their properties, designed to compensate them for the flood losses that they might incur, and to speed recovery after any event from which they might suffer. But consumers purchase the insurance uncritically, with little concern or awareness of any cross-subsidies to which they may be contributing; a trend exacerbated by the fact that flood insurance is bundled in general household insurance policies.

Through a series of agreements between insurance companies and the UK government, there has been a tradition since the 1960s of cross-subsidizing those most at risk by those who suffer almost no risk, so that insurance premiums for those at risk remained artificially low. The evolution of this arrangement has been minimal over the last 50 years (Penning-Rowsell *et al.*, 2014) owing to the coincidence of interests between the UK government and the insurance industry designed to support the role of the private sector and reduce the extent of emergency funds released by local government in order to prevent social blight caused by inability of private property holders to pay for flood damages.

The cross-subsidy from those at low or non-existent risk to those within the flood risk areas has been formalized through the creation of an insurance "pool" termed Flood-Re (Defra, 2013). Flood-Re is the outcome of considerable and consistent pressure placed upon UK government by householders to ensure that the current situation of low insurance premiums continues, although these are insufficient in reality to cover the compensation claims made by those suffering flood damages. Everyone who is at risk will have affordable access to this pool and the cross subsidy ensures the pool will not become rival, and, in that respect, Flood-Re provides a public good. Strenuous efforts have been made to ensure that the pool is sufficient to cover all eventualities, such that its resources will not reach capacity and become rival in nature. The government will, however, be the insurer in last resort, but with their liability only triggered by very serious flooding, with a return period of greater than 200 years (i.e. this is the average interval between events of this magnitude). Thus, in defining insurance as either a public or private good, the insurance policy itself should be considered as private, but affordability of insurance should be considered as a public good as it redefines insurance as accessible

(i.e. non-excludable), in addition to its pre-existing attributes of non-rivalry.

In some respects the cross-subsidy of insurance premiums will make stakeholder engagement and public participation less likely. The process of engagement will be opaque and those claiming from the Flood-Re pool will not even know that they are doing so; simply they will be aware that their claims are being met. The incentive for citizens to invest time or capital in self-help is minimized as the reduced cost of insurance premiums means that other interventions, which may require investigation and lead to increased awareness, are overlooked or considered nonviable or unnecessary. By reducing awareness and stimulus to take responsibility for flooding, Flood-Re can be seen as running counter to the participatory form of Flood Risk Management which current policy promotes. Despite this, the public involvement that there has been in the creation of Flood-Re would indicate that the subsidy is strongly supported, even by those providing the cross-subsidy, regardless of implications for sustainability. What can be seen from this conflict of awareness and financial well-being, is that Flood Risk Management can provide more than one form of public good; however, those goods may not be complementary to one another as both cannot be delivered simultaneously within current frameworks of management.

1.4. Conclusions

In this introduction we have shown that the benefits provided by Flood Risk Management are generally to be categorised as public goods, as defined in classical economic analysis. This is because these goods are often freely available to the populations affected (no one is excluded) and/or because they are not "used up" or consumed by those who benefit

from them. However, exceptions exist, which we have highlighted, with a general trend in Flood Risk Management, in England at least, towards providing some of Flood Risk Management goods as private or "club" goods (e.g. locally funded small-scale Flood Risk Management schemes) through the intervention of individuals and local communities. This is partly because government wants less active involvement in this area, and partly because many communities and professionals see the value of local involvement in Flood Risk Management measures, in order to attract "buy in" through a process of engagement by those who benefit in the provision of the relevant infrastructure and the favourable environments that this can provide.

The next stage of this thesis shall examine how the treatment of flood risk management goods as either public, private, common or club leads to the emergence and forms of public participation in flood risk management. We look at the priorities of the public, what the public wish to gain from their involvement in flood risk management, and how those motivations influence the forms of flood risk management interventions prioritised and the distribution of benefits interventions provide.

1.5. Research Objectives

The literature review highlights a number of issues regarding the future management of flood risk. We have seen that there are many possible interpretations of excludability and rivalry when assessing the distribution and access to benefits provided by interventions. We have introduced the schemes which seek to challenge these existing perceptions of the excludability and rivalry of interventions. In the case of Partnership Funding, this has been achieved through re-delegating costs of interventions to align them with their

beneficiaries, while under Flood Re access to affordable insurance has been increased through placing an appropriate cap on the maximum price of flood insurance premiums. Finally, we have highlighted the importance of public engagement in facilitating the efficient functioning of these scheme, but also identified the challenges that this public integration might pose. In light of these issues, the remainder of this thesis seeks to understand:

- The relationship between the public and England's flood risk management strategy;
- The public's priorities in relation to the provision of flood risk management goods, the motivations behind those priorities, and the mechanisms through which these priorities are communicated;
- The extent to which the public's priorities influence flood risk management service provision, and, to date, the policies which have been implemented as a result of public pressure;
- The tools which have been used to deliver flood risk management policies, and how these tools seek to adjust the characteristics of excludability and rivalry of flood risk management goods; and
- The extent to which these tools are efficient and equitable in achieving their aims, and to identify any gaps in flood risk management service provision as a whole.

The overall objective is to understand whether revised perceptions of the excludability and rivalry of goods provided by Flood Risk Management interventions sustainably align with the scales and intricacies of flood issues, the extent to which public behaviour will have to change in response to these transitions in Flood Risk Management, and whether such a change in public behaviour is feasible.

1.6. Research Contributions

This thesis has contributed to a school of thought which correlates the success of flood risk management policy and interventions with the social feasibility of policy design and implementation. To demonstrate the significance of social feasibility, I have analysed flood risk management interventions in the framework of 'public goods' and then contrasted these to the priorities of the public. I have asked the public whether they were willing to contribute to the provision of flood risk management interventions outside of taxation and the mechanisms through which they can, and would like to, access necessary flood risk management services beyond those provided by the State. Most significantly, however, I have developed a series of agent-based models to test the social feasibility of options by comparing how agents should act to how agents will act once observed behaviours are integrated into simulations. In regards to the latter, such an incorporation had not been previously attempted at the time of writing this thesis, and, though the model in its current state can only be considered as a prototype, the opportunities that its development opens up provide a valuable contribution to the academic field and, through its focus on social feasibility (which implicitly caters to adaptation over time), could be used to assist the development of policy which is able to remain relevant despite adapting populations and changing climate.

Framing flood risk management within the rhetoric of 'public goods'

In regards to the first of these contributions, the approach of this thesis which framed flood risk management interventions in the language of public goods highlighted the sources of conflict which emerge when determining responsibility for service provision. In academic fields, flood defences are frequently assumed to provide a public good, yet

such a lack of debate has led to problems in the provision of flood defences -- namely that flood risk management projects which did not meet the required cost-benefit ratio had limited, if any, mechanisms to ensure their protection at the community scale. Thus State acceptance (indicated through the implementation of a new funding strategy for flood defence) that a good can have multiple and dynamic interpretations is beneficial as such recognition allows for innovative solutions to be developed to enable citizens previously excluded to gain access to services through public-private partnerships.

The framing as public goods also allowed for an innovative analysis of the benefits of Flood Re and Partnership Funding. Typically the support for a new flood risk management scheme would be assessed on whether an intervention met a predetermined cost-benefit ratio: here I assess Flood Re in terms of the extent to which the policy reduces excludability and rivalry of access to affordable insurance and, importantly, how this varies across society. Excludability and rivalry determine whether goods can be considered as 'public' or otherwise, and therefore their measurement provides a fundamentally different approach to assessing whether public finances are being spent effectively and the mechanisms through which interventions can by financed proportionately to their beneficiaries. From the results of this thesis, which demonstrate that cost-benefit analysis can lead to perverse outcomes as their very nature means that protection of more valuable assets leads to a more favourable cost-benefit ratio, measuring the excludability and rivalry of a scheme can enable a more equitable and efficient judgement to be made and for a more appropriate redistribution of funds from both public and private sources. Thus, by the end of this thesis, a key contribution is the assessment of the benefits of flood risk management intervention derived from its characteristics as a public good, rather than its ability to return a certain value in proportion to the capital invested.

A theoretical explanation of why public involvement does not always lead to required outcomes

The next major contribution of this work is an improved understanding of why some interventions were more socially feasible in some communities than others. Much of this variation was due to the predominant form of social interaction between the public and the State within these communities. I identified two main relationship structures; contractual and cooperative. Hobbes' Leviathan (1651) documents the existence of a 'contractual' relationship between authorities and the public, and numerous authors use these concepts to explain social phenomena, with these also being applied to flood risk management (see Adger *et al.* 2013). The other model applied within this thesis was a cooperative model of interaction, which was inspired by activities similar to those described in Anthony Giddens 'Third Way' (2013). The contribution of this work was to identify that both models coexisted simultaneously and that different modes of social order were beneficial in different scenarios, specifically cooperative approaches were more constructive in complex flood environments, whereas simple flood issues (e.g. burst pipes or drainage) were effectively mitigated with contractual approaches. Where contractual approaches were applied to complex flood issues, there were high levels of conflict between authorities and the public, and only the hazard aspects of the flood issue were overcome leaving the public vulnerable to future events. These contributions are of importance as identifying what relationship between the public and authorities exists within a community can help explain why public participation can cause conflict, and how influencing the model of social order within a community can lead to increased community flood resilience.

A series of agent-based models to test the social feasibility of household flood risk management options

The final contribution of this thesis was the development of a series of agent-based models which tested the social feasibility of options by comparing how agents should act to how agents will act once observed behaviours are integrated into simulations. The design and implementation of such a model, to the author's knowledge, had never been previously attempted with multiple contributions to academic theory which have been drawn from the agent-based model's development. These contributions are documented in Table 1.2, with the most significant of these the design of adaptable reference points from which agents weigh their decisions.

1.7. Overview of the Thesis

Flood Risk Management in England is an umbrella term for the multiple approaches aimed at reducing flood probability and magnitude, and minimizing public vulnerability. This thesis first identifies and investigates which of these flood risk management approaches are priorities for the public (Chapter 4), and then takes two flood risk management interventions which are in some way dependent upon public involvement – Partnership Funding (Chapter 5) and Flood Re (Chapter 6) – to investigate how each scheme aims to mitigate flood risk, how this transforms the distribution of benefits provided by flood risk mitigation efforts, and the extent to which the success of these schemes depends on a change in public behaviour. Chapter 7 brings together all of these results to understand the extent to which changes in perception of the distribution of benefits encourages sustainability and equality of access to the benefits provided by

Contributions	Method	Implications
Development of a set of agent-based models to test social feasibility of flood risk management options.	The agent-based model developed utilized behaviour observed by, and incorporated into, Kahneman and Tversky's (1979; 1992) Prospect Theory model, and compared model outputs to a model where agents maximize expected utility within their budget.	Social feasibility is indicated by the difference between outputs from the Expected Utility model and the model which integrated behaviour. Being able to model social feasibility adds a new dimension to analysis of the costs and benefits of flood risk management interventions.
The integration of elements of Prospect Theory into an agent-based model.	Developed a model which is not a 'Prospect Theory model' (i.e. it is not used to explain observed outcomes which run counter to expected utility), but instead a model which adapts elements of Prospect Theory within an agent-based model to develop a tool for theorising outcomes of observed behaviour. The adaptation of Prospect Theory for the purposes of this study required the addition of variable reference points and a selection stage following the editing and evaluation stages.	Prospect Theory has not been previously adapted to be used as a tool for decision making. Despite this, Kahneman (2002) has always sought for his models to have an impact upon real world decision making, using his ideologies to inform interview techniques and meeting structures. The adaptation of Prospect Theory within this thesis, though significantly different to its intended use, implies that Prospect Theory can be used to influence real world decision making.
i. Variable reference points	The model incorporated variable reference points which agents could switch between depending upon their preferences within one model simulation. A key element of Prospect Theory is its editing phase where a reference point is chosen from which people weigh their outcome. I noticed people changed the way they made decisions (and their associated reference points) following catalytic flood events or incremental insurance premium rises, and so developed a method so agents could adapt their reference points over time in response to catalytic and incremental changes.	Despite that a change in consumer behaviour and preferences in the immediate aftermath of a flood event is well documented (see Johnson *et al.*, 2005) this behaviour change had never been incorporated into models. Allowing agents to modify the way they make their decisions in response to catalytic and incremental changes is important to test the social feasibility of introducing new flood risk management options, such as insurance, property level protection, and community flood defence measures.
ii. Selection stage	A final 'selection' stage was added to the structure of the model after the editing and evaluation stages inspired by Kahneman and Tversky's Prospect Theory.	A selection stage allows analysts to distinguish between agents preferred courses of action and the course of action an agent has to take due to restraining parameters.
An addition to cost-benefit analysis which can be used to support analysis of the equity and effiiency of Partnership Funding and Flood Re.	By measuring exludability and rivallry of goods, and then identifying variance of these across the population, I identify whether there are other mechanisms through which a good could be provided outside of the State. Previous financing mechanisms within flood risk management have instead only provided a good if benefits are above a certain threshold (with weightings for deprived areas included).	The approach of testing the excludability and rivallry of a good supports analysis of Partnership Funding as groups within a community who could not afford to contribute beyond taxation can be identified and supported. Analysis of Flood Re is supported as it is possible to hypothesize the impact of caps upon different Council Tax Bands.

Table 1.2.: Research contributions from the development of an agent-based model to hypothesize the social feasibility of household flood risk management options. Limitations of these methods and contributions are identified and explained in Chapter 3 Section 5.1.2

Flood Risk Management service provision. In light of results I assess if public pressure is beneficial for society, and whether the management of flood risk should be left to market forces or treated as a market failure.

The two policy instruments under examination, Flood Re and Partnership Funding, were at different stages of implementation at the time of writing this thesis, with Partnership Funding having already been rolled out across England, whereas Flood Re was still in it's planning stages. Therefore, different approaches were taken for each chapter, with the Partnership Funding Chapter examining how service provision has and might transform as a result of the scheme's implementation, whereas the Flood Re chapter uses computer-based experiments to hypothesize how Flood Re may make the purchase of insurance and / or property level protection a more or less attractive investment. In the case of the former, the interview data presented in Chapter 4 supplements the statistical analysis in Chapter 5. In the latter, the interview data in Chapter 4 is used to inform the reference points from which consumers weigh the value of their investments, the results of which are presented in Chapter 6. Due to the differences in the purpose and structure of Flood Risk Management interventions discussed, each of these results chapters have their own introduction, literature review, and discussion, as well as including the relevant results section.

In regards to the order of investigation, the main body of interviews were carried out in 2012, however, these were supplemented by additional interviews in 2013, 2014, and 2015. Chapter 4 was completed at the end of 2014, with additions made in 2015 due to new data becoming available. I began developing the model in Chapter 5 in 2013, initially developing a two-dimensional model. However, the level of complexity of this model made it black box, and it was difficult to understand how inputs led to outputs, as

such, in early 2015 I developed a final, much simpler model which transparently fulfilled the aims of this thesis, but gave outputs for an artificial stylized environment, rather than known locations.

Chapter 2

Methods I: Qualitative Approaches Chapter 2 introduces the methods used to inform Chapter 4 and Chapter 5 of this thesis. The first section provides the methodology used to understand the form of public engagement in flood risk management today. For this the primary source of information includes interviews with the public who live in flood risk areas, regardless of that flood risk having been realised. The second section of the chapter applies this data in order to understand if the public would support Partnership Funding by making financial contributions to Flood Risk Management outside of taxation. Supporting the public's views of the Partnership Funding scheme is an analysis of the change in planned Flood Risk Management projects between 2012 and 2015. By the end of the Chapter, the reader should be fully aware of the methods used, and the justification for those approaches.

Chapter 3

Methods II: Quantitative Approaches This chapter develops the methodology for testing the efficiency and equity of Flood Re (results presented in Chapter 6), which is a government intervention in England that seeks to make flood insurance more widely affordable through application of subsidies and pricing signals. The scheme has not yet been implemented and, therefore, this chapter develops methods to hypothesize Flood

Re's potential impacts upon the desirability of investing in insurance and / or property level protection. The attractiveness of an investment is informed by two measures; the Expected Monetary Value, and the Prospect Theory Value. The Expected Monetary Value uses probability of damage and costs associated with purchasing options to price the gamble of investment. Prospect Theory also uses probability and costs associated with purchasing options but adds a weighting to these, which is informed by observations of public behaviour, in order to calculate how that gamble feels to the potential investor. These two measures of the attractiveness of an investment are modeled in an agent-based model, which has the benefit of being able to run societies with agents possessing a range of behaviours, and for those agents to keep a memory which updates itself over time according to the agent's experiences.

Chapter 4

Public Participation: The Foundations of Change This chapter explores the role of civic engagement in Flood Risk Management, and the factors which have led to the emergence of 'flood action groups'. Within the emergent groups, I identify two broad categories of relationship between the public and authorities. The first displays 'contractual' characteristics: a level of protection provided by the authority in exchange for taxes or similar support. The second embodies a 'collaborative' relationship: public knowledge, social and financial resources are equal and complementary to those of authority, and seeking 'collective security'. In general, the latter were more successful than the former due to an increased awareness of flood risk, the longevity of that awareness within a community, and the improved ability for the public and Local Authorities to collaborate to improve other community issues. Common lessons were learned in that success in

Flood Risk Management should not be defined purely as the ability to prevent flooding, but as the ability to access a variety of resources across different levels of society at different stages of Flood Risk Management.

Chapter 5

Partnership Funding: Community contributions to hazard reduction A move to encourage Partnership Funding of Flood Risk Management has resulted in current Flood Risk Management measures providing both public, club and private benefits. Yet, the scales of service delivery associated with different goods are likely to influence the form and extent of public participation in Flood Risk Management. In this chapter, I test the extent to which planned projects in England reflect the transition of flood defences from public goods to public, private and club goods. I then seek to test public acceptance of Partnership Funding and associated expectations for public contribution outside of taxation by presenting results of interviews with communities who have been part of the Partnership Funding scheme. Areas which had been approached by the Environment Agency to contribute funds had accepted their revised responsibility. However, when posed with a hypothetical question of contribution the majority of groups said that their communities would not consider a request for contributions outside of taxation as acceptable.

Chapter 6

Flood Re: Household management of flood losses This chapter investigates Flood Re, which is a government intervention in England that seeks to make flood in-

surance more widely affordable through the application of subsidies and pricing signals. The aim of this chapter is to test the efficiency and equity of Flood Re in comparison to other insurance pricing structures when known public behavior traits are internalized within an inter-temporal choice, weighted-value model. Applying prospect theory (described in Chapter 3), householders make decisions on whether to purchase insurance and / or property level protection, or nothing informed by multiple reference points which influence the value of prospects, and weighted probabilities which are sensitive to past experiences of flood events and display preference towards certain outcomes. Model outputs were categorized by Council Tax Band (a measure of house price commonly used as an indicator of wealth in the UK) in order to understand both the magnitude and distribution of benefits. Results indicate that Flood Re only marginally increases the demand for insurance, that the distribution of benefits are weighted towards more wealthy sectors of the population, but also that if the cap is set to an appropriate level householders will begin, and continue, to purchase insurance even after the adjustments of insurance pricing seize. We recommend that in order to achieve the aim of making insurance more widely affordable a cap determined by an arbitrary indicator of wealth is inefficient and inequitable, and suggest that a local authority insurance scheme should be developed to cater for those who currently cannot afford insurance.

Chapter 7

Discussion: Government ideals and Flood Risk Management Strategies The discussion chapter examines the extent to which public priorities should drive the provision of Flood Risk Management goods, and the impact this may have upon equality of access to flood risk reduction measures. I address the linkages between two seem-

ingly disparate policies, specifically addressing how Partnership Funding may foster an environment which increases residual risk for householders, and, bearing in mind access to household measures for flood mitigation presented in Chapter 6, the weight of the associated costs for different sectors of society. With this move to increase responsibility for flood risk at a household level, I seek to understand whether civic engagement can co-exist with individualism, and in doing so address the sustainability of different Flood Risk Management schemes which require the involvement of the public to succeed.

Chapter 8

Conclusions The final chapter concisely answers the leading questions of this thesis; should Flood Risk Management be treated as a public good, and do schemes which involve the public support the delivery of a change in responsibility for service provision? I summarize that flood defences are increasingly moving towards being considered as club goods, and that due to the benefits a community receives and the differential ability of community members to protect themselves, a community approach to Flood Risk Management is highly beneficial. Partnership Funding for the time being appears a good tool to implement this transition. However, these benefits could be undermined by the transfer of residual risk as projects seek to cost cut, an increased frequency of large-scale flooding, and an application of the scheme to locations where community networks do not align with the scale of the flood issue. In regards to loss mitigation, which is increasingly becoming the realm of the householder I contest that, despite Flood Re being of benefit to those who have to buy insurance for mortgage purposes, more needs to be done to support those who would struggle to recover the loss. I contend that the scale of Flood Re does not truly represent the impacts which a flood can have

upon a household, and that more must be done to assist the recovery of flood victims.

2. Methods Part I: Qualitative approaches

2.1. Summary of Tools and Methods

The overall methodology for this thesis utilises a case study approach. Data is derived from interviews and official publications, which are then analysed using textual analysis software (TAMS), systems analysis software (Vensim), Microsoft Excel, Geographic Information Systems (ArcMap), and agent based simulation (TerraMe). A similar methodological approach has been investigated and applied by Boman and Holm (Olsson, 2005) in Sweden who discuss the usage of agent based modeling to analyse spatially constrained social behaviour such as those seen in flood systems.

Below is a summary of the methods used. These are justified and explored in more detail in later in this chapter, with the purpose of them listed below to provide a quick overview for the reader.

2.1.1. Data Collection

Contextual data: Background information on the political, socio-economic and environmental characteristics for each case study and flood risk management intervention was collected in a systematic manner to allow results to be analysed in their wider context.

Geospatial vector data (shapefiles): In Chapter 5, secondary documentation informed the main body of analysis as Regional Flood and Coastal Management Programme for projects (RFCMPs) were imported into GIS to analyse spatial distribution of contributions and benefits of planned flood risk management projects. Shapefile attributes tables were developed and modified using additional data from the Office of National Statistics, and flood risk management Project Appraisal Reports. As such, the RFCMPs analysed in ArcMap had additional information to the form in which they were originally provided.

Interviews: Interviews of community groups, certified-experts and planners were collected. There were three main uses for the interviews; to understand how public activities both drive and respond to changing flood risk management policy, to support outputs of data analysis, and to inform the structure of the agent-based model.

2.1.2. Data Processing

Coding in TAMS: Documents and interview transcripts were entered into a database and coded using detailed qualitative coding. Syntactic coding was used to allow for flexibility and comparability.

Code standardization in TAMS: Codes entered to the database were organised in a hierarchical code-tree to allow analysis at different levels of generality.

2.1.3. Data Analysis

Systems Analysis in Vensim (Conceptual modeling): The aim of using Vensim was to allow clear structuring of thought in order to develop a logical and streamlined agent-based model for assessing insurance demand under Flood Re.

Visual Analysis in ArcMap (Geographic Information Systems): The data from the RFCMPs were presented visually in order to identify any spatial relationship between variable. Graphs were also created in ArcMap using data from the shape-files. The maps were used to understand whether Partnership Funding had increased the number of flood defence projects and the extent to which the distribution of flood defences was equitable over different sectors of society.

Statistical Analysis (Microsoft Excel): Data was analysed in Microsoft Excel for two different purposes. The first was to analyse the data in the RFCMPs and to easily develop a database of parishes and flood risk management project which were then upload into the RFCMP shapefiles for analysis in ArcMap. The second use was to analyse the outputs of the Agent-based Model runs which were exported from the model as .csv files, and then imported into Excel. This allowed me to first identify errors in my initial model development, and then analyse the results of the model.

Behavioural Analysis in TerraME (Agent based modeling): Behaviour identified in interviews was used to inform the range of potential behaviour of agents within the

agent-based model. TerraMe is an agent-based modeling platform designed specifically for modeling nature-society interactions (Carneiro, 2013). The model was used to understand the extent to which different insurance pricing under Flood Re would influence the uptake and distribution of insurance demand, and, thus, allow me to investigate the feasibility of using insurance as a nation-wide, household level flood risk management strategy.

2.2. Understanding public influence in Flood Risk Management

The first aim of the methodology is to understand the catalysts and contexts which lead to public participation in flood risk management. The second aim is to define the roles the public perceive they should adopt when becoming involved in flood risk management and the motivations behind these roles, and the third aim is to assess how those motivations and associated activities influence the flood risk management goods and services provided by the State.

Through preliminary studies, it was decided that the best approach would be through collection and analysis of qualitative data. The use of qualitative data enabled results which would not have fitted into any one category of 'action group', 'resilience', 'recovery' or 'preparedness'. This open ended technique required a highly labor intensive period of sifting through data, but meant that new insights into the role of the public in flood risk management could be identified.

Qualitative research provides both the opportunity and the risk of having its roots spread across "a wide range of intellectual and disciplinary traditions" (Mason, 1996, p.3). As

such, qualitative data can be highly opinionated with the results potentially indicating more the mindset of the interviewer and / or interviewee, than the reality. However, it is in this space between reality and opinion that previously unobserved patterns emerge. To make use of these patterns the boundary between fact and opinion must be accurately identified, and, as such, all facts and figures discussed in interviews were compared against the 'official' data where possible. This comparison, when dealing with ideas of the 'unexpected' and concepts of 'memory', gave another angle to the data collected and provided a good indication of how accurate interviewees were.

Semi-structured interviews are a recognised method of gathering information (Longhurst, 2010). Interviews can be a dominant source of data for informing analysis, and in this thesis interviews are used for that purpose as well as to supplement the data collected from publications and inform model development. Interviews are chosen as, especially in relation to community-scale flood risk management interventions, many flood group approaches to Flood Risk Management are not documented in either official or unofficial publications. Despite the lack of documentation in regards to the scales of Flood Risk Management activities applied by communities, this group of stakeholders are particularly important as they are increasingly used as a social and financial resource by Government to fill the gap in Flood Risk Management provision caused by reduction in real funding, pressure from development, and uncertainties in timing and intensity of rainfall as a result of climate change.

2.2.1. Data Sources: Semi-structured interviews

Determining the best methods to extract information from the public

The structure of interviews were informed by three types of preliminary testing. The first involved casual discussions with residents of flood risk areas, fellow researchers and practitioners in the field of flood risk management. The second, took the form of undercover investigations during which I attended local flood group meetings as an unknown impartial observer. The final approach of developing interview approaches was through designated 'practice interviews' in which interviewees were informed that they were guinea-pigs for the development of a future questionnaire and encouraged to provide feedback on how the interviews could be designed to make the most of the time available.

In all cases, respondents were asked whether they could be quoted. As such, where possible real names both of places and people were used, though anonymity was provided when requested, which was often the case when respondents quoted people they knew. Along with this, a number of respondents who had continued to contact me after initial interviews were asked for to provide feedback on ideas and concepts I had derived from the interviews, which had the added benefit of contributing debate to the results and clarify any misinterpretations.

An example of the methods tested include (1) asking respondents to fill in a timeline of their experiences with flooding; marking what they had learned, and when and how interactions with other stakeholders had developed, (2) testing the outcome of more rigid question structure, but found these to lead the respondent more than was justifiable, and (3), the approach chosen, adopting a conversational approach with a structure of

topics which it was necessary to cover.

The final approach yielded the richest information and utilised empathic neutrality, i.e. "with judgement showing openness, sensitivity, aspect awareness and responsiveness." (Denzin *et al.*, 2000) Interviewees were most vocal when they perceived the interviewer as knowledgeable of both Flood Risk Management and other communities which had been impacted by flooding and may be comparable to their situation. Interviewees wanted to know that their methods of dealing with risk would be shared and benefit other areas at risk from flooding. The open, conversational approach meant that interviewees were willing to embark upon follow up interviews, and often volunteered themselves and their own contacts to assist more.

Deciding who to interview

A hierarchical approach was applied in the selection of samples. This method is often applied when there is a large population of samples. For example, at the time of writing there were over 250 flood groups in the UK, and even more areas where there were public activities relating to flooding. Initially, I contacted all flood groups registered as existing by the National Floods Forum (NFF). The sample was then reduced as a result of accessibility in that only 10 per cent of the original sample agreed to be interviewed. Thus, in this way, my results were limited to accessibility samples.

Valentine (2005) describes how for qualitative research it is not necessary to choose a random or representative sample, and that "the aim of the interview is not to be representative (a common but mistaken criticism of this technique) but to understand how individual people experience and make sense of their own lives." (p.111). Thus, recruitment of participants was achieved by 'cold calling' via email groups (both related

to flooding and not related to flooding) in areas at flood risk. These groups were originally contacted via circa 250 personalised e-mails and, in part, by using cached (i.e. out of date) web pages as many of the groups' details were no longer publicly available: this also allowed us to identify defunct or disbanded groups. Around 100 groups were identified with 24 groups agreeing to be interviewed. Both current and past members were interviewed both in their groups and as single representatives, and both in areas which had established flood groups, and those which did not: here we contacted local residents who, from extensive analysis of blogs and newspaper reports, appeared to have influence in the area.

From the sample of 25 case study areas (see Appendix A for a full list), a stratified sampling technique was applied. The sample size provided a representation of wards in large industrial cities in England, parishes of medium sized cities and towns, market towns and small rural villages. In regards to the distribution of samples, these were not limited by access in quantity of sample size, but to some extent were limited in access in regards to interview type. For example, all areas were initially interviewed over phone, and if more information was subsequently needed, then a face-to-face interview in the location would take place. However, some areas were rural, far from any main centres and without bus routes. As I have no form of private transport I was unable to reach these areas. This did not substantially limit the outcomes of interviews, but did limit the number of interviews per area, as during visits I would often have interviews with multiple stakeholders.

The questions were semi structured in order to gain the respondents opinions on the flood risk management intervention, and to allow for collection of information which may not be obvious to ask. Prior to the interviews a schedule of questions was developed, starting

with questions which built trust and allowed the respondents to warm up; a technique advised in Kitzinger (1994). A schedule of questions meant that trust building question could be asked first, followed by questions which participants might find more sensitive, especially if they believe that politics or other people in the community were responsible for negatively influencing the outcome of flood risk management intervention.

The location of the interviews was determined by the individuals or groups as this meant that the respondents were more comfortable and could express themselves in a way that was best for them. As an interviewer I had to make my approach flexible to unexpected progressions in the interviews (especially face-to-face interviews), and at the same time be aware of my own safety. For example, one focus group took me for a walk up and down the river, taking me to the houses of local residents. Especially in the case of visiting the houses of unplanned residents, I did not enter the home in order to ensure my own safety and the comfort of the resident. Other respondents wished to meet in the local town hall, their homes, or by the river. At no point during the interviews were the respondent or I unsupervised, and at all times my location was known by a friend or relative, with a set time for a meeting prearranged.

The majority of interviews, however, took place over the phone. The information from these interviews were no less accurate when compared against secondary data, and at the close of the interview it was determined whether it would be useful to have a face-to-face interview. The telephone interview had the benefit of being a lot easier to transcribe as during the group interviews respondents often talked over each other, and the interviews often were far longer as the interviewees wished to show me the things they had been talking about.

Who to include in a sample required particular thought; previous studies had only ap-

proached flood groups, rather than areas which were at risk from flooding but with no recognised flood group. However, it was decided that a key part in assessing public drivers and responses to changes in flood risk management intervention provision was to find locations which did not have any form of recognised collective action related to the flood problems in their communities. It is easy to ask why flood groups emerge and how they impact flood risk, but asking why flood groups do not form is a potentially more important question as it implies that there is a gap to be filled and the potential for increased vulnerability to flood risk. Thus, it was decided to contact flood risk areas that did not necessarily have any official collective action aimed at dealing with flood risk.

Lack of presence of civic engagement Forming evidence of no civic engagement presents a difficulty. The approach that was taken was to use Environment Agency maps to locate areas at risk from flooding, both in areas where floods had occurred since 1998 (chosen because of it's catalytic significance as identified in Johnson *et al.*, 2005) and in places which were deemed to be at risk but had not been flooded since 1998, and then to contact local residents who, from newspaper articles, blogs etc, appeared to have influence in the area. On contacting these people, I introduced myself and the topic of my research, and asked interviewees they, or anyone they knew, would be worthwhile talking to. Many respondents came back and said they did not feel qualified to talk about flooding, to which they were informed that not knowing or understanding a risk was just as valuable information as knowing about the flooding in their localities. The other approach of getting into a community was to contact existing institutions in the flood risk area, such as residents' associations, churches and community centres, yet again, laying out the situation and calling for any help they could provide.

Both approaches were equally successful and the interviewer found communities to be open and willing to help. Many people were simply happy that an interest was being taken in the something that they cared about, and often interviews lasted in excess of 4 hours and involved me being given a tour of the length of an area impacted by flooding and introduced to numerous locals. Accumulating data in areas in which no groups had emerged really provided information that had not been taken into account by previous studies and, as will be shown, are key to this project's findings.

The presence of civic engagement It was the aim of this research to let patterns of collective action emerge and define themselves. As such, the manifestation of collective reorganisation was both identified by the presence of a flood groups, and by indications in news articles and other open sources of information that some form of collective action was taking place. As a result, the study managed to collect data for both official flood groups recognised by the National Floods Forum (an independent organisation aimed at providing advice to flood risk communities) and the Environment Agency, and also groups which managed flooding but had no official related title.

Collecting contact details of flood groups was challenging. Contact details of flood groups had previously all been public on the NFF's website. However, group details were no longer public and I was not granted permission to get this data from the NFF. As such, I made use of cached pages which held partially outdated information. In many ways this was an advantage as it meant that groups which had subsequently disbanded could be contacted. The most recent version of the contact details went back to 2008, with no subsequent updates. However, I supplemented this list of around 100 flood groups by making a note of groups who had been in the news, talked at conferences and mentioned in academic journal articles. In addition to this, I undertook a substantial

online search looking for any kind of collective group which was concerned with flood issues.

In the initial attempt at contacting groups almost 250 personalised emails were sent out, from which I received a 10 per cent return. Unfortunately, many email addresses were old and, as such, were not working. There were just under 40 respondents, of both groups and individuals. Following on from the initial email contact, I organised a telephone meeting, and if it was deemed worthwhile and feasible, the flood group was visited in person. Respondents were allowed to lead the meeting, with the interviewer setting a structure. This proved highly beneficial as many groups wanted me to see how they operated, i.e. offering an invitation to a meeting, and then left time for questions at the end. This provided a great contrast in how groups operate, some working from village halls, other from pubs and some from living rooms, and also illustrated patterns of networking and hierarchies within the groups. Face-to-face meeting proved far more valuable than telephone interviews as the latter ran the risk of representing the personal opinions of individuals rather than the collective ethos of the groups. In analysis, it was taken into account that the opinions of individuals were far more likely to be prejudiced or harbour conspiracy theories than when discussed in group meetings in which these suspicions were mediated.

Transcription

Interviews were recorded using a Dictaphone which allowed upload on to a computer. These recordings were then transcribed using intelligent verbatim, i.e. missing out umms and ahhs, but not missing out repetitions, mistakes and different conversational strands. There are many kinds of transcription (discussed in Richards, 2009), however, it was my

decision to chose a method which reflected the recording as closely as possible in order to prevent my own values potentially clouding the data while editing. Using textual analysis software (described in the next section), the transcripts were analysed alongside the recordings (the software allowed the recordings to be 'attached' to the transcript). This attachment of recordings made analysis far easier; interviews were completed over a period of three months, and, though notes were made and recordings transcribed quickly, collective analysis occurred sometime after the initial interview. The software therefore, allowed the mood of the conversation and thoughts which emerged from the interview to be recalled with ease.

The transcription experience was a learning curve, with mistakes realised later on, such as electrical equipment disrupting the recording and one interview not being recorded. However, as detailed notes were made throughout the interviews, this caused limited problems, and in the case where the recorder had run out of batteries, handwritten notes were typed up immediately following the interview and emailed to the interviewee to confirm they held true to the interview. It was advised in Richards (2009) to keep unrelated conversation to a minimum, however, it was decided the benefits of not taking this advice would far outweigh the extra transcription work. These benefits were realised as interviewees were free with their thoughts and feelings (which is important when assessing preparedness and expectation of floods) and contacted me to inform me of any updates; a source of data which came in great use. The result was increased transcription load, but also some valuable data which would have not been obtained otherwise. The transcription of the recordings also enabled me to develop a thorough knowledge of, and relationship with, each case study, making categorization and comparison of data a natural transition from the transcription.

Summary

In summary, the method of sampling meant that the data was more representative of the variety of public drivers and responses to flood risk management interventions than demonstrated in earlier studies, such as Coates (2011) and Simm (2011). Interviewing in areas where there was no flood group proved extremely important during the analysis, with the inclusion of generic action groups, such as residents' associations and anti-development groups, highlighting the plethora of civic engagement in Flood Risk Management which is currently unrecognized. There was of course some degree of in-built bias in the sample as it was only possible to collect data from those who contacted me back, which may have skewed results towards areas where there is flood related action.

2.2.2. Data Analysis: Text Analysis Markup System

Text Analysis Markup System (TAMS) (see Weinstein, 2012) is a qualitative research tool chosen because it is both open source and compatible with the hardware held by myself. Other textural analysis software were tested, including N6, however, TAMS came highly recommended by other researchers with significant instructions of how to analyse data. Furthermore, it was not significantly different from other textual analysis software available and was designed specifically for transcription, with the capability to apply time codes and jump to certain parts of a recording.

The aim of textual analysis is to allow easy identification of themes in text (allowing upload of pdf, images, recordings as well as Word documents). These themes can then be coded with either predefined categories or creation of theme codes as they emerge

during analysis (Silverman, 2010). TAMS also allows researchers to apply the context to the recording as well as text specific codes, which, in the case of this project, enabled me to perform tasks such as comparison of the flood disturbance attributes against collective behaviour patterns. It is argued that use of software packages can distance the researcher from the data (Charmaz, 2000), however, the practice of coding and finding the best categories to make the most out of the data led to each transcript being read at least a dozen times, and probably more knowledge of the cases than would have been possible otherwise. The problem that did arise though, was finding categories that would suit all scenarios, and this was achieved through trial and error.

Representation In qualitative data analysis, the process of writing is as much a method of analysis as the use of textual analysis or any other analysis methodology. As a researcher writes up, patterns emerge, which can often lead to a researcher going back to the original data to restructuring or re-categorizing what has been done. This is a highly productive form of analysis as it involves getting to see data from numerous perspectives and really developing an in-depth relationship with the project (Richards, 2009).

In the analysis writeup, there was the dilemma of how much direct quotation should be used to illustrate a trend or supporting theoretical concepts, and whether an emergent pattern should be supported by deriving data from individual cases or whether to apply categories, even though, the boundaries of those categories were in many cases flexible. After assessing the data, it was decided that quotes from interviews should make up a large part of the results and analysis. This was because respondents had thoroughly summarized their experiences, and displaying this data in their words, rather than my own avoided misrepresentation, and gave depth to the analysis. The approach to displaying

quotes represents the ideology behind this thesis; empowering groups through validating their personal knowledge.

2.2.3. Evaluation of interviews

There are numerous approaches to examining public participation. One potential major gap in this project is the lack of representation of the opinions of those in authorities. A number of groups had councilors and experts as part of the team, and in many cases the person who was being interviewed was a certified expert of some form. However, there were only three interviews from members of authorities. It must be acknowledged from the beginning that this study is representative of the public's opinion, not of any other stakeholders. Future studies may want to examine the contrasting opinions and experiences of experts and lay people, however, for the scope of this thesis on the public shall be represented, and this acknowledged as both a limitation and advantage of this study.

Through testing different interview methods, it became clear that the interview approach that worked best was group interviews. As mentioned, interviewing individuals often led to the discussion of conspiracy theories, which were not brought up during group interviews. That respondents were most likely to broach conspiracy theories when interviewed alone was only realised after a number of individuals were interviewed before or after interviewing the flood group together. It must, therefore, be taken into account that some of the interviews may not be representative of the group as a whole, though all interviews have been compared to secondary data, such as news articles and the group's publicity material. In all cases possible more than one member of the group was contacted.

The final problem was the quantity of data collected. The study included over thirty interviews across twenty-five locations, in addition to a number of informal conversations, with interviews lasting from thirty minutes, to, in one case, four hours. My conversational approach meant that there was a great deal of data to transcribe, yet it also encouraged respondents to continue to collaborate with me throughout the writeup. Despite the quantity of data to transcribe and analyse, the sheer breadth of the data meant that the interviews could inform debate on a wide range of issues.

The interviews provided extensive data on how the public were involving themselves in flood risk management. They gave a clear indication of the changes in flood risk management service provision which they would like to see, and stated their responses to the implementation of new policies. Thus, the data was able to both inform the perceived success of policy instruments, and provide foundations to project responses to future policy initiatives. Importantly, the interviewed respondents also clarified motivations for public involvement and from this it was possible to understand the benefits the responded expected themselves, and their communities, to receive as a result of their engagement.

2.3. Assessing social responses to Partnership Funding

The aim of this methodology is to gain an insight into how the contributions to, and benefits of, goods provided by flood defences have changed, and the policy tools which have been used to facilitate that change. To fulfill the aims of this section data is derived from two sources; Regional Flood and Coastal Management Programme for projects from 2012 to 2015 which contain data of planned flood risk management projects, proposed

contributions and distribution of beneficiaries across indices of multiple deprivation, and the interviews from Chapter 4 which include case studies of groups who experienced the Partnership Funding Scheme. For both of these sections methods of data collection and data processing are described.

In order to understand how the goods provided by flood defences have transformed from either public or private, to public, club, and private datasets were compared from 2012 to 2015, with supplementary data from Project Appraisal Reports (PARs) and Strategy Appraisal Reports (StARs) giving an indication of the goods provided by flood defences prior to 2012. The data was acquired from two sources. The first came in the form of RFCMPs, which were available for the years 2012 to 2013, and 2014 to 2015. For the earlier dataset, only an Excel spreadsheet of the projects planned was available (we shall discuss how this was later made comparable to the latter dataset), for the later dataset shape-files were available so that a geographic analysis could be made as well as a statistical analysis.

The second source of data was from interviews and focus groups from areas which had undergone Flood risk management projects both prior to and after the implementation of Partnership Funding. We examine the experiences of these groups, making a comparison of how public priorities of goods provided by flood risk management have changed with the introduction of Partnership Funding, and how satisfied these groups felt with the new funding scheme.

Overall it is my aim to assess the extent to which transition from public good to private, club, and public good is appropriate for the social context in England, and second to understand the effectiveness of Partnership Funding in achieving this transition, both in terms of efficiency and equality

2.3.1. Data Sources: Interviews and RFCMPs

Regional Flood & Coastal Management Programmes The secondary data sources used to contrast the change in contributions and benefits of flood defences were RFCMPs which were supplemented by Catchment Management Plans (CMP), Project Appraisal Reports (PARs), Strategy Appraisal Reports (StARs), and Catchment Partnerships (CPs). Flood Risk Management strategies are well documented in PARs, as well as CMPs, SARs and CPs. These documents either describe planned flood risk management interventions, providing a justification of what they would achieve and why they are suitable, or evaluates the success of a past flood risk management interventions. Documents contain a great deal of information on the process of choosing a Flood Risk Management strategy, and the objectives of these Flood Risk Management strategies.

The reasoning behind the choice of documentation was to enable a comparison over time between the relative contributions and benefits received by different stakeholders towards flood risk management projects. The distribution of benefits could be identified from the form of flood risk management intervention, and, in the case of RFCMPs, the different Outcome Measures registered within the Excel or shape-file database. The RFCMPs provided a summary of future flood risk management projects, while the PARs and StARs gave an in depth analysis of flood risk management interventions that had been applied in the past. The documentation provided a broad sample of flood risk management projects, both planned, in the case of the RFCMPS, and otherwise with around 150 documents (spreadsheets, reports, and shape-files) in total. Data were provided directly from the Environment Agency as well as Local Authorities and National Government websites.

In the case of the reports, the documents were uploaded into TAMS to create a database

of projects. The aim of this was to process the data to create a library of comparable information relating to different aspects of the flood risk management intervention, i.e. the form of defence, the social benefits, environmental benefits, and economic benefits, and the land uses which the intervention would predominately benefit. For example, a section of text which discusses the creation of an embankment would be labeled under 'Strategy>Embankment'. If a structure had a particular level of protection, it may be labeled under 'Strategy>Embankment>OneInHundred'. In addition to this, other key features will be defined within the document such as year that the project was planned, and location. This method is well tested, with its application discussed in Cope (2010). Once all of the projects were marked-up by type, contributions and benefits, analysis began.

Semi-structured interviews The second part of this methodology was aimed at understanding the extent to which the public were accepting of the Partnership Funding Scheme and it's driving ideologies. A measure of success of the revised funding structure is the revised application for a new flood defence project which would not have previously been considered for any amount of government funding and the associated support of those projects by the public and other stakeholders, which would tangibly be expressed in the form of public contributions in capital or in kind.

The concern here was that the public would not accept the revised requirement for them to make contributions outside of taxation to flood risk management schemes despite being the primary recipients of the benefits, and would not top-up the the funding grant. Therefore this section discusses both sides of the story; the planned projects according to Environment Agency data, and the acceptance of these projects in areas where they were to be implemented. This second part of the methodology discusses the

extent to which Partnership Funding was accepted in areas where it was introduced.

We interviewed these groups to get an understanding of how flood risk management had been carried out in their local community, if they had been included in the Partnership Funding scheme, and their feelings towards Partnership Funding scheme both if they had been included, and hypothetically if they were to be asked to raise funds contribute to local flood risk management schemes. The results focus on the experiences of groups which have undergone Partnership Funding, because the aim of this study is to see the success of Partnership Funding, however we use the experiences of the other groups to provide context and comparison to these results.

2.3.2. Data Analysis: Geographic Information Systems and TAMS

Spatial distribution of contributions and benefits

The first data to be analysed were the two sets of RFCMPs. As mentioned, the 2012 to 2013 dataset was only available as an Excel spreadsheet. However, due to regional biases I had noted in interviews, I wanted to examine the spatial distribution of any change. The benefits of visual representation, such as maps, allows patterns to be identified which may be difficult to perceive with one-dimensional statistical analysis, and also, when displayed spatially, any spatially influenced patterns are disproportionately easy to identify. Therefore it was decided to make the 2012 to 2013 dataset into a shape file so that it could both be seen, and then compared to the 2014 to 2015 dataset which was provided in the form of a shapefile by the Environment Agency. We shall now describe the process by which this was achieved.

The first challenge faced was the process of turning the 2012 to 2013 dataset into a shape file which required the location of the area and project named in the excel spreadsheet. The Excel spreadsheet provided was often incomplete, and the names of locations and projects were extremely vague. For all 398 projects in this dataset we went through and found the geographic location, or as close as was possible. There were many difficulties in this process with project descriptions such as "Kempton Park Trash Screen", "Lower Axe - Health and Safety improvements to structures (Phase 2)" or "Kirkley Screen" being the only information provided to locate these projects. Despite this the majority of projects were successfully located.

Once all projects had been matched with their geographic location, the next hurdle to overcome was to decide the best way to present this data. Different options included mapping the data on by river shape-files, constituency shape-files, or some other spatially influenced dataset. However, all of these had issues relating to comparability and suitability of that dataset to the multiple forms of flooding. In the end, it was decided to map the flood projects by parish. This was decided because parishes are suitably small geographically meaning that the boundaries of flood projects would have more accuracy to their actual boundaries. The parish level presentation of results also allowed convenient comparison to maps of multiple deprivation, and, also of importance, the interview data illustrated that parish level politics were highly influential in the outcome of local flood group initiatives. The main issue was that not all areas have parishes, in these locations the most suitable and similar scale of local authority was identified and used as an alternative.

Once the flood projects had been associated with their parishes, and this data added to a shape file of parish data, the 2012-2013 data was then compared to the Environment

Agency shape-file of projects from 2014 to 2015. This comparison took place using a number of different methods, however, the main analysis focused on comparison of the changing Partnership Funding scores.

Partnership funding scores are a conversion of:

> "...the potential FCRM Grant in Aid[1] available into a "raw" Partnership Funding Score, which describes the proportion (%) of costs that can be justified against national budgets. Funding contributions from other sources can be used to adjust and boost the Partnership Funding score. The adjusted Partnership Funding score must exceed 100% before FCRM Grant in Aid is allocated and a project can proceed." (Environment Agency, 2014)

Therefore, the Partnership Funding score is a very useful indicator in understanding the extent to which the benefits provided are of public nature in comparison to a private or club benefit. Only those goods that receive a Partnership Funding score of 100% are able to access funds from central government, and therefore are considered to be purely public nature and in benefit. Those projects that score below this are considered to be club goods, with some good scoring 0% or just marginally above that which can be considered effectively private in nature.

We wanted to see the change in the number of projects which were granted partial funding because these reflected a change in the excludability of flood defences, and the stakeholders responsible to fund their provision.

[1]FCRM Grant in Aid is "funding from government to pay for flood and coastal erosion risk management works that reduce the risk or impacts of flooding and coastal erosion"(Environment Agency, 2015, p.3).

Coding in TAMS

Publication data were uploaded unto TAMS in order to make the data sets, which may have had different terminology and structure, comparable. This technique of cataloging data collected is well tested (see Cope, 2010), with the process used described in this section. Following data collection, electronic recordings were then transcribed and then both publications and transcriptions were input and analysed using the Text Analysis Markup System (TAMS) (Weinstein, 2014), which is a piece of software which enables the reader to tag text under a give label, and then search for all of these within a collection of documents. Textual markup can also be achieved manually, however, computer assisted software enables the input and comparison of more data, and, as shown by van Hoven (2010), reduces the extent to which outcomes of analysis are informed by the researchers own beliefs. Thus, using a computer a TAMS a database was created to explore what flood groups were doing, the scales that they were working at, and the barriers they had faced which may have limited the options they had in their Flood Risk Management strategies.

Text Analysis Markup System (TAMS)(Weinstein, 2014) is a qualitative research tool chosen because it was both open source and compatible with my own hardware. Other textural analysis software were tested, including N6, however, TAMS came highly recommended by other researchers with significant documentation of how to analyse data. Furthermore, it was not significantly different from other textual analysis software available and was designed specifically for transcription, with the capability to apply time codes and jump to certain parts of a recording.

The aim of textual analysis is to allow easy identification of themes in text (allowing upload of pdf, images, recordings as well as Word documents). These themes can then

be coded with either predefined categories or creation of theme codes as they emerge during analysis (Silverman, 2010). TAMS also allows the researcher to apply the context to the recording as well as text specific codes, which, in the case of this project, enabled me to perform tasks such as comparison of the flood disturbance attributes against collective behaviour patterns. It is argued that use of software packages can distance the researcher from the data (Charmaz, 2006), however, the practice of coding and finding the best categories to make the most out of the data led to each transcript being read at least a dozen times, and probably more knowledge of the cases than would have been possible otherwise.

During the coding I used a combination of data-driven (open) and concept-driven (closed) coding (Gibbs, 2008). This enabled me to answer a limited number of simple questions about the documents (such as what were the intervention types, and reference to other components of the flood system, e.g. past flood defences, limitations due to geology, consultation with civil society actors, etc.), as well as providing me with a detailed, structured overview of the argumentation used in the document (such as the list of objectives and policy actions, the way problem descriptions refer to different components of the flood system, etc.)

As described in Franzosi (1994) a balance should be struck between the openness of coding and the need to standardize the coding for the purpose of comparison. Franzosi (1994) advises the use of a syntactic coding scheme in order to overcome this compromise. Syntactic coding is a coding method in which statements in documents are coded as structured sets of simpler codes following a pre-given structure (story grammar).

Based on the characteristic statements found in texts belonging to the genre of policy documents, a number of categories, or 'story grammars', were defined to record infor-

mation found in documents. These are: current interventions, past interventions, stakeholder considerations, environmental considerations, economic considerations, funding considerations, flood frequency, flood magnitude, flood damage, etc. Some of the fields in the story grammars were more interpretive than others, using more abstract categories than found in the documents. However, in these cases a detailed description was made of what each of the codes meant.

Despite use of pre-defined syntactic coding which encourages standardization, open coding was still applied as it has the benefit that different words could be used in the fields of story grammars to code the same basic information. The need for open coding is a result of applying qualitative analysis, in which it matters a lot whether a document is using one label for a description or another (e.g. embankment versus levee) with a different label for each potentially skewing the frequency of any particular result. However, viewed differently such language variations are not particularly important, but do require more comprehensive and abstract codes, and a log of those codes by the researcher. In order to ensure such a log highlighted discrepancies brought about by different language usage between publications, the individual codes entered to the system were organised into a hierarchical structure.

In this standardization process codes that were similar to one another were organised into more general, higher-level codes. However, the hierarchical approach to coding meant that the meaning behind the language were not obscured by the need to create a category which could then be compared. Thus, rather than using a fixed set of generality levels, the depth of hierarchies vary between the different branches in the categories, with these being reviewed later on in the methodology.

Besides the flexibility in terms of the depth of hierarchy, codes could also be attached to

more than one category, allowing a multi-dimensional grouping of codes. Thus, e.g., the category of 'flood wall' was added to the categories of 'hard defences', and 'flood wall', all organised within even more general categories ('hard defences', 'physical interventions') within the overarching category of Flood Risk Management interventions. The hierarchy also allowed for cross-linking of categories so that any term could be applied to multiple headings (e.g., linking together institutional actors such as the National Floods Forum, with 'third party interventions' and references to documents referring to public participation to create the abstract category of 'stakeholder involvement').

The flexibility of this hierarchical organisation means that the analysis of documents can be achieved across several levels, from a detailed comparison of a smaller number of documents to a comparison of overarching variations between different case study areas.

2.4. Outcomes

The outcome of this chapter is a robust methodology to inform the understanding of how the public at flood risk act in order to manage flooding, the motivations behind their activities, and, where possible, how public activities influence the outcome of flood risk management interventions. The analysis of RFCMPs will shed light on the proportion of flood risk management projects planned which require capital beyond that delivered through general taxation, which is then used as an indicator of the perceived excludability and rivalry of the benefits of flood risk management interventions. The interview data contributes to the analysis of whether Flood Re and Partnership Funding are socially feasible.

3. Methods Part II: Quantitative Approaches

This chapter develops the methodology for testing the efficiency and equity of Flood Re (results presented in Chapter 6). Flood Re is a government intervention in England which encourages more widely affordable household insurance for those at high levels of flood risk through application of cap on the flood element of household insurance, the level of which is determined by Council Tax Band and increases over time until the cap is in line with risk reflective prices. At the time of writing, the scheme had not yet been implemented and, therefore, this chapter hypothesizes Flood Re's potential impacts upon the desirability of investing in insurance and / or property level protection, looking at whether Flood Re improves absolute affordability of flood insurance, the risk value of investing in insurance, and finally whether that gamble feels more attractive to householders once observed behaviours of flood risk householders are incorporated into the agent-based model.

The aim of this methodology is to hypothesize whether Flood Re will reduce the excludability of access to affordable insurance policies for those households who are at high flood risk. Informed by observed behaviour from flood risk households, I challenge

the notion that a reduction in the cost of insurance premium implicitly reduces the excludability of access to affordable flood insurance due to the way in which householders generally (though not universally) make decisions in these scenarios. In order to achieve the aim of this methodology three agent-based models were developed. The first links the concept of affordability to the caps on the flood element of insurance premiums proposed within Flood Re. The second model uses EMV to calculate the risk value of purchasing insurance under a Flood Re scenario in comparison to risk reflective insurance prices and continuously capped insurance prices, and whether, under different scenarios of risk, purchasing insurance is of greater value to the householder than purchasing nothing or property level protection. The final model looks at the social feasibility of Flood Re when taking into account observed behaviour of those at flood risk. In this model elements of Kahneman and Tversky's Prospect Theory (1979) – a theory used to explain observed behaviour which does not adhere to Expected Utility – were integrated into the agent-based model in order to theoreticize how, under various risk scenarios, the gamble of purchasing insurance under Flood Re feels in comparison to purchasing other options. Thus, I examine not only whether Flood Re increases absolute affordability of insurance, but also whether it improves the risk value of that investment and how that value feels to the consumer.

3.1. Summary of Tools and Methods

3.1.1. Interviews

The behaviour of agents within the model was primarily informed by the behavioural traits identified by Kahneman and Tversky (1979). However, Kahneman and Tversky

had not dealt with flood insurance decisions specifically, and so the influential factors in considering the purchase of flood insurance were drawn from semi-structured interviews. The interviewees were asked about their perceptions of flood insurance, what issues surrounding flood insurance concerned them, and what future developments they would like to see. The issues brought up regarding insurance were highly influenced by the affluence of a community and access to centrally funded flood defences. For example, in Naunton the primary concern was the increase in insurance costs from years to year, whereas in Hull and Merseyside the issues regarding insurance were more focused on emergency aid for those without insurance. Data from Merseyside and Hull was very useful in that special schemes had been rolled out because so many residents had been uninsured following large scale flood events. I managed to get interviews with the charities leading these, and even telephone operators in charge of encouraging insurance uptake. Such data is invaluable as it is the 29% of low income households that are uninsured which Flood Re claims to benefit. The casual nature of these interviews allowed me to draw out key themes, which I then related to Kahneman and Tversky's (1979) Prospect Theory Model.

Semi-structured interviews were split into training and test batches so that I was able to use the data both to inform and check model outputs. It is of note, that it would be desirable for further validation of the model, however, due to (1) household insurance being bundled with other risks, (2) an overly competitive market which results in below risk reflective prices limiting my ability to calibrate insurance prices, and (3) mortgages leading to an almost compulsory uptake of insurance, resulting in a generally high insurance uptake across the UK (91% of households [ABI, 2015]), validation had to be based on questions put to respondents regarding their perceptions of insurance. As such the

results of this study are best examined as the extent to which the inclusion of observed behaviour traits regarding the purchase of insurance influences the efficiency and equity of an insurance scheme in comparison to the omission of behaviour in the analysis of insurance demand.

3.1.2. Agent-based modeling

The use of agent based modeling in testing decision making under conditions of uncertainty is well practiced (Olsson, 2005; Eckles and Wise, 2011). The preference for agent-based models over other methods of modeling is due to the functionality available to programme a range of observed agent behaviour (Brown, 2006). These include:

- "Heterogeneity in agent behavior can be represented by drawing parameters of a utility function from a statistical distribution, or using alternative decision making approaches for different agent types;
- Rationality can be bounded by imposing limits on the amount of effort agents use to search for and/or evaluate alternatives;
- Alternatives to utility maximization can be included by, for example, using satisfying behavior, in which agents select alternatives that are "good enough" using heuristics to determine agent choices; and
- Randomness in environmental conditions, information availability, or decision outcomes can be incorporated through inclusion of stochastic processes." (Brown, 2006)

Thus, different agent behaviour can be informed by observed consumer motivations, which is important for representing the diverse range of public response to realised and

unrealised flood risk, the range of choices available to those agents (such as choosing any particular flood risk management option) and the varying influences of these variables, such as past experience and memory, upon their decision making. Agent-based models also allow for a range of characteristics to be assigned to agents, such as decision-making heuristics, and learning rules or adaptive processes. These are then used to interact within a landscape with other agents in order to understand how nature-society interactions influence the outcome of a chosen scenario. The details of which are described at each stage of the model development.

In addition to rich behavioral representations, agent-based models also have the advantage of incorporating both positive and negative feedbacks, such that the behavior of an agent has an influence on the subsequent behavior of other agents. In regards to fulfilling objective of this thesis, being able to model feedback is important when assessing how longer term behaviour change responds to the rapid implementation of policies, and how this behaviour change is distributed across different groups within the population.

My preference for the TerraME programming environment was multifaceted. First, the modeling platform had been created with the specific purpose of testing how the behaviour of agents influences patterns of forest fires in the Amazon Rainforest (Moreira *et al.*, 2009). This meant that the programming environment was specifically designed with the intention of spatial dynamical modeling. Reflective of this is the inclusion of anisotropic spaces and of hybrid automata models within TerraME. Anisotropic spaces are common in human influenced environments as development and flows of material often follows anisotropic patterns along rivers, roads, paths etc. Also reflective of TerraME's application to the natural environment is its use of nested cellular space. This was particularly attractive for a project which dealt with agents who acted upon multiple

scales, from household to national level. Finally, an opportunity was provided to learn directly from the developer of the programming environment (Carneiro *et al.*, 2013), applying the software to hypothesize the spread of dengue fever alongside other socio-environmental phenomena. As such, it was possible to gain an in-depth knowledge of the TerraMe programming environment, which may not have been possible with the other agent platforms available.

The modeling platform had the benefit of separating the landscape, spatial processes and agents. Such a facility was extremely useful in the model development stage, in that each section of the model could be tested separately without influencing the functions in other model parts, i.e. the society interacts with the landscape, which does not necessarily change the original data of the database or of the society.

Within the cellular space the following features of the flood system were defined:

1. "The physical attributes of the earth's surface involved in the water cycle, i.e., the processes of rainfall, snow melt, and marine storms that lead to fluvial and coastal flooding, runoff from the land, groundwater flows, and flood inundation in fluvial floodplains and coastal lowlands.
2. The artificially created systems of drainage, storage, and flood defence that are intended to convey flood discharges and resist or control inundation of floodplains.
3. The economic, social, and environmental assets that are located in floodplains and are impacted upon by flooding and/or have an impact on the flooding process." (Hall *et al.*, 2003)

These are features of the landscape which interact with agents. The landscape of the agent based model is developed in TerraView, which, like other software, such as ArcMap, allows the easy viewing and editing of geographic data. TerraView can visualise vector

data (polygons, lines and points) and raster data (grids and images), which can both be stored in a relational or geo-relational databases, including ACCESS, PostgreSQL, MySQL and Oracle (Moreira *et al.*, 2009). Additional data can be uploaded into the database which can update as an agent makes decisions.

Despite the use of cellular space in the model development, the final model was one-dimensional. This is because I could not get enough data to make comprehensive maps across England of insurance demand, the model ran at household level and running a simulation for just a 10 mile area took around 15 minutes, and I did not have the computer power to continue the simulation. The model structure to apply the outputs of this thesis to place specific locations therefore exists, and it's completion is a goal which I would like to achieve outside the realms of this thesis.

3.2. Three Agent-based models

3.2.1. Approach and model overview

All model descriptions follow the protocol for describing individual- and agent-based models (Grimm *et al.* 2006; Grimm and Railsback 2005) and consists of three elements. The first element provides an overview of universal and agent variables, the second element explains the sub-models and processes and the third describes the experiments run. Below are diagrammatic overviews of each model:

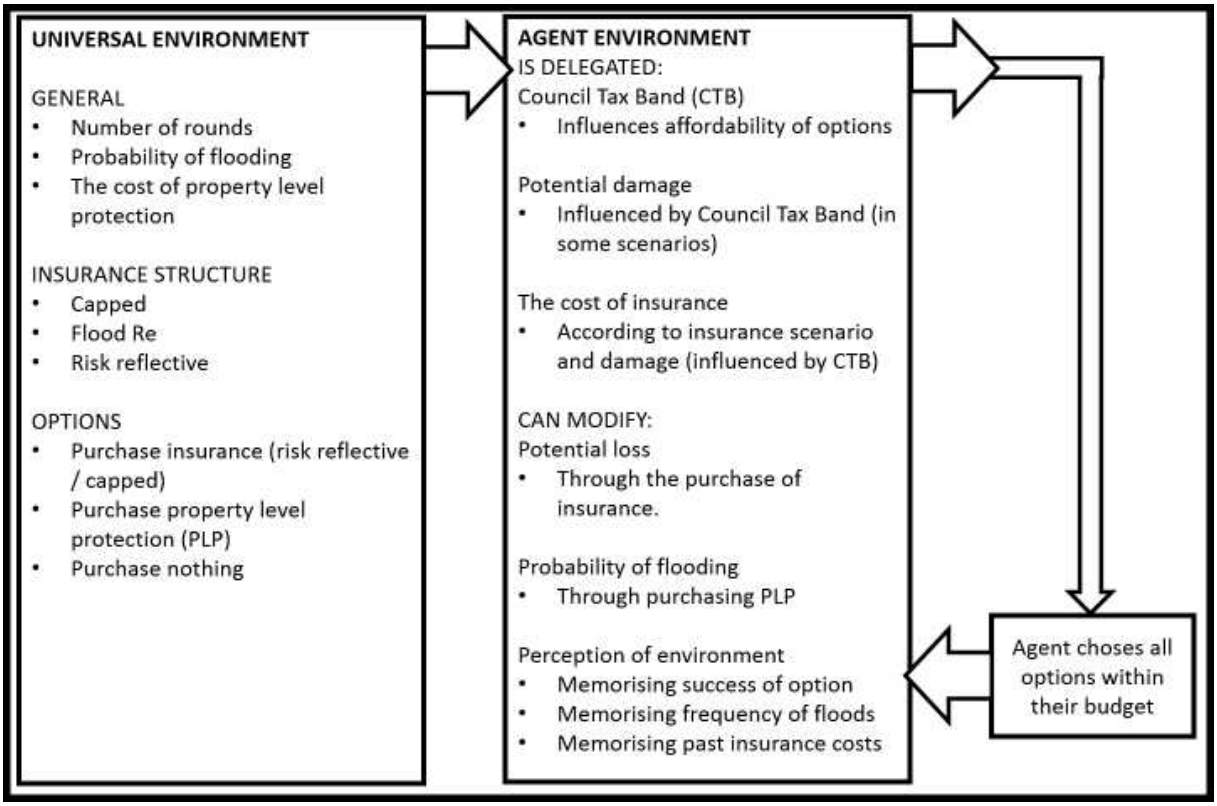

Figure 3.1.: An overview of agent-based model 1. This model is used to hypothesize how Flood Re may improve the absolute affordability of flood insurance by linking Council Tax Bands to the the capital a householder may have available to spend on insurance. Within this set of model runs an agent will purchase insurance if they are able to afford this option.

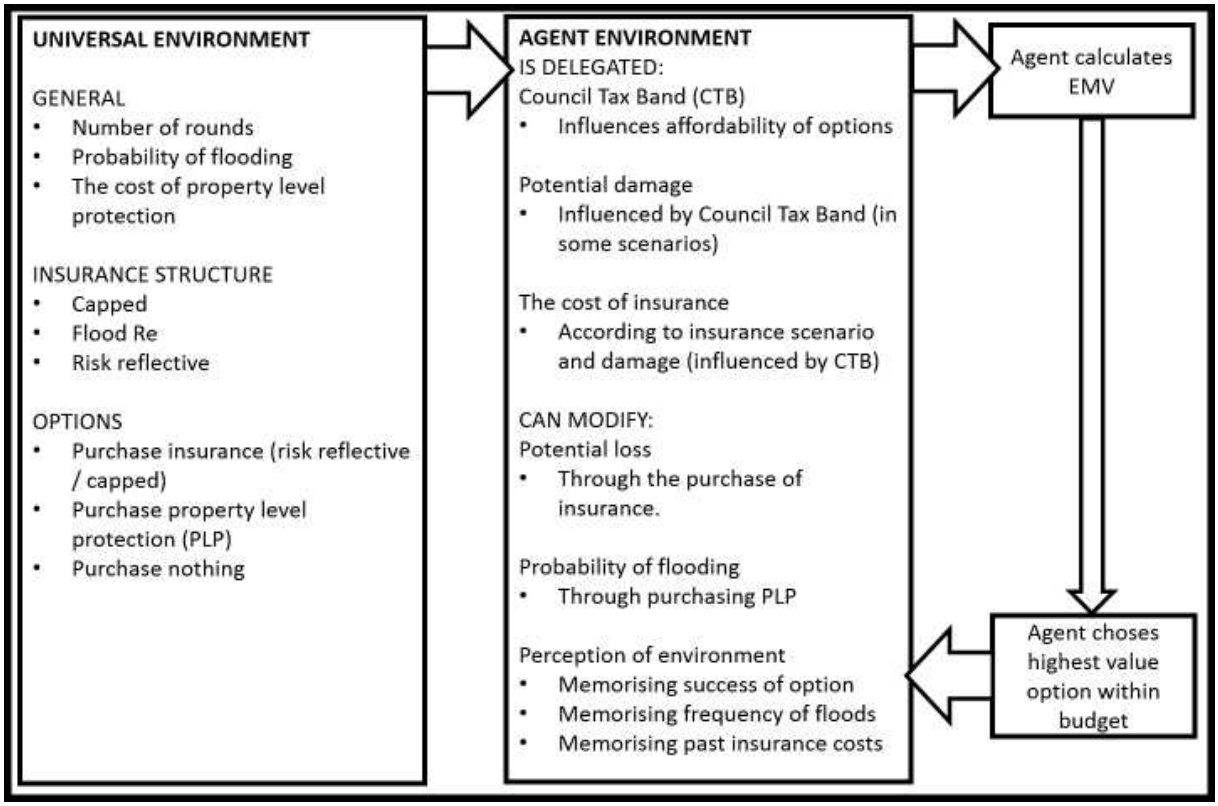

Figure 3.2.: An overview of agent-based model 2. This model is used to hypothesize how Flood Re may improve the value of investing in insurance in relation to other options under various flood risk insurance scenarios and damage frequencies. Within the prerequisite that the agent can afford an option or bundle of options, the agent prioritizes and chooses options according to its absolute value.

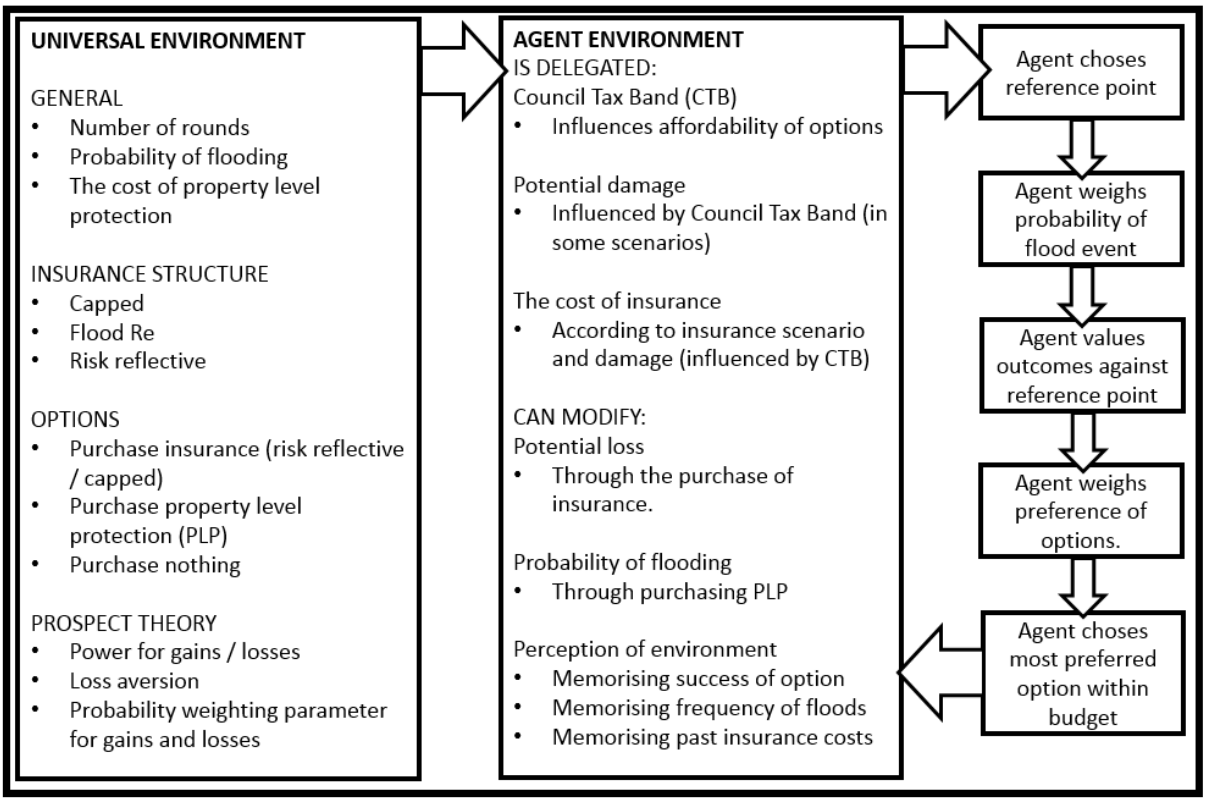

Figure 3.3.: An overview of agent-based model 3. This model is used to hypothesize how Flood Re may improve the perceived value of investing in insurance in relation to other options under various flood risk insurance scenarios and damage frequencies. Within the prerequisite that the agent can afford an option or bundle of options, the agent prioritizes and chooses options according to their perceived value. The perceived value is influenced by behaviour traits identified in Prospect Theory and supported by observations of householders investing in mitigation strategies in uncertain environments.

3.2.2. State variables common to all agent-based models

All models are based on the proposed structure of Flood Re as far as information was available at the time of model development. Despite the use of cellular space in the model development, the final models were one-dimensional. This is because I could not get enough data to make comprehensive maps across England of insurance demand, the

model ran at household level and running at simulation for just a 10 mile area took around 15 minutes, and I did not have the computer power to continue the simulation. The model structure to apply the outputs of this thesis to place specific locations therefore exists, and it's completion is a goal which I would like to achieve outside the realms of this thesis.

The universal variables therefore are not influenced by geographic variations[1], with the modification of these variables occurring within the agent itself. The universal variables are summarized in Table 3.1.

3.2.3. Agent variables common to all agent-based models

All agents are subject to a chance of receiving damages to their property, and are able to modify the cost of this damage by insuring their loss and / or by purchasing property level protection which influences the probability that a universal flood event will cause damages to their property. To assist in making their decisions agents within the model are able to remember past flood events, the average cost of insurance, and the past cost of damage. Six scenarios are run. Two linking affordability to Flood Re, two linking value to Flood Re, and two linking social feasibility to Flood Re. There are two of each as different methods of calculating damage were applied (discussed in Section 3.2.5.1). The decisions the agent makes are constrained by the money they have available to spend on flood defences in any given year. The range of money delegated to an agent is determined by their Council Tax Band which they are delegated in year one of the

[1]It is of note that all households which are eligible to be entered into Flood Re are already considered to be at flood risk, therefore, their proximity to features which may influence the probability of flooding is not vital to the development of a model as we can assume if they are entered into Flood Re – which all households within this simulation are – they are already in close proximity to such feature. As such, a 1-dimensional model should not have a significant impact on the outputs of the model.

Universal variables	**Value**	**Sensitivity test range**
Rounds	30 rounds	25-100
Start chance of flooding	0.01-0.2	0.001-0.5
End chance of flooding	0.01-0.2	0.001-0.5
Total policy length	25 rounds	25-100 years
Transition time from subsidized to risk reflective pricing	10 rounds	10-25 rounds
Cost of property level protection	-£4700	-£4700 to -£15,000
Lifetime of property level protection	5 rounds	5 to 15 rounds
Loss aversion*	2.25	1.00-2.5
Power for gains / losses*	0.88	0.88-1.00
Probability weighting for gains*	0.61	0.61
Probability weighting for losses*	0.69	0.69

Table 3.1.: UNIVERSAL VARIABLES. *Only applicable to ABM 3.

model run. The money they have available to spend does not change throughout the model run[2]. The method by which Council Tax Bands are calculated are described in Section 3.3.1. The challenge faced was to find a linkage between Flood Re's indicator of affordability, Council Tax Bands, and the amount of money people generally have to spend on insurance. The process of this is fully described in Section 3.3 as a linkage

[2]A number of model runs were attempted where an agent had a variable bank balance impacted by expenditure on defences and or insurance, and by flood damages. If the agent was in credit for a number of years running they were able to liquidate their property assets, and devalue their Council Tax Band (and property) to a lower level. However, this model version was not used as there were too many assumptions, such as the point at which the agent liquidates their assets, or the Council Tax Band their house is reduced to. As such, the simpler option was applied.

between the wealth and Council Tax Band is a result in itself. However, in summary using data from the Office of National Statistics the following process was undertaken. Council Tax Bands are an indication of house price in 1991. Therefore for each Council Tax Band the average cut-off house price for each category was found, then these prices were updated to current prices. From current house price it is possible to calculate a range of potential incomes, and from this range of potential incomes it is possible to calculate a range of savings. Savings were used to indicate wealth available to spend on insurance as this capital would not have been earmarked for other household expenses, such as rent, electricity, entertainment etc. The full process, barriers and assumptions necessary to formalise a link between Council Tax Band and capital available to spend on flood insurance and / or property level protection is described in Section 3.3.

3.2.4. Sub-models and processes common to all agent-based models

3.2.4.1. The cost of potential flood damage

Risk reflective insurance premiums were calculated by probability of a flood event occurring multiplied by the potential magnitude of a claim, and, as such, the potential damage costs can have a significant impact upon the price of insurance. I needed to decide how the potential damage costs caused by a flood would be calculated by insurance companies and then translate into insurance premiums. The multicoloured manual (Penning-Rowsell *et al.*, 2013) provides an accurate insight into the rebuild costs of different properties, however, due to the nature of insurance, these cost are not always reflected in the cost of an insurance premium. Kunreuther and Pauly (2014) describe

Agent variables	**Abbreviation**	**Sensitivity test range**
Agent Council Tax Band (CTB)	A_{CTB}	CTB A-I
Agent savings (according to CTB)	$S_a \propto A_{CTB}$	See Section 3.3
Potential damage costs	$A_d \propto A_{CTB}$	See Section 3.2.5.1
Rebuild damage costs	Where A_d=$C(rbv) \propto A_{CTB}$	See Section 3.2.5.1
Partial rebuild damage costs	Where A_d=$C(rbv/x) \propto A_{CTB}$	10% to 80%
Average flood claim	Where A_d= £30,000	£20,000-£40,000
Average flood claim weighted to A_{CTB}	Where A_d= £30,000 $\propto A_{CTB}$	0.02-8

Table 3.2.: Agent variables (Part 1)

Agent variables	**Abbreviation**	**Sensitivity test range**
Risk reflective insurance costs	$C(rbv) \cdot P_f$	See Section 3.2.5.2
Cap on insurance premium	$\max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}$	See Section 3.2.5.2
Transition period costs	$((1-I) \cdot \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}) + I \cdot (C_d(rbv) \cdot P_f)$	See Section 3.2.5.2
Increment of transition	$I = \frac{T_c - (T_p - T_t)}{T_c}$	See Section 3.2.5.2
Reference Point (RP)*	$RP_a \begin{cases} A^{max}_{damage} & if \quad N_{floods} \geq \frac{T_{st}}{w} \\ A^{average}_{insurance} & if \quad N_{insurance} \geq \frac{T_{st}}{r} \\ A_{savings} & otherwise \end{cases}$	See Section 3.5.3.2.
RP: Experience of flooding*	$A^{max}_{damage} = \frac{T_{st}}{w}$	See Section 3.5.3.2.
RP: Agent insurance routine*	$A^{average}_{insurance} = \frac{T_{st}}{r}$	See Section 3.5.3.2.
RP: Agent available funds*	$A_{savings} \propto A_{CTB}$	See Section 3.5.3.2.

Table 3.3.: Agent variables (Part 2). *Only applicable to ABM 3

how some insurers charge a flat rate of potential damage based on data from previous claims. In addition to this, householder may under-insure in order to keep their premiums low, and to only protect items which they do not have funds to replace themselves.

Bearing in mind this variation in the potential cost of damage considered by insurers, I decided to run the model for multiple methods of estimating potential damage (see Figure 3.4 and Figure 3.5). These include a flat rate damage over all Council Tax Bands informed by the average claim made following flood damage according to ABI (2015), and the rebuild cost informed by the ABI's Rebuild Calculator (2015). In the final model runs displayed in the results section, two sets of results are shown; flat rate damage costs, and a lowered rebuild cost, which most closely matched the average claim caused by flood damage. Both results are displayed as insurers are known to use both methods.

3.2.4.2. The cost of insurance premiums

One of the major sub models within the all agent-based models developed is the calculation of insurance costs. The next stage of the methodology describes how the three stages of the Flood Re scheme were programmed. At the time of writing, the Flood Re scheme was to be capped insurance with a limit by Council Tax Band, followed by a transition to risk reflective pricing, followed by risk reflective pricing only. Of note is that 'maximum' value is taken because the costs of insurance are programmed as minus numbers, i.e. the cost of insurance might be -£210 under capped pricing, but -£160 under risk reflective pricing. Therefore, the maximum value of these is -£160. The structure of Flood Re was designed as follows:

$$(T_t \leq T_s) \Rightarrow C_i^a = \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}$$

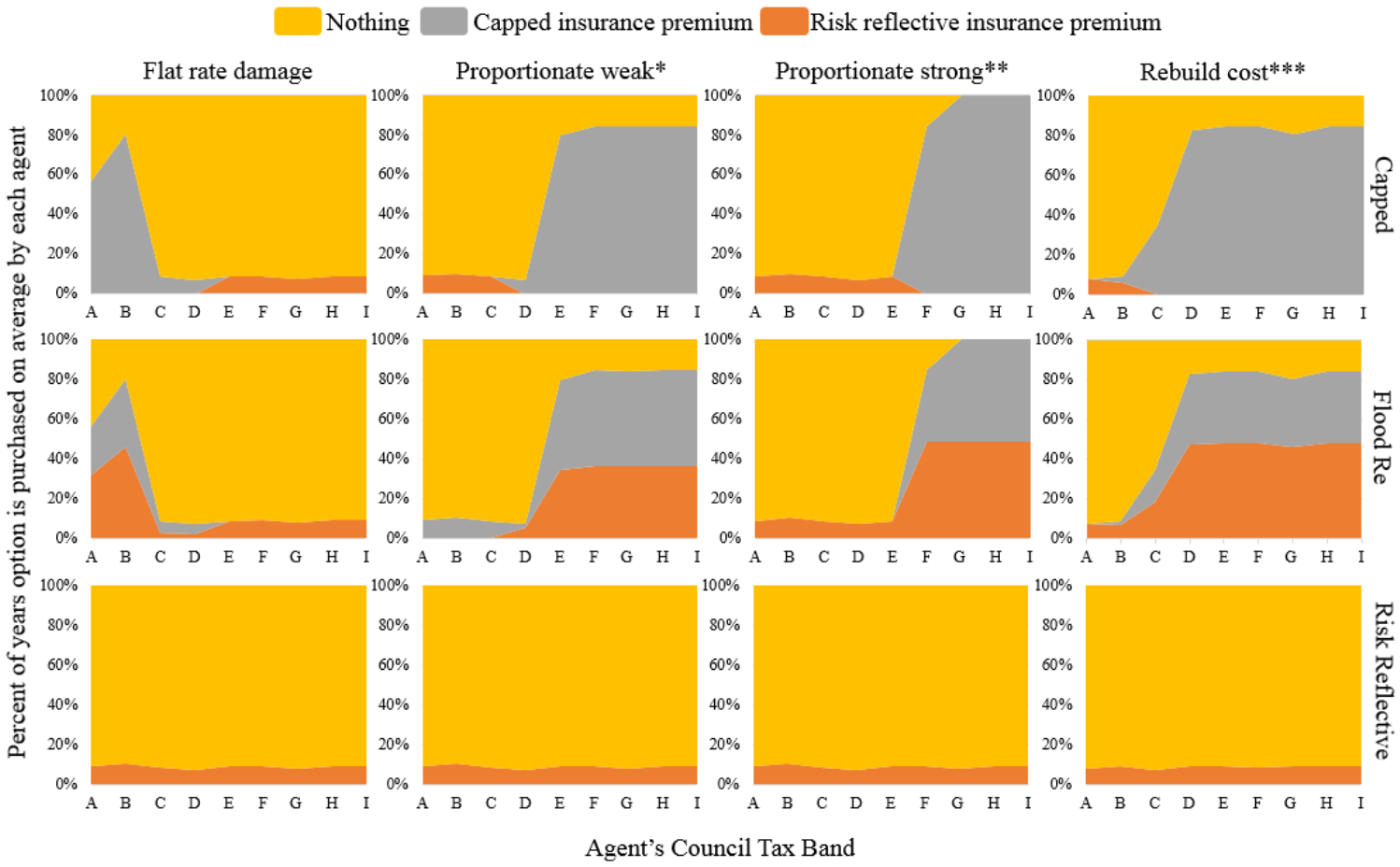

Figure 3.4.: THE INFLUENCE OF DAMAGE CALCULATIONS UPON INSURANCE DEMAND. Examines how the way in which damage costs are calculated influences consumer demand for different household flood risk management options. Under 'Flat rate damage' all households are liable to a maximum of £30,000 damage following a flood. Within the 'proportionate weak' and 'proportionate strong' model runs, the maximum damage of £30,000 is staggered according to Council Tax Band, with Council Tax Band 'D' being the midway point of damage increasing or decreasing from £30,000. The 'Rebuild cost' model run is informed by the ABI's rebuild cost calculator, but is reduced to a partial rebuild, discussed further in Figure 3.5.

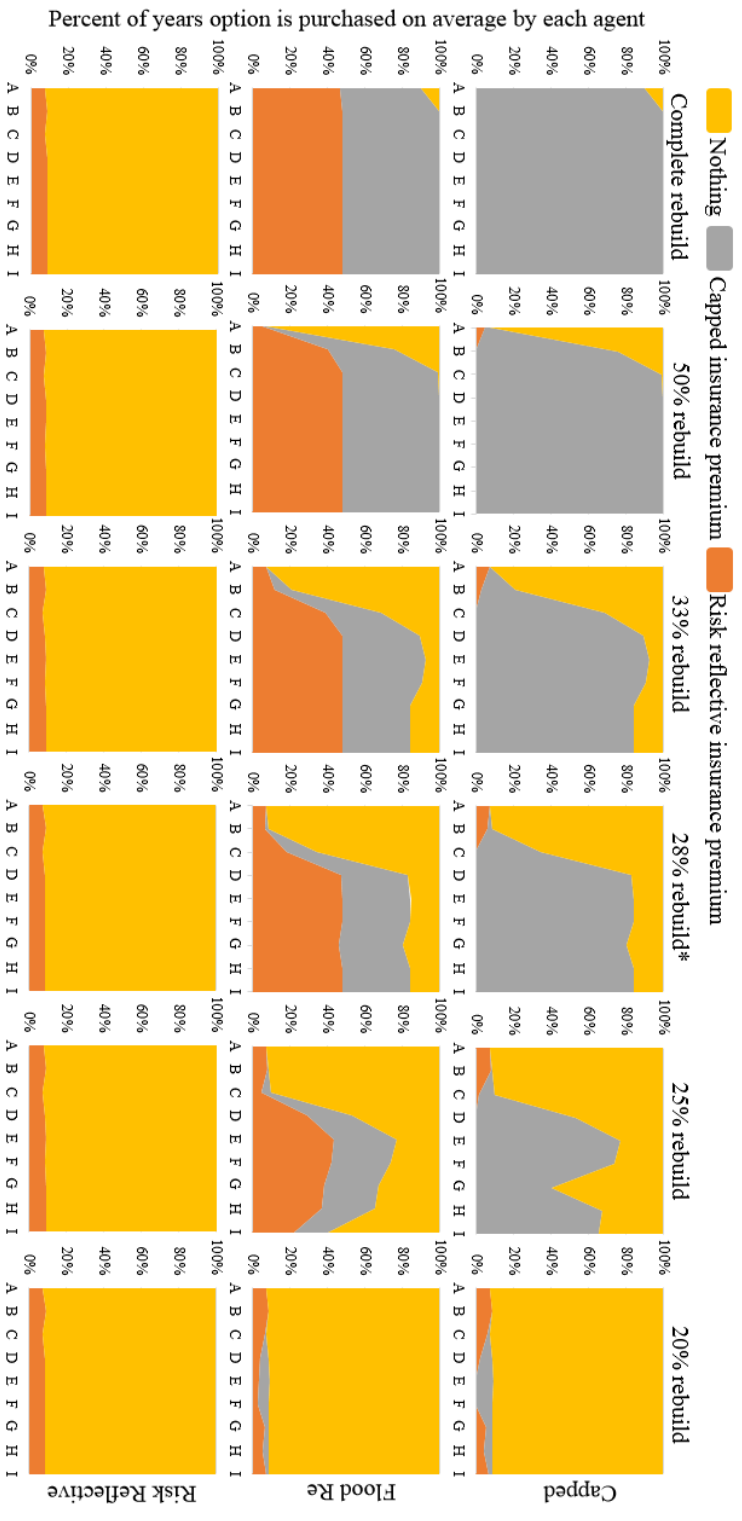

Figure 3.5.: The influence of rebuild costs upon insurance demand. Examines how manipulation of the rebuild cost of houses influences the purchase of different insurance options by agents.

$$(T_t \geq T_s) \wedge (T_t \leq T_p) \Rightarrow C_i^a = ((1 - I) \cdot \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}) + I \cdot (C_d(rbv) \cdot P_f)$$

$$(T_t \geq T_s) \wedge (T_t \leq T_p) \Rightarrow C_i^a = C_d(rbv) \cdot P_f$$

Under a continuously capped scenario insurance costs are always set at:

$$C_i^a = \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}$$

Where the ratio between Council Tax Band and combined insurance is predefined below:

Council Tax Band	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Combined insurance (A_{CTB})	210	210	246	276	330	408	540	1101	1101

Table 3.4.: The cap upon the maximum price of the flood element of combined insurance under Flood Re

Under a continuous risk reflective insurance pricing scenario insurance is always:

$$C_i^a = C_d(rbv) \cdot P_f$$

Where no transaction costs are added, and there is the assumption that no other risks exists outside those presented by flooding.

The agents insurance costs are represented by C_i^a with the potential components of that cost including the cap determined by Council Tax Band A_{CTB} , the agent's expected

damage costs A_{dc} and the probability of that damage occurring to that agent in any given year A_{pf} . This data was then input into a model where T_t is the current simulation time, T_s is the current age of subsidized insurance policy duration, T_p is the policy length of Flood Re scenario including transition time, T_c is the transition time of the policy between capped and risk reflective. The components of I , the increment of the transition, shall now be discussed.

At the time of writing the duration of the Flood Re policy as a whole had been decided, but the transition arrangements had not been published. In regards to my dilemma of programming this transition within a model this lack of clarity led to uncertainties as to how I should structure such a decision. Following a period of 15 years of capped insurance premiums which would allow householders time to implement adaptation measures, the second part of Flood Re was to send pricing signals which would pressurize a person to adapt to the flood risk, but would be able to do so with adequate warning to make savings and take action. As such the rate of transition from capped insurance premiums to risk reflective insurance premiums is of importance because the signal must be great enough to encourage adaptation, but not so great that adaptation would not be possible because of costs. However, as the rate of transition over the last 15 years of the policy had not been published at the time I was developing the model, I made the educated decision to structure the increment evenly over time as follows:

$$I = \frac{T_c-(T_p-T_t)}{T_c}$$

Where I is the increment at which capped insurance premiums return to a fair market price, T_p is the policy length of the Flood Re scenario, T_c is the transition time of the

policy between capped and fair insurance premiums, and T_t is the current simulation time. The increment would be distributed equally across the transition time.

An external contributor which increased the uncertainty surrounding the most appropriate transition from a capped insurance premium to a risk reflective price over time emerged from the difficulty in accurately identifying the end value of 'risk reflective' insurance. In a climate of uncertainty where we cannot be sure how flood frequency, magnitude and type will be influenced by both changing climate and population pressure (Wilby and Keenan, 2012), the value of 'risk reflective' insurance in the future is uncertain. However, the purpose of my thesis was not to project changes in damage frequency and magnitude over time, and, therefore, it was my decision to run the model against a number of damage frequency scenarios. Within my model I took the average flood claim as defined by ABI (2015), and ran scenarios where the frequency of this claim was the same or increased.

The only constraints on a purchase are the agent savings A_s, determined at random in the first round and which are bounded by the Council Tax Band allocated to the agent. Whether the agent purchases capped or risk reflective insurance is dependent upon (1) the scenario (i.e. in a risk reflective only scenario the option to purchase capped insurance does not exist), and (2) the amount of savings an agent has. In all scenarios, if the agent has savings of a great enough quantity then they will purchase insurance.

In the case of property level protection, the data used and structure applied in the purchase of insurance was unchanged with the addition of property level protection as an option to purchase. As in the previous experiment, the minimum pricing was applied to the options. As a result, in this particular experiment the average cost of the cheapest (in regards to up front cost) form of property level protection was applied. This form

of property level protection influences the probability of a flood event, as opposed to the magnitude of damage caused by a flood event, and, according to the Environment Agency (Merrett, 2012) costs on average £4700.

In these experiments, the agent is only able to purchase property level protection with existing funds. In reality, a person would most likely be able to take out a loan. However, the aim of this experiment is to test that a cap on insurance, the level of which is determined by Council Tax Band, decreases excludability of access to flood insurance. The ability to take out a loan adds a new level of complexity to the system outlined, and, even if all agents had equal access to a loan, such an action would disproportionately increase the burden upon those who already have limited funds, and would be classed as unsustainable, which goes in the face of subsidizing a public scheme. Here I test the extent to which a cap on insurance frees up enough capital to allow an individual to invest in Flood Risk Management.

Within this first set of model runs, it is assumed that if an agent can purchase an option they will purchase an option. Therefore, the only constraint placed upon the agent is savings. There are four potential options an agent may take; (1) Purchase nothing, (2) purchase insurance, (3) purchase property level protection, and (4) purchase property level protection and insurance simultaneously. The purchase of property level protection influences the future probability of the flood water entering the agent's home for the lifetime of the property level protection, which is informed by statistics of the average lifetime of property level protection (Merrett, 2012). The final option, to purchase property level protection and insurance simultaneously, is a combined option which is more there for programming purposes[3].

[3]Due to the way Prospect Theory ranks outcomes, the agent can only chose one option in any one round. However, I wanted the agent to have the option of purchasing both property level protection

The model was run over 25 rounds, for a society of 5,000 individuals who were randomly delegated Council Tax Band and, in turn, assigned an annual savings within a range associated with their Council Tax Band which would remain the same for the duration of the model run. Model outputs were imported into excel. The total number of years capped insurance, risk reflective insurance, and nothing was purchased was averaged across the entire population. These values were the plotted against the Council Tax Band (x axis) and the average number of years each agent purchased other options (y axis).

In order to compare how market adjustments influence purchasing behaviour in relation to risk reflective insurance a number of additions were made to the model. The risk reflective insurance premium C_{ip}^{rr} was informed by the potential damage costs multiplied by the flood probability. The damage costs were weighted for each agent according to the rebuild cost of their home which was informed by ABI's Residential Rebuilding Cost Calculator and the house price of the agent so that $C_d(rbv)$ where C_d are the damage costs and rbv is the weighting applied to houses of different values:

$$C_{ip}^{rr} = C_d(rbv) \cdot P_f$$

The probability of a flood was universal across the society, but may not be incurred at the same time by each member of the society, and may be modified by the actions of the agent, such as purchasing property level protection. Whereas the cost of insurance under a continuously capped scheme would be as follows:

and insurance simultaneously so the combined purchase of two options had to be conglomerated into one option.

$C_i^u \propto A_{CTB}$

Where the ratio between Council Tax Band and combined insurance is predefined in Table 3.4. Under a Flood Re scenario however, the price of insurance premiums is not capped for all time, with cost of insurance premiums gradually return to risk reflective pricing, as shown below:

$$(T_t \leq T_s) \Rightarrow C_i^a = \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}$$

$$(T_t \geq T_s) \wedge (T_t \leq T_p) \Rightarrow C_i^a = ((1-I) \cdot \max\{A_{CTB}, (C_d(rbv) \cdot P_f)\}) + I \cdot (C_d(rbv) \cdot P_f)$$

$$(T_t \geq T_s) \wedge (T_t \leq T_p) \Rightarrow C_i^a = C_d(rbv) \cdot P_f$$

Where T_p is the policy length of the Flood Re scenario, T_c is the transition time of the policy between capped and fair insurance premiums, and T_t is the current simulation time. The increment would be distributed equally across the transition time. P is the increment at which capped insurance premiums return to a fair market price. At the time of writing this thesis, the increment by which this transition would occur was unknown, and, thus, it was decided to make this increment steady across the transition period. The calculation of which is as follows:

$I = \frac{T_c - (T_p - T_t)}{T_c}$

Therefore, there were three potential insurance scenarios; capped for all time, capped followed by a transition to risk reflective (Flood Re) and risk reflective.

3.3. Agent-based model 1: Can people afford insurance under Flood Re?

The link between Council Tax Band of householders and the ability of householders to gain access to affordable insurance is not clear, and, as such, I justify the development of ABM 1 by identifying the need to clarify this relationship.

3.3.1. Approach: Linking Council Tax Bands to affordability of insurance

Within this section I present a potential linkage between Council Tax Band and the concept of affordability in order to understand if the caps imposed by Flood Re might increase the affordability of insurance premiums, and project the distribution of these benefits across Council Tax Bands. Documentation stated that the cap upon insurance premium would be applied by Council Tax Band, and would be separated into buildings insurance, contents insurance, and combined insurance[4]. The caps applied to these Council Tax Bands are shown below in Table 3.5.

[4]Please note: all figures are based on those published at the time of writing.

Council Tax Band	A	B	C	D	E	F	G	H	I
Buildings only	132	132	148	168	199	260	334	679	679
Contents only	78	78	98	108	131	148	206	422	422
Combined	210	210	246	276	330	408	450	1101	1101

Table 3.5.: Proposed Flood Re insurance caps for buildings, contents and combined insurance premiums

Flood Re was planned to remain active for twenty five years. Within this time period, the first ten years would see no transition from a cap on insurance premium to risk reflective pricing, and after this time the cap would gradually be raised to risk reflective pricing.

Underlying the ideology of Flood Re is the assumption that access to insurance is correlated with insurance price, and that a cap will render insurance more affordable. Thus, in the first set of model runs (prior to the introduction of Expected Monetary Value or Prospect Theory weighting) the assumption was made that householders would definitely purchase insurance if they could afford insurance. This assumption allowed me to test whether the caps at their current level determined by Council Tax Band would significantly increase the numbers of householders that could purchase insurance. The caps set as part of Flood Re should significantly increase the number of householders able to purchase insurance, and the distribution of any increase in uptake of insurance policy across different Council Tax Bands should be equal. If there is no significant increase in the uptake of insurance following a cap this may have substantial ramifications as to why flood insurance premiums are being subsidized by other policy holders, and the extent to which this is ethical and cost beneficial.

Once the assumption of a correlation between affordability and uptake of insurance had been recognized, the next stage was to identify how Council Tax Band might relate to affordability. The underlying assumption here is that those people who live in houses

with a lower Council Tax Band have less disposable income, and those people that live in higher Council Tax Band properties have more capital. This assumption is a product of Council Tax Band being determined in part by house price, and the affordability of a house being seen to be determined by wealth.

During my initial investigations I found that there were a number of factors which brought the correlation between wealth and Council Tax Band into question. These factors include, but are not limited to, the fact that Council Tax Bands are determined by the value of the property in 1991, and can be renegotiated in the case that the occupant's wealth is not strongly correlated to house price, especially in the case of pensioners, students, and disabled people. Reflective of this is the right of a person in Council Tax Band C, for example, to apply to be treated as if they are in Council Tax Band B. An example of the minimum income prior to being able to apply for a reduced Council Tax Band is demonstrated in Table 3.6.

Council Tax Band	A	B	C	D	E	F	G	H	I
Maximum income (£ per week)	132	144	157	169	181	194	206	218	231

Table 3.6.: The maximum income a person may earn before they can apply to reduce Council Tax Band tier.

Within this thesis I had to make an assumption that if household income fell below the threshold at which they could apply to be at a lower Council Tax Band then the agent would apply for a Council Tax Band reduction, and the insurance company would set their insurance premium cap by the renegotiated Council Tax Band.

As with much of the other data, the level at which an occupant of a house could apply for a council tax reduction was not always publicly available. Some Local Authorities

published parts of the data and from those I used the average increment between each cut-off to estimate the level of increase between each Council Tax Band. The result is that the cut-off for a reduced Council Tax Band for those living in Council Tax Bands E and above are most likely lower than they would be in reality. However, as the results show, for the Council Tax Bands where I had to estimate the minimum income level prior to Council Tax Band being upgraded, none of the householders were reaching the cap upon the insurance, and, therefore, that they may have been in a Council Tax Band lower than their house price would imply made no difference to the end results.

After calculating the minimum income at which a householder could apply to reduce their Council Tax Bands, I then proceeded to identify a correlation between house price and income.The cap upon the cost of insurance is determined by Council Tax Band, as such we needed to find some correlation between Council Tax Band and money available to purchase insurance. The first challenge we faced was that Council Tax Bands are valued by the value of the home in 1991. As such, I had to then convert the value of the home in 1991 to the present value of the house. According to the Nationwide House Price Index, the value of a home in 1991 has now increased by 60% (ONS, 2015). Once I had updated the house prices to present-day values, we then used data from the Office for National Statistics (2015) to identify an average ratio between income and house price. This ratio was 6.6. From this I identified the minimum and maximum house price in a given Council Tax Band, income per Council Tax Band, and finally average range of savings for that income according to Economics Online (2015). These minimum and maximum values can be seen in Table 3.7.

Council Tax Band	A-lower	A-upper	B-lower	B-upper	C-lower
House value (1991)	0	40000	40000	52000	52000
House value (present)	0	65652	65652	85347	85347
Estimated income (£'s)	0	9947	9947	12931	12931

Council Tax Band	C-upper	D-lower	D-upper	E-lower	E-upper
House value (1991)	68000	68000	99000	99000	120000
House value (2015)	111608	111608	162488	162488	196995
Estimated income (£'s)	16910	16910	24619	24619	29842

Council Tax Band	F-lower	F-upper	G-lower	G-upper	H-lower
House value (1991)	120000	160000	160000	320000	320000
House value (2015)	196995	262606	262606	525213	525213
Estimated income (£'s)	29842	39789	39789	79578	79578

Council Tax Band	H-lower	H-upper	I-lower	I-upper
House value (1991)	320000	424000	424000	650000
House value (2015)	525213	695907	695907	1066839
Estimated income (£'s)	79578	105440	105440	161642

Table 3.7.: Estimated income based on Council Tax Band

However, it cannot be assumed that a householder will spend all of their income on flood insurance. Instead, I determined that the funds available to a householder to spend on flood insurance should be informed by their savings as this is money which they have available after essential expenditure, as opposed to non-savings which may not be available to spend. Yet, savings vary from household to household. According to Economics Online (2015) the savings of a house holder varies between 4 and 12 per cent of their income. Informed by these figures, I decided that within my model a householders savings would be delegated randomly between 4 per of the lowest savings and 12 per cent of the highest savings of the income associated with their randomly delegated Council Tax Band. These limits are shown in Table 3.8.

Council Tax Band	A-lower	A-upper	B-lower	B-upper	C-lower
Savings (£'s)	0	1194	398	1558	1518
Insurance Cap (£'s)	210	210	210	210	246
Estimated income (£'s)	0	9947	9947	12931	12931

Council Tax Band	C-upper	D-lower	D-upper	E-lower	E-upper
Savings (£'s)	2029	676	2954	985	3581
Insurance Cap (£'s)	246	276	276	330	330
Estimated income (£'s)	16910	16910	24619	24619	29842

Council Tax Band	F-lower	F-upper	G-lower	G-upper	H-lower
Savings (£'s)	1194	4775	1592	9550	3183
Insurance Cap (£'s)	408	408	540	540	1101
Estimated income (£'s)	29842	39789	39789	79578	79578

Council Tax Band	H-lower	H-upper	I-lower	I-upper
Savings (£'s)	3183	12652	42127	19397
Insurance Cap (£'s)	1101	1101	1101	1101
Estimated income (£'s)	79578	105440	105440	161642

Table 3.8.: Estimated savings based on Council Tax Band

The data were put into an agent based model (described in Chapter 4), and run for the period of Flood Re. The graphs show the output of that model with the average number of years that an agent was able to purchase insurance over 25 years. The results are split into Council Tax Band, because this is how the insurance cap is determined in the Flood Re scenario, and the model is run over a total of 12 scenarios, with four scenarios of different damage frequencies for an average flood claim, and three scenarios demonstrating different approaches to determining the price of insurance premiums. As noted in the methods, in this set of model runs, if an agent could afford to purchase any option, they would purchase that option – consumer behavior is not included until

Section 3.5.

3.3.2. Model development

As discussed earlier, the structure of ABM 1 is as follows:

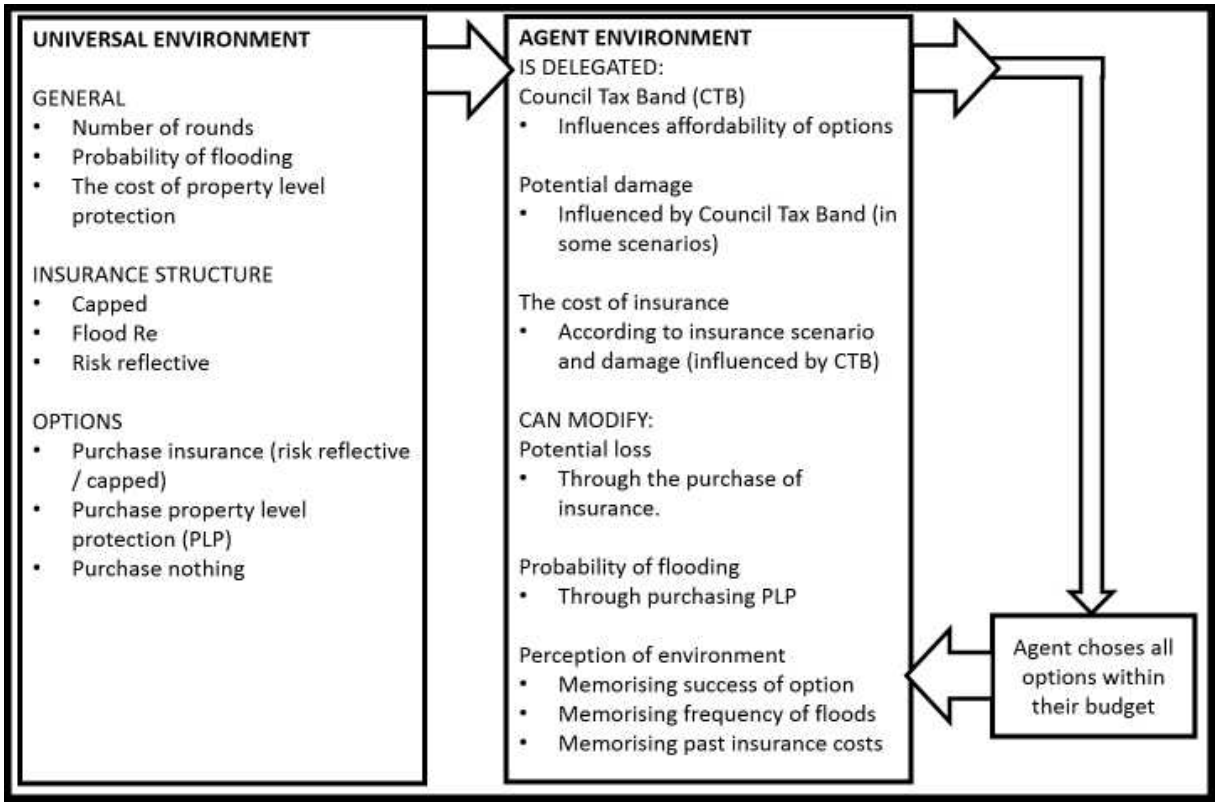

Figure 3.6.: Diagrammatic summary of agent-based model 1. This model is used to hypothesize how Flood Re may increase the absolute affordability of flood insurance by linking Council Tax Bands to the the capital a householder may have available to spend on insurance. Within this set of model runs an agent will purchase insurance if they are able to afford this option: there option is not ranked by its perceived or real value.

The main features, processes and sub-models of ABM 1 have already been addressed in Sections 3.2.3 to 3.2.5. As ABM 1 depicts a simple correlation between savings

available and cost of options, the only addition to this model which is an exception to earlier features described is:

$A_s \geq C_x \rightarrow Y_x$

Where $A_s$is agent savings, $C_x$is the cost of options, and $Y_x$denotes the purchase of an option. Under this scenario if an agent can afford any option, they will purchase that option, regardless of whether such an investment is good value in comparison to other options.

3.4. Agent-based model 2: Should people purchase insurance under Flood Re?

The previous experiments analysed the extent to which an agent *can* purchase insurance under different insurance scenarios. This section investigates whether agents *should* purchase insurance, i.e. does Flood Re make insurance a better gamble for investment than purchasing nothing. I justify developing an agent-based model for this issue because even if an agent can afford insurance due to a reduction in costs as a result of a cap imposed upon the maximum price of risk reflective premiums doesn't mean that purchasing insurance is a better investment than purchasing property level protection or not purchasing anything at all. In addition to this, modeling the EMV provides a point from which the change in model outputs following the introduction of behaviour into the agent-based model in Section 3.5 can be contrasted.

3.4.1. Approach: Integrating EMV into Agent-based models

The approach to the development of ABM 2 follows the structure of Expected Monetary Value (EMV). According to Au (2014):

> "The basic unit of risky decision making is the gamble. A gamble $G = (x_1, p_1; x_2, p_2; x_n, p_n)$ is a set of *n* objective consequences x_i with the probability of each objective consequence being p_i and $\sum_{i=1}^{n} p_i = 1$. The individual outcomes $\{x_i\ , p_i\ \}$ are considered to be mutually exclusive and exhaustive. Given two or more gambles to choose from, it is assumed a decision maker will prefer the gamble that has the highest utility." (p.3)

EMV is the accepted method of calculating how much a risky decision is worth. The purchase of insurance or property level protection is a risky decision because a flood may not occur, and, therefore, the goods purchased are not utilised. EMV helps the rational agent determine which of those choices has the highest utility. The purchase of nothing is a risky decision because a flood may occur. As such the EMV model makes use of probability *p* and the outcome of the option *x*:

$$EV(G) = \sum_{i=1}^{n} p_i x_i$$

In context of flood insurance, probability within the model includes the probability of a flood water damaging the property (a probability which can be changed by the agents purchase of property level protection measures), a claim being made by the agent, and that claim being accepted. *P*, therefore, is a product of these probabilities with the assumption that the policy holder will make a claim and that the insurance company will accept this claim. I acknowledge that these assumptions do not always hold true, and recommend this model being used at a later date to understand how claims behaviour

across society influences the efficiency and fairness of Flood Re. The outcome of a flood event is the amount of damages which the policy holder makes a claim for. Thus, average insurance claims as informed by the Association of British Insurers was used to inform the value of *x*, a figure which was proportionately adjusted to the rebuild cost of a house according to the Association of British Insurers Rebuild Calculator (ABI, 2015) (discussed in more detail later).

The calculation of expected monetary value falls under the umbrella of 'Decision Analysis'. Decision analysis does not present a descriptive theory of actual behaviour, instead decision analysis prescribes how an individual should go about making a decision under conditions of uncertainty, bearing in mind that individuals preferences and judgments (Raiffa, 1968). In these experiments the preferences for consequences are determined absolutely by Expected Monetary Value (EMV), and uncertainties in the purchase of property level protection and insurance include the belief a flood will occur and the belief that the considered Flood Risk Management option will deliver the intended services.

A temporal element of the agent-based model is added to the calculations as agents update their decisions based on previous experiences of flooding, the average cost of past options, and previous experiences of the success of options. The algebraic formula behind these calculations is "Bayes' Theorem" which is a method used to describe how "the conditional probability of each of a set of possible causes for a given observed outcome can be computed from knowledge of the probability of each cause and the conditional probability of the outcome of each cause" (Oxford Dictionary, 2008). As such, the gamble is updated to:

$$EV(G) = \sum_{i=1}^{n} b\,(p_i) \cdot (x_i)$$

Where b is agent belief. The model was run for both Expected Monetary Value scenarios; where the agent had full knowledge of probabilities and outcomes though is uncertain of the timings of the flood event within the model simulation, and for where the agent had to learn the probabilities and outcomes, and then update their decisions.

3.4.2. Model development

The method here is a progression from Section 3.3, built on the structural basis that the savings of the agent and level of cap for their insurance premiums were delegated by Council Tax Bands. The scenarios to which the model was applied are also the same with the current average of insurance claims for flood damages (as informed by ABI [2015], and the ABIs Rebuild Calculator [2015]), increasing frequency of damage over multiple model runs, and three scenarios of insurance structures; capped for all time, capped transitioning to risk reflective, and risk reflective.

However within this model there were fundamental differences; namely that the agents were able to calculate the EMV of each option and the combination of these options, and the agents were able to learn from past experiences of flood damage[5]. Models were run for both scenarios where the agent was able to learn, and for scenarios where agents already had perfect knowledge of flood risk and of the probability that an option would function effectively. The believed EMV is a product of the believed probability of a flood and the believed probability the option will work if there is a flood, against the expected and known costs if:

- The agent buys the item, there is a flood and the option works

[5]This learning element was not included in ABM 1 as the aim of ABM 1 was to illustrate whether agents can afford insurance premiums under Flood Re which did not require knowledge of whether those options would work or whether there would be a flood in the future.

- The agent buys the item, there is a flood and the option does not work

- The agent buys the option and there is no flood.

Therefore, in this set of model runs, if agent savings are greater than the cost of the option, and if the age of the option is zero or more than the life expectancy of the option, then, and only then, can the agent can calculate the expected monetary value of any option. This is calculated as follows:

$$(A_s \geq C_x) \wedge (0 < A_x > L_x) \Rightarrow$$

$$EMV_x = \Big((A_{pf} \cdot X_{pw}) \cdot \Big(\tfrac{C_x}{L_x}\Big)\Big) + \Big(A_{pf} \cdot (1 - X_{pw}) \cdot \Big(\tfrac{C_x}{L_x} + A_{dc}\Big)\Big) + \Big((1 - A_{pf}) \cdot \Big(\tfrac{C_x}{L_x}\Big)\Big)$$

Where the constraints are agent savings S_a , the Flood Risk Management option costs is C_x, the life expectancy of the option L_x, and the current age of the option A_x. EMV_x is the believed estimated monetary value of a Flood Risk Management option, A_{pf} is the agents probability of flooding, X_{pw} is the probability that a Flood Risk Management option will work[6], and A_{dc} are the damage costs incurred by the agent if a flood were to occur.

The following EMVs of each scenario were calculated:

[6]Within the model costs are uniformly spread over the lifespan of the option. It would be more usual to discount Present Value. However, there is evidence that householder do not discount property level protection products, and may actually value them more highly the more times they work as opposed to discounting their value over time. Therefore, a uniform distribution of costs averaged out the behaviour of those agents who place increased value on goods which perform to standard over a long period of time, and those agents who are able to correctly calculate the discount rate applied to property level protection.

Nothing	Insurance	PLP
Y	N	N
N	Y	N
N	N	Y
N	N	N
N	Y	N
N	N	Y
N	Y	Y

Table 3.9.: The scenarios for which Expected Monetary Values were calculated

Once EMV had been calculated, if funds permitted the individual would purchase the option(s) which they perceived to have the highest EMV. These options were:

Y_{ip}= buy insurance premium

Y_{plpp}= buy property level protection which influences the probability of damage in the case that there is a flood

Y_{ic}= buy claim

Y_{n}= buy nothing

These are expressed as follows within the model, where A_{dc} is the average damage costs for the agent prior to mitigation efforts, $X \sim U([0,1])$ represents a random number between 0 and 1, C_{ie} is the cost of insurance excess, P_f is the probability of flooding, P_{plpp} is the probability property level protection works, U_{dc} are the universal damage costs, and A_{rc} , the agent's rebuild costs, is adjusted by Council Tax Band with damage costs informed by the ABIs Rebuild Calculator (ABI, 2015):

$$Y_{ip} \wedge (X \sim U([0,1]) \leq P_f) \wedge Y_{ic} \rightarrow A_{dc} = C_{ie}$$

$$Y_{ip} \wedge (X \sim U([0,1]) \leq P_f) \rightarrow A_{dc} = U_{dc} \propto A_{rbc}$$

$$Y_{plpp} \wedge (X \sim U([0,1]) \leq P_f) \wedge (X \sim U([0,1]) \leq P_{plpp}) \rightarrow A_{dc} = 0$$

$$Y_{plpp} \wedge F(X \sim U([0,1]) \leq P_f) \wedge (X \sim U([0,1]) \geq P_{plpp}) \rightarrow A_{dc} = U_{dc} \propto A_{rc}$$

$$Y_n \wedge (X \sim U([0,1]) \leq P_f) \rightarrow A_{dc} = U_{dc} \propto A_{rc}$$

The cost of options C_x was not included as part of the damage costs because this expense has already been paid and should be considered as a 'toll' which is paid by the agent in order for the privilege of being able to change their damage probability. However, the cost of insurance excess C_{ie} was included as in order to make a claim from insurance companies, this has to be paid in order to have £0 damage following a flood event. As with all costs, the lowest possible cost was taken for the option, and this cost was:

$$C_{ie} = \left(\frac{A_{ic}}{M_i} \cdot 0.1\right) C_{ip}$$

Where A_{ic} is the number of insurance claims made buy the agent, M_i is the memory of the insurer, C_{ip} is the cost of the insurance premium. The calculation is representative of the cost of an insured excess, the components of which were determined by using insurance price comparison sites (www.comparethemarket.com) who offered quotes on premiums and compulsory excess from a number of insurance companies, and then phoning up excess insurers (www.floodexcess.com) to get quotes on the cost of insuring that excess. These results were put into a table, and then a formula was made to predict the cost of an unknown insurance excess, and the outputs of this then compared to a real quote. From these quotes it was found that the number of floods which had occurred within five years determined the cost of the insurance excess, with quotes showing a high degree of insensitivity to the magnitude of damage.

3.5. Agent-based model 3: Will people purchase insurance under Flood Re?

Both the interviews conducted and wider research indicated that in general people living in risky environments do not adhere to expected utility. As such, I justify the development of an agent-based model which integrates observed human behaviour into decision making because it can be shown that householders do not universally purchase insurance in a scenario where they can afford to invest because the price has dropped or in a scenario where the drop in price of insurance renders its purchase a more attractive investment than purchasing nothing. Thus, to understand whether Flood Re improves access to affordable insurance, the behaviour of the public must be integrated within a model as behaviour is one of the key barriers to the uptake of insurance. This phenomena

is referred to as social feasibility which is the assessment of how readily solutions to flood risk management imposed upon flood users will be adopted as a result of behaviour and perception. Therefore, while the previous agent-based models examined whether under Flood Re agents *can* and *should* purchase insurance, this section hypothesizes whether agents *will* buy insurance.

The use of Prospect Theory to inform agent-based models

Prospect Theory has been applied within agent-based models (Castro and Parsons, 2014; Takahashi and Terano, 2003; Andriotti, 2009), yet, this application has been predominately applied to problems in the financial market, with no evidence of the application of Prospect Theory to flood insurance decisions at the time of writing. In addition to this, the way in which Prospect Theory has been adapted to purpose within the agent-based model described here is fundamentally different to its intended use (as will be described and justified in Section 3.5.2) and, as such, the reader should not consider the agent-based model to be a model of Prospect Theory, but instead a model which utilizes the behavioural traits documented within Prospect Theory in order to hypothesize the choices of agents.

At the time of writing there was limited documentation as to how Prospect Theory is programmed within an agent-based model, with the most in depth example being that of Au (2014) who succeeds in designing an R package of Prospect Theory to systematically illustrate the predictive results of Prospect Theory against other theories of risky decision making. The package allows choices to be created and visualised as a decision tree, the predictive results of expected and non-expected utility decision making theories to be compared for these choices, and for tests for decision making, such as the

Allais paradoxes, to be examined. However, a practical application of this package is not followed through. Here we apply TerraMe, a specialised programming environment for spatial dynamical modeling of nature-society interactions (Carneiro *et al.*, 2013).

As described in more detail in Section 3.1.2, the benefits of using an agent-based model over other forms of analysis is that each agent has an individual, path dependent set of preference and is able to choose their own actions at each step time according to the agents context, experiences and preferences. Within the agent-based model a set of finite actions θ are defined; first, a choice of reference point for decision making, and then the choice to purchase insurance or to purchase nothing. Under expected utility, an agent would select an action $i \in \theta$ with the highest expected utility according to their wealth. However agent-based modeling of Prospect Theory allows us to include additional behavioural traits as outlined in the previous section. Thus, under Prospect Theory the action $i \in \theta$ chosen may not be that with the highest expected utility for a rational agent, but instead the highest utility for an agent with imperfect knowledge of flood probabilities, and an individual reference point by which they measure differently weighted gains and losses. Here the agent has two tiers of decisions to make prior to reaching an outcome. This section discusses the computation of those two tiers.

3.5.1. Approach: Adapting Prospect Theory to Agent-based models

The approach taken to hypothesising whether agents will purchase insurance among other options was to integrate elements of observed decision making into the agent-based model. The model developed to test the social feasibility of Flood Re was inspired by Kahneman and Tversky's Prospect Theory (1979; 1992). Prospect Theory is used

to explain observed behaviour which does not adhere to Expected Utility. The way in which I have been inspired by, and utilised, Prospect Theory is fundamentally different from its intended use: I have used the behavioural traits identified and catered for within Prospect Theory to hypothesise the attractiveness of taking a gamble, i.e. purchasing insurance or property level protection under different likelihoods of flood damage. Thus instead of saying, 'this is what I observe, can Prospect Theory explain this?' I have said 'my observations match the behaviour documented in Prospect Theory, can I use this to hypothesise future demand for insurance or property level protection?'. My primary objective was to illustrate that when contrasted to models in which agents follow Expected Utility the addition of public behaviour has a significant impact on the attractiveness of purchasing insurance, and therefore a drop in the maximum price of insurance alone may not decrease excludability of access to insurance. Instead, a policy which targets public behaviour directly, or differently, rather than indirectly through pricing signals may lead to more efficient household mitigation of flood damages.

Within the following sections, I shall explain Prospect Theory, describe and justify how I have adapted and changed its intended usage, and explain the limitations of such an interpretation when applied to an agent-based model. I argue that despite that Kahneman and Tversky would not recognise the agent-based model developed as Prospect Theory, the addition of the behavioural traits identified in Prospect Theory can significantly aid our understanding of how the way the public respond to flood risk influences the social feasibility of household flood risk management interventions.

3.5.1.1. What is Prospect Theory?

Kahneman and Tversky (1979) identified five important behavioural concerns from the empirical data which influenced the outcomes of decision-making under risk and uncertainty. These include reference dependence, loss aversion, risk aversion in gains, risk seeking in losses, diminishing sensitivity to gains and losses, and probability weighting.

Prospect Theory is split into two stages. The first phase consists of editing and simplifying the problem at hand in order to assist with the second evaluation stage. The editing stage is achieved by identifying potential outcomes as gains or losses in relation to a specific reference point (Hardman, 2009). This reference dependence is a key behavioural concern to those wishing to understand whether or not insurance will be purchased by an agent. Reference dependence means that instead of an agent comparing the absolute outcome of a gamble, the outcomes are instead evaluated as deviations – losses or gains – relative to some reference point. Therefore the milestone by which the gains and losses are defined is critical in determining the outcome of an agent decision, and the extent to which policy instruments target these.

A reference point does not have to be fixed; Siegel (1957) gives the suggestion of an aspiration level, Baucells et al. (2011) uses past observations, Wakker et al. (1997) and Syndor (2010) both use initial wealth. However, a reference point which is not a product of the absolute value of an outcome presents problems in programming Prospect Theory within an agent-based model and applying it to empirical data with the only other papers analysing insurance demand under Prospect Theory being Eckles and Volkman Wise (2011) and Schmidt (2003). Yet, neither of these papers attempt to do what this study does in creating an agent-based model to programme the problem, and, what's more, developing reference points which adapt over time in relation to the agent's experiences.

The next phase of Kahneman and Tversky's model is the evaluations stage, the formula for which is:

$$U = \sum_{i=1}^{n} w\left(p_i\right) v\left(x_i\right)$$

Where *U* is the utility, *w* is the weighting given to the probability, *p*, of an event and *v* is the value weighted upon, *x*, the potential outcome. As can be seen from the formula of expected value (below), there are many similarities between expected value and the previously described Prospect Theory:

$$EV(G) = \sum_{i=1}^{n} p_i x_i$$

Yet, empirical studies, as well as the interview data previously presented illustrate that agents rarely maximise expected monetary value when faced with individual choices, such as the purchase of insurance. This can be explained by the behavioural additions to the formula; the value and probability weighting, which will be discussed in more detail later in this chapter.

3.5.1.2. Contradictions to the intended use of Prospect Theory

As already stated, the way in which elements of Prospect Theory are applied within the agent-based model are fundamentally different to the theorys intended use. Some of the reasons for these contradictions include the difficulty in programming Prospect Theory, the ability of agents within an agent-based model to adapt over time which allows for the novel application of Kahneman and Tversky's reference points, and the multiple possible approaches to structuring processes, such as memory, within a model. The main systematic contradiction to the application of elements of Prospect Theory within the agent-based model developed emerges from its application as a tool for theorising

outcomes of observed behaviour as opposed to its intended use as a theory to explain observed outcomes which run counter to expected utility. I now look at the key features of Prospect Theory which were used within the agent-based model, examining how these elements were incorporated and how this aligns with the intended use of Prospect Theory.

The very notion of applying Prospect Theory to an 'agent' in a simulated reality runs contrary to Kahneman and Tversky's intended use. An agent is an entity defined by a range of behaviours applied to it. In contrast, Kahneman and Tversky developed a theory which draws key features from the, at times, seemingly chaotic actions of people to explain why people chose to take such actions. Here, the model developed assumes that the key features identified in Prospect Theory must be true, applies them, eliminates any other causes of ambiguity which could indeed inform decisions which do not result in expected utility. Such an elimination means that behaviour traits which have gone unobserved in reality will not be represented in model outputs. Despite this, evidence supports that, in general, the public does follow similar behaviour as documented in Prospect Theory (1979) and, as such, an assumption can be made that the outputs of ABM 3 will be more aligned to reality than ABM 2. What the model cannot be used for is to explain the behaviour of the public or give absolute probabilities that an agent will purchase an option. As such, the model developed must be considered as a prototype, applied to an artificial reality which does not take into account the complexity of the insurance market. However, in the future, such a model could be applied to improve insurance demand by informing increasingly tailored insurance products by using real-time, most likely web-based, consumer data to inform the behaviour of 'agents', and calculating insurance costs using whatever model the insurance company already uses. Thus, my usage of agents within the agent-based models would not be recognised as

Prospect Theory, but instead utilises aspects of Prospect Theory in a novel way.

Next, the kind of problems Prospect Theory has been applied to are short term and answered by respondents who may have an insignificant long-term investment in the problem posed to them. For example, the theories developed for Kahneman and Tversky's original Prospect Theory model (1979) were informed by hypothetical lotteries posed to university students. In contrast, the problem of buying insurance is highly complex in that the occurrence of a flood and the cost of damage incurred are uncertain, the outcome of a householders decision may have a significant and long-term implications for their wellbeing, and the householder is most likely looking into the future for at least the duration of time which they are to reside in the property at risk. Thus, not only am I not using Prospect Theory for its intended usage (i.e. as a model to explain behaviour which does not adhere to expected utility) and instead using identified behaviour traits to hypothesize possible outcomes, but I am also applying the agent-based model to problems which are far more complex than the problems which informed the behavioural traits which culminate in Prospect Theory. Such an application cannot be described as a Prospect Theory model, but instead as an agent-based model informed by behavioural traits identified in Prospect Theory.

In regards to the structure of the agent-based model, like Kahneman and Tversky's Prospect Theory model, I have included an editing and evaluation stage which the agent goes through prior to making a decision. Due to the alternate use of the model – to hypothesise probable actions of agents – I also added another stage to the agent-based model after editing and evaluating, the process of which could be considered as a 'final selection'. I will now discuss how each stage has been incorporated into the model and how this may run contrary to Prospect Theory.

The editing stage within Prospect Theory identifies a reference point against which the agent values their decision. Unlike EMV, this reference point does not need to be the absolute loss or gain incurred by an agent choosing an option and, importantly, losses are valued more heavily than gains. In the agent-based model developed I was inspired by Kahneman and Tversky's use of reference points because I had noticed among respondents that not only did they make choices related to reference points which were not the absolute value of the gamble, but that those reference points changed in response to their experiences. For example, a householder who had never been flooded might weigh the value of their gamble in relation to the change in the price of insurance from year to year, i.e. they would look at a £100 increase rather than the absolute cost of insurance which might have changed from £300 to £400 per annum. Following a flood event, householders might significantly change their reference point from which they assessed the risk value of purchasing insurance, often comparing it to the level of damage costs which they had previously incurred. Thus, if the damage from a previous flood had been £30,000, by purchasing insurance the agent felt as if they were saving £29,500 (if the cost of insurance was £500). In the immediate aftermath of a flood, the householder perceived themselves as protecting their property against a threat which they felt was imminent (regardless of the accuracy of this feeling).

Within the agent-based model, I designed and programmed adaptable reference points which allowed for this change of preferred reference point following a flood, and, from this threshold, the behaviour of agents could remain or change to another reference point. Thus, it may never have been the intended use of Kahneman and Tversky's Prospect Theory model to have adaptable reference points, and for these to be applied in order to demonstrate how adaptable reference points significantly alters the probability

that consumers will make investments in insurance or property level protection. Yet, the influence and process of decision making which is highlighted by having adaptable reference points could make a significant contribution to understanding if policies, such as Flood Re, are socially feasible and, more theoretically, for exploring the impact of catalytic events and incremental developments upon longterm decision making. That Kahneman and Tversky would recognise or have expected such an application is highly unlikely, and ultimately was not the intended use of their model.

A product of the adaptable reference points which I develop within this agent-based model is that agents were required to have a memory. This is because the agents adapt in response to their memories of past flood events, their memory of the previous price of insurance premiums, and their memory of whether their previous decisions led to their preferred outcome. Within the model, I designed the experiences of agents to be remembered equally (and have an equal influence on decision making) over a duration of memory time which was rolling. The process of this memory storage undoubtedly does not match the way in which people would remember such events, however, the duration of each memory is justified within the methodology. If Kahneman and Tversky were to have developed a model with a memory of past events it is most likely that they would have applied observed behaviour similar to that documented in Kunreuther and Roth (1998) who state that "people do more to prepare for future earthquakes, including buying insurance against them, just after an earthquake than at any other time. As the memory of the earthquake fades, the motivation for preparedness decreases." (p.58-59). I believe Kahneman and Tversky would have applied such a memory to losses[7] because in all of their work they seek to explain observed behaviour. The agents memory process

[7] I am unsure of whether Kahneman and Tversky would have applied such a weighting of memory to gains, and suspect from their adherence to observing real behaviour that they would have treated memory of gains differently to losses.

programmed within this model, therefore, runs counter to the ethos of Prospect Theory and is more of a reflection of my desire to retain simplicity within the model. In a future version of the model, a more realistic weighting for memory retention would be recommended.

Following the editing stage in Prospect Theory is the evaluation stage where the investor calculates the value of options in light of the reference point which has been chosen, and from here each option is ranked. Within this section of the agent-based model, the integrity of Prospect Theory is retained and not manipulated in any way. However, following the ranking of options I add a new stage which would not exist within Prospect Theory because of the intended use of Prospect Theory in comparison to this model, i.e. following the ranking of options, I needed to know which option would be chosen. In contrast, within Kahneman and Tversky's experiments the option would have already been chosen and the choice used to justify the structure of Prospect Theory.

Thus, within this final 'selection' section of the agent-based model, the agent chooses the highest ranked option, but will only register that option as the choice in the case that the agent can afford the option. Importantly, this final cull of options did not need to be located at this point of the agent-based model and was placed there solely because I wanted to examine what the choice of agents would be if there were no financial constraints upon them, which I could only do once the options had been ranked. This is one stage which I am unsure of whether Kahneman and Tversky would have placed during the editing stage of the model or after the evaluation stage, the latter being where I chose to place it. The ambiguity in my mind of what Kahneman and Tversky would have chosen to do emerges because the existence of an editing stage holds the implication that Kahneman and Tversky believe that the parameters of the gamble should

be determined prior to that gamble being evaluated, i.e. editing out all of the implausible options. However, Kahneman and Tversky also seek to explain observed behaviour, and it may be the case that a consumer has a preferred option, but cannot afford that option and therefore chooses the next best choice (As is facilitated by numerous online stores which allow the consumer to narrow their choice with a final filter option). The thought process is to formulate the ideal choice and then chose the best option within the defined parameters, this parameter may not only be cost, as used in this thesis but the distance from the consumer, delivery options etc. Thus, in Prospect Theory a final selection stage would not be necessary, however, if a selection stage were to be integrated there is fair justification for it to be positioned either during the editing stage or after the evaluation stage – either option should have no impact on the final choice.

The final issue I would like to bring attention to is the fact that householders living at flood risk may follow Expected Utility. This final agent-based model does not allow for an agent to follow Expected Utility (though the outputs of a scenario which agents do follow expected utility are those formulated by ABM 2) and integrates behavioural traits which almost ensure the outputs do not fulfill Expected Utility. Though the decisions of householders in risky environments are frequently shown not to follow Expected Utility, with those observations justifying the development of this final agent-based model, this trend will not be universal, and there will be householders who are calculated in making investment decisions regarding the purchase of property level protection and / or insurance. Though supporting the treatment of Prospect Theory within this agent-based model are the outputs of Pope and Schweitzer (2011) who demonstrate that even the behaviour of highly experienced, well incentivized professional experts does not adhere to expected utility. Thus, there may be individuals who are able to calculate EMV ac-

curately than others and who do so on a regular basis, which will mean the probability weighting which influences the perceived probability of outcomes and the feeling of gains / losses will vary within a community. However, the agent-based model built represents the documented majority who do not adhere to expected utility.

3.5.2. Model development

The model description follows the protocol for describing individual- and agent-based models (Grimm *et al*. 2006; Grimm and Railsback 2005) and consists of three elements. The first provides an overview of universal and agent variables, the second element explains the sub-models and processes and the third describes the experiments run. An overview of the model is displayed in Figure 3.3.

3.5.2.1. Defining agent reference points

In this thesis, three reference points are identified from the previously discussed interviews, the outcomes of which are supported by literature (Tversky and Kahneman, 1991). The first of these is the adequate access to funds. Kunreuther *et al*. (2014) describes a reference point in relation to wealth, which is supported in part by the earlier interviews with respondents discussing how they are unable to afford insurance. Yet, the idea of affordability is not necessarily correlated with wealth, leading to a flaw in Kunreuther *et al*.'s (2014) application of wealth within Prospect Theory. Instead, the availability and quantity of savings are used within this study as they indicate the wealth remaining after all other expenses have been taken into account. Using savings has the flexibility of allowing for variance in lifestyles and expenditure which influence the extent to which insurance might be prioritised over other expenses.

The second reference point identified from the interviews was the cost of insurance itself. Many of those who regularly purchased insurance based future purchases of insurance upon the relative cost of earlier purchases of insurance. Thus, if insurance was regularly purchased and the price at the time of the purchase decision was the same as the cost previously incurred then the householder would not view the purchase of insurance as either a gain or a loss. Despite that flood insurance is bundled into house insurance, policy holders stated they they had been subject to premium and excess increases following both the identification by the insurance company or Environment Agency that they were in flood areas with some householders challenging this delegation of being 'at risk' and having claimed for flood damages within the last five years. However, such a reference point does present challenges in its implementation within a model. First, the reference point only applies to regular consumers of insurance meaning that some definition of 'regular' had to be made. Second, I had to decide how consumers might compare past prices of insurance premiums to current prices. For example, some consumers may compare the current cost to the minimum or maximum costs of insurance they had previously incurred, whereas other buyers may compare the cost to the average cost over a period of time. Finally, the duration of memory for defining the average value of insurance costs had to be defined. Thus, having a reference point of past insurance costs provided more realism to consumer behaviour in regards to decision making under uncertainty, yet, it also presented programming challenges.

The final reference point identified from interviews was the maximum cost of damage previously incurred. Earlier empirical studies demonstrate that significant flood events lead to highly reactive responses from those impacted by them (Tobin and Montz, 2004). In the case that people were impacted by these large scale, unexpected flood events they

often then used this extreme reference point as a basis for all of their decisions regarding avoidance of future events. The result is that these consumers have a much higher risk aversion than their less experienced counterparts and often are over-insured, both through insurance itself and with other flood risk management options, such as property level protection. Within the model this loss aversion is quantified by the probability weighting, which is introduced and justified below.

Programming the 'experience' reference point demanded an increased model simulation time so that the agent adaptation to past flood events could be identified for low probability flood events. I programmed the memory length of the experiences to exceed that of the memory of insurers, due to respondents referring back not only to flood events which may have occurred decades in the past, but also to recollections of elder members of their community who talked of experiences outside of the living memory of those intending to purchase insurance. In response to this reactive behaviour, I determined that the second possible, but not definite, reference point for agent decisions would be the maximum damage experienced.

Out of these three reference points – savings, average insurance, and extreme experience – savings where the constraining reference point. This decision was made because even if an agent desired experience or average insurance to be the reference point by which they made their decisions, if they were unable to afford insurance, then ultimately their overriding reference point would be the money that they had at their disposal. The presence of three reference points, which can be updated depending upon the experience of agents during the model simulation provides an important distinction from previous studies, and allows me to not only have a more accurate representation of the reference points by which consumers gauge their gains and losses, but also track how this reference

point is updated by agents depending upon a number of variables, such as insurance cost and damage frequency, which ultimately allows me to demonstrate whether policy instruments, such as Flood Re are able to change the psychological processes which inform the decisions which lead to the purchase, or otherwise, of insurance.

The model built was designed according to Prospect Theory with a probability and value weighting to a level previously justified. In each round the agent is able to choose between three different reference points, a choice which is constrained by prerequisites which will now be discussed further, and then four prospects which are presented to that agent, to purchase insurance, to purchase property level protection and insurance, to purchase property level protection alone, or to purchase nothing.

In regards to the choice of reference point, as previously discussed three reference points (RP) are available to the agent RP_a. The justification of values for these reference points is presented in the Sensitivity Analysis of this chapter. Where the maximum damage experienced A^{max}_{damage} will become the reference point if the number of floods experienced N_{floods} is greater than the simulation time divided by *w*, where *w* is a weighting to indicate a high frequency of flood events. As justified below and tested in the sensitivity analysis, the value for *w* is set at 5 for these model runs. The average insurance costs $A^{average}_{insurance}$ will become the agents reference point if the condition for A^{max}_{damage} is not met and the number of insurance purchases $N_{insurance}$ in the agents past is regular, as determined by whether $N_{insurance}$ is greater than $\frac{T_{st}}{r}$. Where *r* is a ratio where the purchase of insurance is considered to be regular (the ratio level is discussed below and tested in the sensitivity analysis). If none of these conditions are met then agent savings $A_{savings}$ will be the reference point.

$$RP_a \begin{cases} A^{max}_{damage} & if \quad N_{floods} \geq \frac{T_{st}}{w} \\ A^{average}_{insurance} & if \quad N_{insurance} \geq \frac{T_{st}}{r} \\ A_{savings} & otherwise \end{cases}$$

Within the first decision, which determines the agent's reference point, conditional statements are used. The Boolean condition for each of these statements was informed by secondary empirical evidence and interview data which described how people make decisions in purchasing insurance. Thus it should be noted that the Boolean conditions are open to debate. For example, the number of floods a person must experience before their reference point changes to maximum damage will vary from person to person, the number of years which a person purchases annual insurance before that purchase becomes internal to their annual expenses will also vary in change in relation to people's circumstances. Ideally, different agents would have different thresholds at which they would become 'regular' consumers of insurance, or experienced in having dealt with severe flood events. If this model was to be taken further, a larger sample size of respondents, and data from insurance companies would be necessary. However here the aim is to get a broad understanding of how market adjustments will impact public behaviour in comparison to the assumption made by Flood Re that it is absolute affordability alone which influences insurance uptake.

The first reference point is the maximum damage a person has experienced. The Boolean condition here is if the number of floods is greater than or equal to the total simulation time divided by a flood regularity weighting the decision in that simulation year will be made according to the maximum damage reference point. Therefore if there was one flood in five years, for example, a person would prefer their reference point to be the

maximum damage incurred rather than any other reference point.

Within the model the agent only has to have experienced a flood on average once every five years in order for their reference point to be set to experience. This ratio is higher than the probability of flooding in any of the model runs which varies from 1 percent chance of damage in any given year, up to a 2 per chance. The logic behind this is made clear if we look at the period between 1998 and 2012 where there were extreme flood events on average every other year. This clustering is typical of chaos within a random system and despite that the flood may still only have a return period of one in 100 years such clustering is not implausible. However as demonstrated in Prospect Theory (Kahneman and Tversky, 1979) the public are reactive to these low probability events with very few people considering the logic behind such clustering (Kunreuther and Pauly, 2014). The result being an extreme public response to any flood events, and a poor ability to unconsciously distinguish between a flood event with a return period of one in 20 years and that of one in 100 years. Thus a the ratio of floods to memory length required to make experience the reference point allowed for this reactionary behaviour to emerge within the model, which ratio reflective of true flood risk would not.

The second reference point, average insurance, also had a ratio of 1 to 5, with the justification for this having a different source. Within the insurance industry, though there is no definitive duration of memory for insurance, there is evidence in the form of published news reports and primary investigation where I varied the time between flood events and got insurance quotes. That the length of an insurance memory is five years is a reflection of the insurance quote a person would receive which is based on the previous five years of quotes outside of the five year period quotes were not rolling. Thus, if an agent purchases insurance at least one time within a five year time period then in the

insurers eyes this purchase will be seen as regular as it can be used to inform their prices.

The final possible reference point is the alternative outcome for the *if – else* statement. This reference point is agent savings, which, as mentioned, is the ultimate constraint upon the purchase of insurance. It is for this reason that the savings are considered to be the alternative. From the interview data, very few participants referred to the cost of insurance in relation to their available capital. Most of those that were purchasing insurance, or concerned about the purchase of insurance, were already buying insurance which indicates that the respondent were already able to afford insurance. The major concern for these people was the increase in price – not the absolute value of insurance. Therefore savings can be seen as the final parameter which influences decision-making in insurance if other parameters are not met.

As can be seen there are three reference points for determining gains and losses within this model. In reality there are countless more reference points, however these are the reference points which have been identified from the respondents in the earlier interviews. The presence of a reference point provides a disproportionate level of realism in comparison to the expected monetary value because, as indicated by the interview data, people rarely make decisions on the absolute value of the gamble of purchasing insurance. It is accepted that the Boolean statements are open for the debate in not only their values, but in their form, i.e. whether the maximum damage or the average damage should been the reference point. These technicalities are of limited concern in this chapter which aims to explore a concept of market adjustments, as opposed to the technicalities of a single policy. However, if this model was to be adopted by insurers more investigation into concepts such as regularity of purchasing or reference back to past flood events would be required.

Sensitivity Analysis of Reference Point Within this section I test how sensitive model outputs are to changes in the order of reference points and intensity of weightings of those reference points. The model was run for a 0.01 chance of flood event in any year of a 30 year model run, and the agent based model had 5,000 agents in the society to ensure that there were similar numbers of agents in each Council Tax Band and the entire spectrum of possible outcomes were covered. To test the sensitivity of the model I investigated how changing the reference point variables altered the end outputs of the model, i.e. the options an agent might purchase. All of the other constraints and variables remained unchanged.

As can be seen for Figure 3.8, the magnitude of weightings influences the strength of the trend of model outputs, but not the overall distribution of results. In comparison, Figure 3.7 which changes the order of reference points and the ability of agents to chose reference points has a significant impact upon whether an agent will prefer to purchase insurance over purchasing nothing within the constraints of their budget. The reference point of savings appears to be the most influential to outputs when all three reference points are run within the model, however, this is because of the constraint added at the end of the model run which means that the option an agent purchases is limited by what they can afford. However, when the model is only run for experience and / or average insurance costs, the trend changes significantly. When the only reference point is maximum damage experienced all agents purchase insurance. When the only reference point is average insurance cost around half of agents purchase insurance, though this reduces to under 30 per cent for Council Tax Band A and B.

When dealing with human behaviour it is very difficult to be certain of what drives people's motivations for the action they take. From interviews, I have identified three

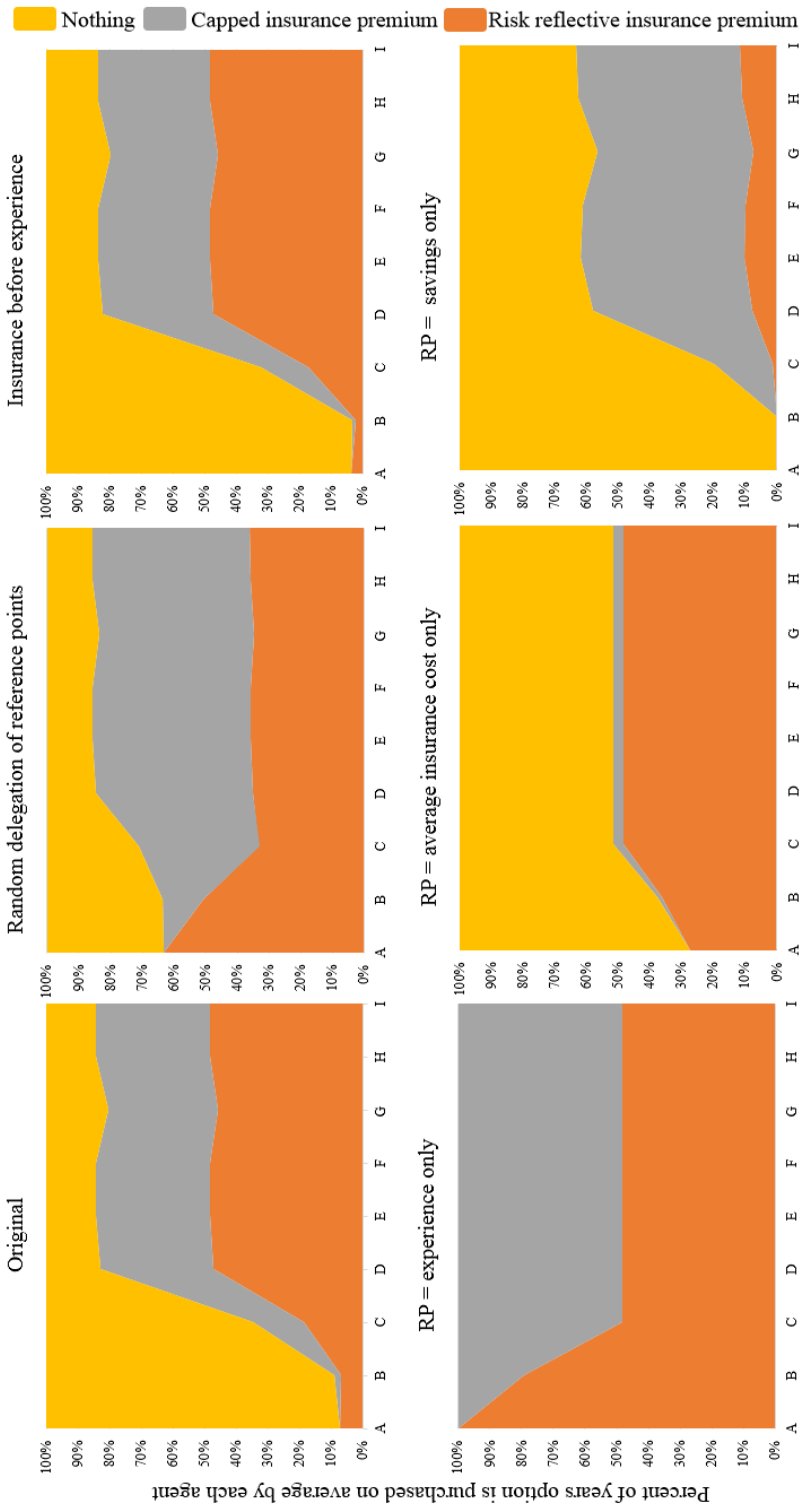

Figure 3.7.: TESTING THE ORDER OF REFERENCE POINTS UPON DEMAND FOR INSURANCE. Working clockwise from 'original' graphs which shows the order of reference points as outlined within the text, the next graph shows the purchase of different options when reference points are delegated randomly, when the order of the *if* statements are reversed, when the only reference point is experience, insurance or savings.

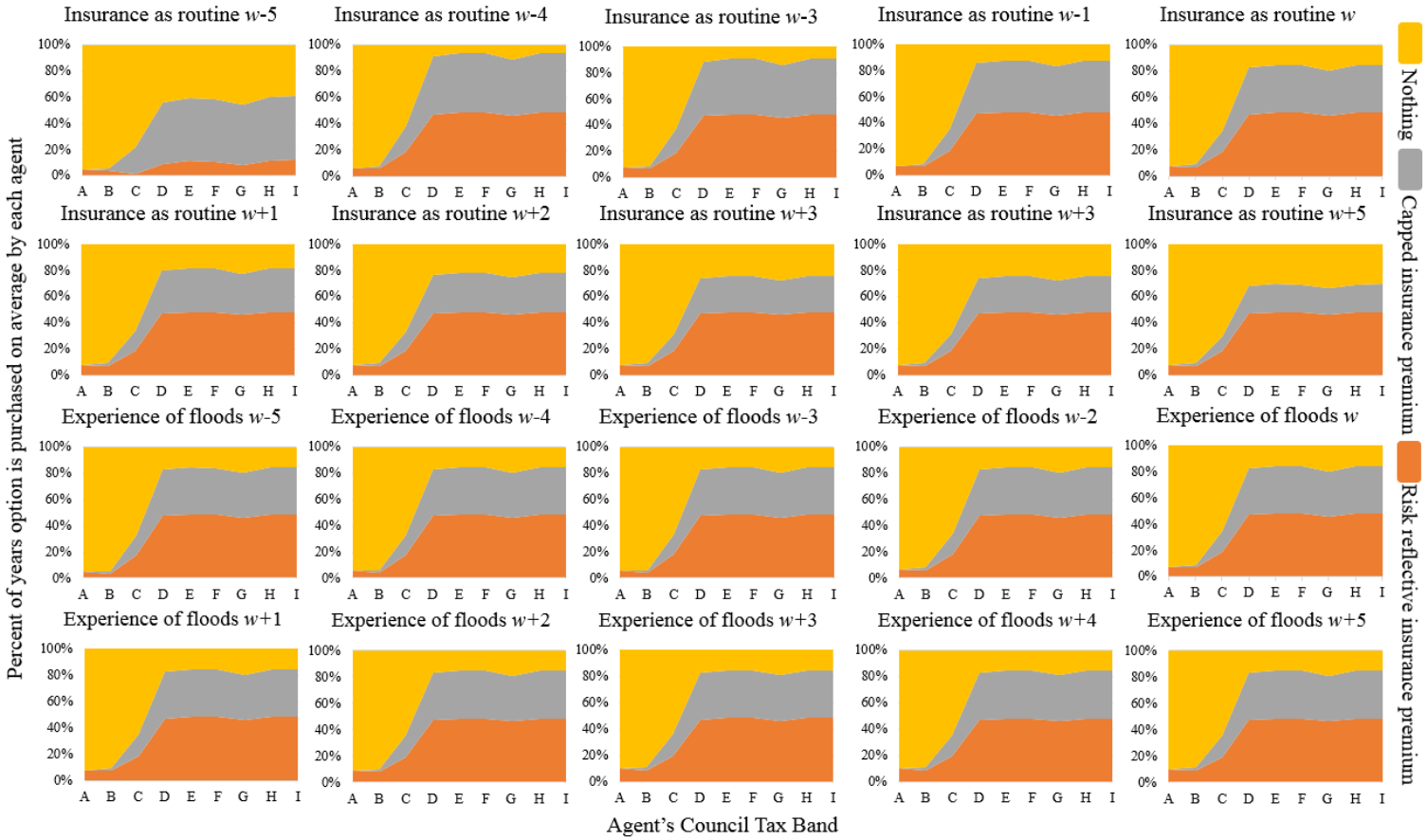

Figure 3.8.: TESTING THE WEIGHTING OF REFERENCE POINTS UPON DEMAND FOR INSURANCE. Altering the magnitude of the weighting for reference points, i.e. the number of years an agent needs to purchase insurance before the purchase is considered routine, and the number of floods an agent needs to experience before they consider the maximum damage they have ever experienced as their reference point.

key reference points from which people base their decisions; the maximum damage an agent has experienced, the average cost of previous insurance purchases, and the money an agent has available to spend on insurance. Due the structure of the model developed, which limits the agents potential purchases according to the funds the agent has available, the reference point which has the most influence upon purchases is savings. In reality, however, if a person's motivation is to avoid flood damage at all costs then they might take out a loan to purchase insurance or property level protection – within this model, such an option is not possible[8]. As such, the graphs presented in Figure 3.7 can assist in hypothesizing the behaviour of agents who prioritise different reference points. In contrast to the main model outputs (discussed further in the results section) which provides an overview of society behaviour, these graphs illustrate the behaviour of a society who all prioritize one specific reference point.

3.5.2.2. Probability weighting of agent perceptions of future damages

Following the identification of a reference point, the next phase of Kahneman and Tversky's model is the evaluations stage, the formula for which is:

$$U = \sum_{i=1}^{n} w\left(p_i\right) v\left(x_i\right)$$

Where U is the utility, w is the weighting given to the probability, p, of an event and v is the value weighted upon, x, the potential outcome. As can be seen from the formula of expected value (below), there are many similarities between expected value and the previously described Prospect Theory:

[8] A model version was created where an agent was able to liquidate assets if they which to increase their amount of money to spend on different options, and after a prolonged period of debt the agent's Council Tax Band would be reduced reflecting a decreased quality of life.

$$EV(G) = \sum_{i=1}^{n} p_i x_i$$

Yet, empirical studies, as well as the interview data previously presented illustrate that agents rarely maximize expected monetary value when faced with individual choices, such as the purchase of insurance. This can be explained by the behavioural additions to the formula; the value and probability weighting. In Kahneman and Tversky (1979) the probability weighting function is shown by Figure 3.9.

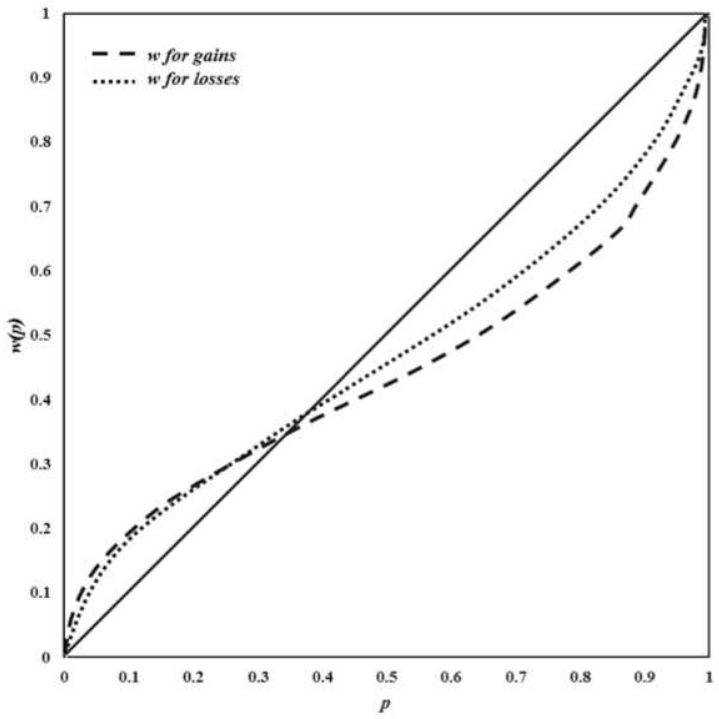

Figure 3.9.: The probability weighting applied within Prospect Theory. Where the real probability is *p* and the perceived probability is *w(p)*.

The curvature of *w* in Figure 3.9 reflects the large effect certainty has upon preferences, a phenomena identified in the Allais Paradox (1953). That preferences change between sub certain and certain choices violates expected utility theory, and is referred to as Savage's (1954) 'sure-thing' principle. However, the Allais Paradox shows that people

do not normally maximize expected utility, with this behaviour trait being accounted for in Kahneman and Tversky's (1979) Prospect Theory through a weighting against the probability shown above.

The weighting function in Prospect Theory leads to a preference reversal when choices switch from certain to sub certain, and also accounts for the disproportionately large impact small probabilities have upon preferences. In regards to the latter, the reverse 'S' shape demonstrated in Figure 3.9 represents that decisions are greatly impacted by small probabilities in comparison to high probabilities. This is a particularly pertinent point when assessing the impact of Flood Re as flood events greater than those of a 1 in 200 years event are considered to be the responsibility of the Government, with the Solvency II Directive (Persaud, 2015) only requiring insurers to hold capital to protect against floods of that level. Importantly, experiments which informed the development of Kahneman and Tversky (1979) Prospect Theory model demonstrated the probability of an event occurring has a far greater impact upon the sensitivity of the model outputs than the value of that loss.

Programming the probability weighting function for practical application does however pose challenges. Figure 3.10 below demonstrates the range of probability weightings commonly applied within Prospect Theory:

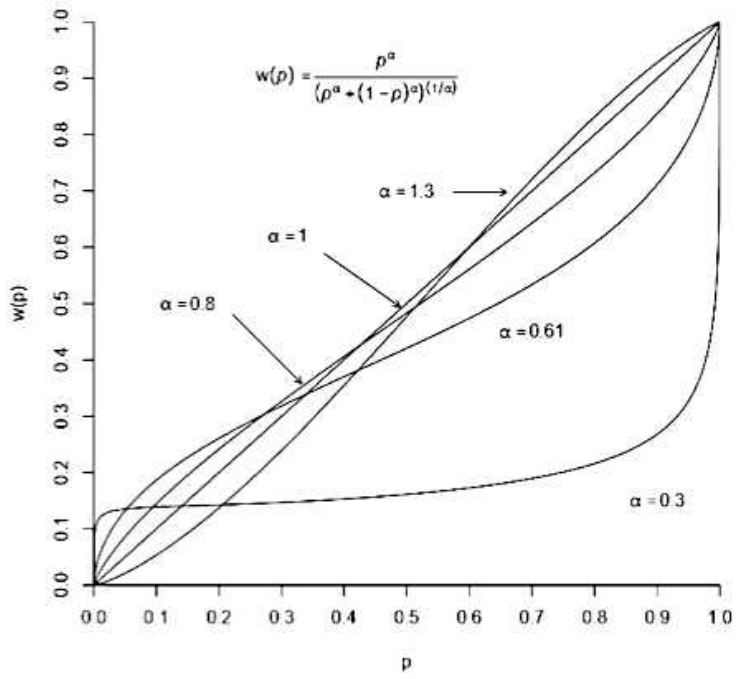

Figure 3.10.: Ranges of probability weighting applied within Prospect Theory. Where the real probability is *p* and the perceived probability is *w(p)*. Probability weightings can be influenced by emotive experiences.

The curvature and elevation of the weighting function influences the model probability, discriminability and gamble attractiveness (Gonzalez and Wu, 1999). Rottenstreich and Hsee (2001) found that the curvature of the weighting function should be more pronounced when decision aroused emotive feelings. Such findings are of importance to decisions regarding flood insurance. As indicated in the earlier discussion on the important impact past flood events have upon the reference points for decision making. The interviews showed that insurance was not only an emotive subject, but was the most heavily conflicted of all household scale Flood Risk Management issues (Geaves and Penning-Rowsell, 2015). However, upon examination of the literature, extreme curvature of the weighting was rarely applied, with academics developing models for

insurance decisions choosing Kahneman and Tversky's original weighting of 0.61 for gains and 0.69 for losses (Tversky and Kahneman, 1991). This standard weighting was also chosen for this thesis' model as it averages out the diversity in emotive feelings between those who do and do not have exaggerated feelings towards flood insurance decisions. A future model might expand this curvature so that those who had a reference point as 'experience' would have a stronger probability weighting; a prospect first proposed by Gonzalez and Wu (1999).

3.5.2.3. The value weighting of agent options

The second behaviour trait represented in Kahneman and Tversky's (1979) Prospect Theory is the value weighting applied to outcome deviances from the reference points previously discussed. The value, *v*, applied to the decision outcome, *x*, is weighted by losses and gains so that:

$$v(x) = \begin{cases} x^{\alpha} & if \quad \geq 0 \\ -\lambda \mid x \mid^{\alpha} & if \quad < 0 \end{cases}$$

Where the value x is determined by loss aversion λ and power for gains α depending on whether the outcome is a gain or a loss from the reference point. Under this formula losses are felt more keenly than gains, thus, the graphical representation in Figure 3.11 shows gains as a concave curve and losses as a steeper convex curve. That the line from the reference point is curved, as opposed to linear is a representation that people are more sensitive to changes which occur close to the reference point than those which are more distant. For the purpose of this study I applied the values which have been widely

used when Prospect Theory is used to understand decisions in demand for insurance. This value is the original from Kahneman and Tversky (1979) where is 2.25 and is 0.88.

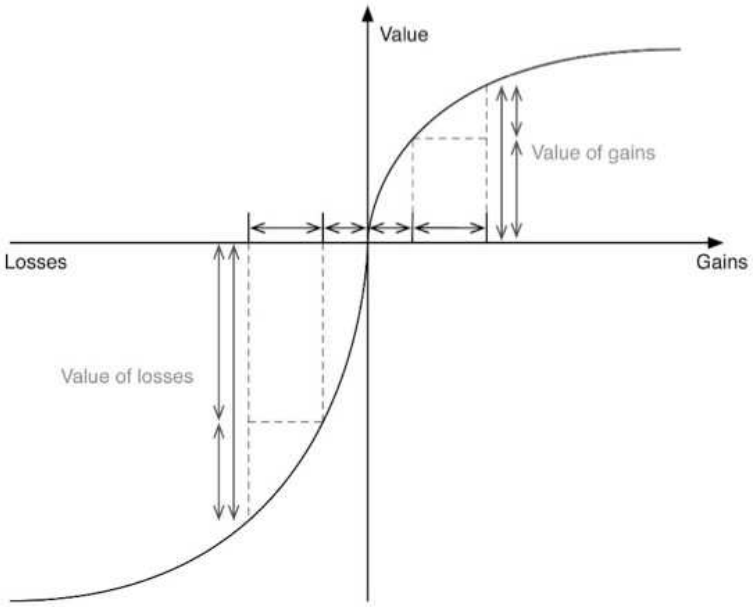

Figure 3.11.: The weighting of gains and losses within Prospect Theory.

That Prospect Theory values gains differently to losses around a flexible reference point is of importance when considering that under an Expected Value scenario all outcomes would be considered a loss. However, under Prospect Theory the choice of purchasing insurance or nothing when flood risk exists does not definitely render the decision as one which only results in a loss; a feature that may considerably alter model outputs of consumer demand for insurance.

Tversky and Kahneman (1991) show that people tend to experience the pain of loss twice as keenly as the enjoyment from gains, and have a strong loss aversion. This pattern was also seen among respondents from the earlier interviews of this study, especially by those who had already felt the impacts of flooding. Therefore, whether Flood Re is able

to change the reference point by which consumers make decisions indicates an agents reassessment of the primary source of their risk, be it a future flood event, change to annual expenditure, or inability to fund other expenses, and ultimately whether policy instruments which function through changing agent behaviour are successful.

Thus, Prospect Theory overcomes the limitations of expected utility by including a reference point which may not be wealth, and by feeling losses more greatly than gains from this reference point. The result is a model where loss aversion is included, as well as risk aversion for gains and risk seeking in losses.

3.5.2.4. Calculating Agent Prospects

The next tier of decision-making after choice of reference point is the decision of whether or not to purchase three different options; to purchase nothing, to purchase insurance, or to purchase property level protection. This decision is determined by the most attractive Prospect Theory output and constrained by availability of funds.

Whether the output of the model is considered attractive is an outcome of (1) the original reference point, (2) whether the proposed cost is a gain or loss in reference to that reference point, (3) the weighted magnitude of that gain or loss, and (4) the weighted probability of the flood event. The computation of the outcome therefore has multiple stages, and different elements of the Prospect Theory function had to be calculated independently and then strung together instead of written as one formula. The result was as follows:

$$(RP_a = RP_x) \bigwedge ((C_x - RP_a) \geq 0) \rightarrow PT_x = \sum_{i=1}^{n} \gamma\left(p_i\right) v\left(x_i^{\alpha}\right)$$

$$(RP_a = RP_x) \bigwedge ((C_x - RP_a) < 0) \rightarrow PT_x = \sum_{i=1}^{n} \gamma\left(p_i\right) v\left(-\lambda \shortmid x \shortmid^{\alpha}\right)$$

Where if an agents reference point RP_a fell with the criteria of one of the three reference points discussed RP_x and the cost of the potential purchase of an option C_x minus the agents reference point was greater or equal to zero then the gamble was perceived as a gain. In the case where the cost of an option minus the agents reference point was smaller than zero the gamble was treated as a loss. It is of note under Prospect Theory the loss of capital can still be seen as a gain if that loss is greater than expectations.

Once the gamble had been determined as a gain or a loss, the Prospect Theory value was calculated for all options. There were a total of four possible options in order to ensure that a householder could buy property level protection and insurance simultaneously: (1) the purchase of nothing, (2) the purchase of insurance, (3) the purchase of property level protection, and (4) the purchase of property level protection and insurance. For property level protection, the function included the change in probability of water entering a house, a probability that the structure would work correctly, and the lifetime of the structure, all of which were informed by Merrett (2012).

Finally, the agent chose the option with the maximum Prospect Theory value within the constraint of their budget:

$$\max_{S_a \geq C_x} \quad \{PT_x\}$$

In the case that agent savings where less than the cost of the preferred option the next preferred option $S_a \ngeq C_x$ was chosen, which would be to purchase nothing if neither

insurance nor property level protection could be afforded.

3.6. Simulated Experiments in an Artificial Insurance Market

Following the development of the model, a number of experiments were designed in order to understand how consumer agents within a simulated market would react to adjustments in insurance cost under current and increased damage frequencies. The results were analysed both comparatively against previous experiments in order to understand the extent to which Prospect Theory changes the output trends in demand for insurance, and as isolated experiments to assess the extent and form of behavioural change caused by insurance premium adjustments. As previously stated, the overriding aim of analysing these results is to understand the extent to which flood risk management should be funded as a public good, with the absolute change over and within the population being used to assess differential benefits across society.

Models were run for average (ABI, 2012) events for damage frequencies of 1%, 1.15%, 1.25%, 1.5%, 2%, 5%, 10% and 20%. That there is an apparent weighting towards lower frequencies is a result of the sensitivity of the model; between 1% and 2% chance of an average flood event occurring in a given year there was a dramatic change in results, probabilities larger than 2% were much more stable in their output.

3.6.1. Outcomes

The outcome of this section on consumer demand of insurance under a Flood Re scenario is to understand whether a loss mitigation flood risk management strategy at household level can be effective when taking into account observed consumer behaviour. I make this analysis by looking at the efficiency and equity of Flood Re using computer-based experiments, and we assess these results in their context, conceptualising the impacts of mortgage agreements, emergency distribution of funds following flood events, and the impacts of Solvency II Directive upon the amount of capital insurers must hold.

4. Public Participation: The Foundations of Change

The aim of this chapter is to gain a greater insight into public perceptions of Flood Risk Management, how these perceptions drive the goods provided by Flood Risk Management strategies, and if pressure from different groups within the public influences the distribution of benefits provided by Flood Risk Management schemes. We examine the relationship between the goods provided by Flood Risk Management and the motivations for the emergence of public activity, and the activities groups seek to undertake. Finally, we assess how the public have responded to changes in the management of Flood Risk Management goods, and how this might change the role of the public in Flood Risk Management in the future. The results of this chapter are used to support the outputs of subsequent chapters. As such, there may be repeats of some quotations later in the thesis. The main bulk of the interviews took place in 2012, but were later supplemented with follow up interviews in 2014/15.

The research here is of significance as local engagement is transforming how flood risk is managed in countries of diverse contexts around the world. In many locations, the State is being pressured into providing goods and services perceived to be of public

priority which could be provided through the market. The provision of these services often requires adjustments of the market through subsidies and/or regulation, and utilise policy tools to reduce the natural excludability and / or rivalry of the services provided. If provided by the State, it would be expected the these nationally funded goods would provide a degree of efficiency and equality to ensure fair delivery of services at the expense of the taxpayer.

4.1. Introduction

In many parts of the world, the management of flood risk is changing, driven by shifting governance arrangements (Sayers *et al.*, 2013). Thus between 2010 and 2015 Flood Risk Management in England could be transformed from 98% of expenditure being funded by the central state to where perhaps 90% of projects will require 'Partnership Funding' involving local/central cost-sharing (Environment Agency, 2010; Defra, 2010). Already some 36% of Flood Risk Management schemes had some form of Partnership Funding in 2012/13, rising to 71% for the 2013/14 new entrants (McNally, 2014).

The change reflects a reassessment of the distribution of benefits provided by Flood Risk Management interventions; previously being considered as either public or private, and now being considered as private, club or public, with a new funding structure which reflects this transition. The change in perception of the goods provided by Flood Risk Management interventions is driven by pressure upon authorities to find savings within their budgets, a recognition by national governments that flooding under increasing climatic and development pressures can pose threats to individuals, public services, the tax base and the economy (Wilby and Keenan, 2012), and that more efficient and

equitable scales of management are necessary to reduce overall risk (Hayek, 1945). As traditional stakeholders assess their revised flood vulnerability (Johnson and Priest, 2008), the public is expected to reconsider their position and possible role in relation to the flooding that they face, the contributions they provide, and benefits they expect.

Our concern here is to understand how the public have driven and responded to the transition within Flood Risk Management in regards to the provision and funding of Flood Risk Management goods and services. We base our enquiry around two interpretations of public engagement which hold merit in the literature. The first interpretation is grounded in post-Marxist theory, and suggests that the emergence of collective action is motivated by a threat to the public good, stimulating civic action to defend against the perceived tyranny of Authority (Young, 2000). A contradictory standpoint views collaboration between the public and relevant authorities as a source of empowerment for all stakeholders (Giddens, 2013). These pro-collaboration theorists argue that the promotion of active citizenship can maximize knowledge and skills within a community; a goal achieved by re-delegating and devolving power and responsibility to the relevant locality.

The associated public engagement activities are also different. The post-Marxist standpoint requires a strengthened democracy to ensure justice and reaffirm accountability, while a collaborative approach encourages communication and an efficient sharing of responsibility. This continual contradiction between the two ideologies behind civic engagement raises questions regarding the forms public engagement in Flood Risk Management might take, the drivers leading to these contrasting forms of engagement, and the risk outcomes associated with different public interpretations of their involvement, and associated activities. These are questions we seek to address here.

From these interpretations on the role of public engagement we present two models for state-society interactions in public service provision. The first category displays 'contractual' relationship: where a level of goods and services are provided in exchange for taxes or similar support, such as water bills in the case of private provision. Within this category the public viewed the benefits of flood defences as "public" with their involvement aimed at ensuring contractual agreements were met. The contractual relationship also applied to breaches in "private" contracts with water companies, (i.e. if a utility company does not fulfil it's Standards of Service) with the same motivations driving public involvement; to ensure the other party fulfilled their contractual obligations.

A contractual relationship can be either legally binding or an output of the institutional framework which leads to asymmetry of knowledge or access to resources which are then provided in exchange for capital or some other resource. Numerous philosophers have debated social contracts, yet it is Hobbes' Leviathan (1651) which was the first to discuss social contracts as a model of social order. Within this model there are two parties, typically the citizen and state, who have a relationship equivalent to a "servant and master" (Gauthier, 1977, p.137[1]), and there is significant power asymmetry between those two actors caused by disproportionate access to resources, be they knowledge, capital, networks etc., which could not easily obtained or developed by the other agent. In the provision of these services there may be little public understanding of how the service is produced, and limited two way dialogue regarding how the service or good is provided. In the case that the terms of the agreement are not met, be that agreement casual or legal, power imbalances mean that, as an individual, the weaker party cannot easily

[1]Gauthier is primarily concerned with understanding the ideology of the social contract, examining the intersection between appropriate human activity and the concept of maximizing utility. As such, Gauthier's ideology is relevant across this thesis, where I examine the difference between maximizing utility and human activity, identifying the gulf between the two as 'social feasibility'.

challenge such abuses. To overcome dissension within the social contract, individuals may chose to associate themselves with a group or activity in order to gain a voice through association and representation, and through that voice bring the State under control of Society. However, a group may also find that the resources provided by an authority can be sourced elsewhere or even grown through developing their own skills, leaving the social contract imperfect, but avoiding the conflict created by pressurizing the authority to amend that contract.

The second form of public participation displays a 'collaborative' relationship: public knowledge, social and financial resources and responsibility are equal and complementary to those of authority, seeking 'collective security' and comprehensive risk mitigation. These groups often treated the benefits of flood defences as "club" goods, understanding that even though the benefits were felt by the wider population, it was themselves as householders who had the most to gain from flood risk management service provision. In general those that had a collaborative relationship with service providers and had approached Flood Risk Management services as "club" goods were more successful than those that did not, but common lessons were that success in Flood Risk Management should not be defined purely as the ability to prevent flooding, but as the ability to access a variety of resources across different levels of society at different stages of flood risk realization.

As described in Chapter 2, for the methodology we adopted an inductive approach, locating our research within contemporary ideas concerning how civic society becomes involved in environmental management. In terms of method we located areas identified as being at flood risk. Here we identified the existence of flood groups, either via the National Flood Forum (using both existing and cached pages to identify disbanded

groups) or by a wider web search and via circa 250 personalised e-mails.

From some 100 groups we received 25 useful responses (see Figure 4.1). We proceeded with telephone interviews initially and, if invited, also visited in person, using 'empathetic neutrality' to gain interviewee attention (Denzin *et al*. 2000). When visiting an area we talked to a number of different residents and stakeholders involved in Flood Risk Management, thus, in total we held circa 40 interviews across 25 locations. In areas where no flood group existed we contacted local residents who, from blogs and newspaper reports, appeared to have influence. Following initial contact, the same interview procedure was applied. All recordings were transcribed and analysed using the Text Analysis Markup System (Weinstein, 2012) to explore our two main interconnected themes: how and why the groups emerged (or did not), and how their motivations for engagement influence the provision of Flood Risk Management services.

Engagement issues and dilemmas

Civic involvement in Flood Risk Management may well be inherently problematic, however, such involvement is necessary if the public are to raise funds to contribute to flood defences.

We judge this to be the case because, first, the public are expected to adopt roles traditionally held by authorities, which they find difficult to accept. In the past when Flood Risk Management goods were predominately seen as serving the benefit of the wider public, people were expected to be aware of flood risk but not participate in project planning or management, which was led by regional committees supervising professionals (Green and Penning-Rowsell, 1986). Today they are required both to be risk-aware and to work collectively to develop Flood Risk Management solutions, and contribute towards

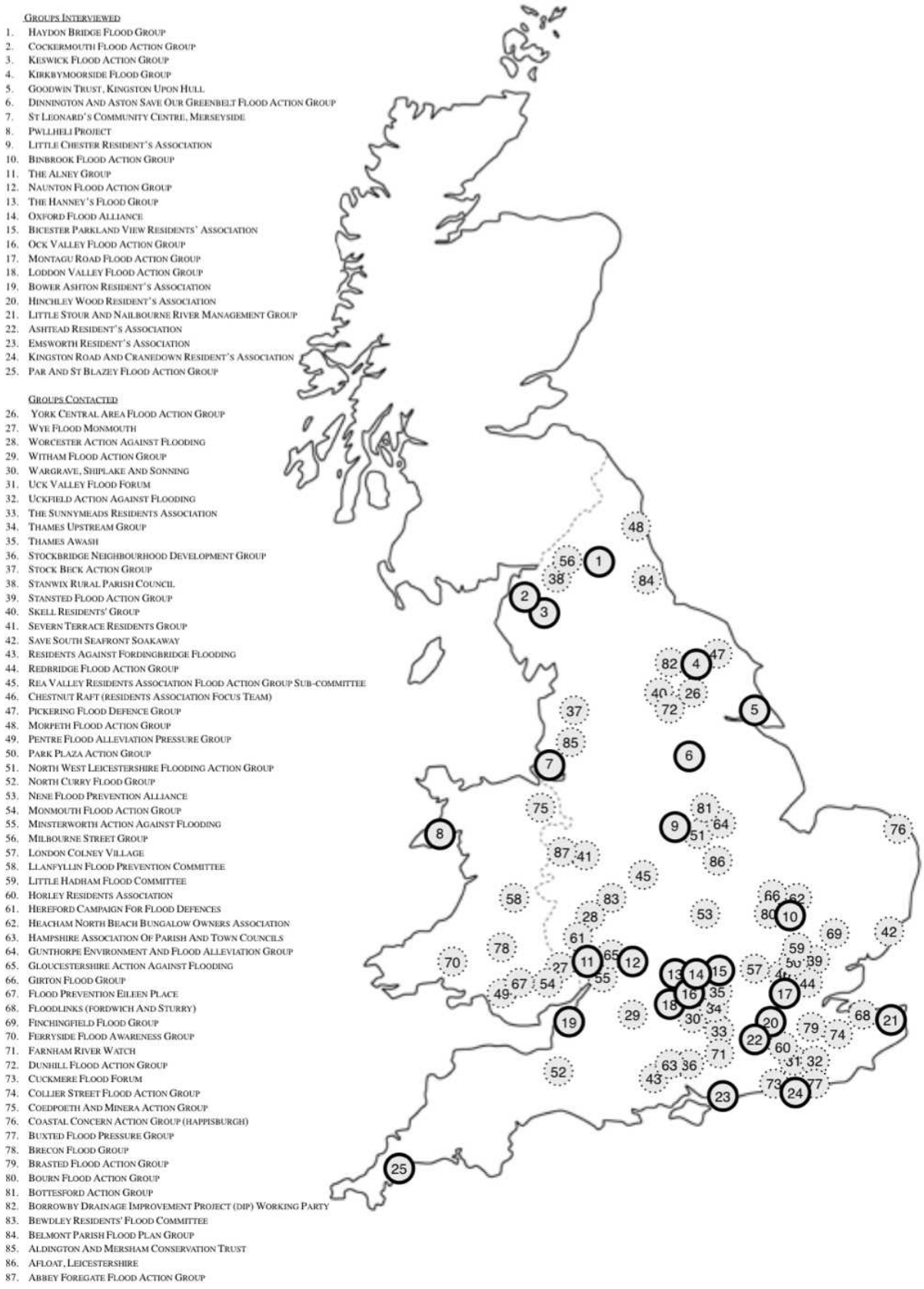

Figure 4.1.: The location of respondents.

the funding of Flood Risk Management goods. Giddens (1998) argues that engagement in the UK is dwindling, but a strong 'volunteering' culture exists. Thus "In 2009/10, 10% of people (were) ... involved in civic activism" whilst 54% of adults had volunteered, formally or informally (Harker, 2011, p.5), suggesting some doubt the public will move far from non-civic volunteering.

Secondly, public involvement in Flood Risk Management is hindered by the necessarily complex institutional arrangements and the confusion caused. Responsibility is fragmented (the Environment Agency; utility companies; Local Authorities, etc). As Buchecker *et al*. (2013) discuss, ordinary citizens are often unaware of these categories of authority and their different responsibilities, and struggle to connect with the appropriate Flood Risk Management institutions, whose staff were often not trusted by the public yet held key resources. The previous treatment of goods, as either being public or private, was as much about streamlined access to clearly identifiable and centrally stored resources as it was the ideology behind such state focus service provision. However, the centrality of resources led to them becoming 'gated' in some respects, and, thus, inaccessible, if not unknown, by the public. The change of public responsibility will also require institutional change and access to resources previously only available to certified experts.

The third barrier to active civic involvement is awareness. Flooding takes many forms - riverine, surface, coastal, groundwater, etc. - with different risks and intervention strategies (Pitt, 2008). Flooding is also episodic, so areas deemed at risk may not experience a flood event within a human lifetime, yet only those who experience a flood have much understanding of its character: people are trapped within a 'prison of experience' (Kates, 1962). The Environment Agency's role in retaining the 'collective

memory' of Flood Risk Management may be further weakened by the devolution of responsibilities to local communities, unless those communities can find a way of storing that knowledge themselves in collaboration with authorities.

Another issue, fourthly, is identifying when the public's involvement is practicable. Clearing drains often requires road closures. Building a flood wall requires engineering expertise and access to the river. Both require power and authority. Even with flood insurance, property level protection, or raising funds for a Flood Risk Management authority's scheme several layers of public regulation is required, though the public act more or less alone. As such, Flood Risk Management authorities are likely to encourage activities such as fund raising, improved awareness schemes, and expansion of the insurance base, rather than activity 'on the ground'. And if fund raising is the preferential form of participation, this could marginalize community members without those skills – in a state-defined currency - and those for communicating with both 'state' and 'society'. Pertinent here are Kisby's (2010) suggestion that 'Big Society' schemes can be exclusionary and Hayek's (1945) question as to whether public participation should focus on creating efficient solutions or strengthening democracy.

How does public behaviour drive the provision of Flood Risk Management services?

The idea that the public as individuals have a legitimate role in taking measures to protect themselves from flooding is well established in policy. However, these views have traditionally focused on private, household level goods such as insurance or property adaptation (Defra, 2004; Defra, 2010). Despite this, the practice of how to get the public to adopt such private, household scale measures, and to do so in a way and at a

scale which is effective is less well understood.

Recent changes in Flood Risk Management policy graduate from the known, if still rocky, territory of individual private engagement, towards community participation and the development of club Flood Risk Management goods. As a national strategy for Flood Risk Management, the augmented involvement of the public raises theoretically foreseeable risks highlighted in research demonstrating the imperfect perceptions of the public under scenarios of uncertainty (Allias, 1953), and unforeseeable dilemmas which come hand-in-hand with rolling out new forms of flood risk governance.

The purpose of the following theoretical framework is to give a broader understanding as to how the involvement of the public in Flood Risk Management has changed over time, and the extent to which the public is now involved as a contributor to, as opposed to a recipient of, flood risk management services. We examine academic perceptions of how the behaviour of the public influences the public's ability to make decisions regarding local flood risk management, and ultimately drive the direction of national scale Flood Risk Management policy.

4.1.1. The public as recipients of Flood Risk Management services

Unlike other studies which address the changing societal aims from management of flood risk in the UK (Johnson and Priest, 2008; Johnson *et al.* 2005), the historical context addressed here refers more specifically to how perceptions of public behaviour in relation to flood risk has influenced the provision of form of flood risk management services in England. This section addresses why, despite extensive research, public behaviour

in Flood Risk Management was not more widely and strategically applied to flood risk practice in the UK prior to the late 1990s, with the next section addressing the reasoning why behaviour research is so integral to the success of Flood Risk Management strategies today.

Flood Risk Management in the UK did not take into account extensive research on the behaviour of the public in response to flood risk until the late 1960s (Haggett and Chorely, 1969) due to the discipline's origins in physical geography (Parker and Penning-Rowsell, 1983). Flooding was originally conceptualised as a product of geomorphological processes, with societal influences overlooked in the development of management strategies until the late 1990s. However, it was not lack of knowledge or interest which led to the omission of societal processes in the development of flood management strategies; the 1960s and 1970s in fact saw significant research into the role of behaviour in influencing flood risk.

Parker and Penning-Rowsell were amongst the first academics to help formalize flood risk as an area of academic research. Their efforts transformed flood hazard research to flood *risk* research, i.e. flooding as a product of behaviour and socio-economic processes in addition to geomorphological phenomena. In their publication 'Flood Hazard Research in Britain' (1983) Parker and Penning-Rowsell summarize the formative influences in the development of flood hazard research, explaining the causes of why behaviour was not fully applied to flood mitigation strategies in the UK.

As Parker and Penning-Rowsell describe (1983), the role of behaviour in Flood Risk Management was not considered in the formation of risk reduction strategies until the late 1960s, when growing discontent grew towards the inapplicability of physical geography to real world problems (Haggett and Chorely, 1969). The result of this discontent was to

encourage the study of flooding and the development of management strategies which would increase soil potential and land capability (MacDonald, 1972). The outcome of which was the extensive destruction of wetlands and continued flooding of urban areas, but improved agricultural productivity. The management strategy was ultimately unsustainable as it ignored the high value placed upon the natural environment by the public, imposing the belief that the greater benefit to society was to improve economic security through agriculture, as opposed to reducing social blight exacerbated by flooding. In this case the simultaneous provision of two public goods – nature and a stable economy – was not possible, and it was the decision of the State to prioritize the latter at the expense of the former.

When concepts of behaviour first began to influence flood management strategies, they were not to maximize the outcomes of individual susceptibility to flood risk, but to further the goals of institutions, which in turn would support society. Literature suggests that it was this interpretation of how behaviour should be applied within flood mitigation strategies which influenced common beliefs of which stakeholders should be included in decision making in Flood Risk Management (Parker and Penning-Rowsell, 1983). It is these beliefs which we shall now discuss.

Parker and Penning-Rowsell (1983) illustrate how the UK had shadowed the United States in the development of Flood Risk Management mitigation strategies. However, the contextual differences between the two countries were overlooked. Specifically influential was the preference for institutions above individual responsibility in the UK, property rights in the USA which were incomparable to England's due to the massive size of U.S. drainage basins, and research into floodplain encroachment in the USA, which was applied in the UK with the assumption that the results of floodplain en-

croachment would be the same. The result was behaviour research which would be overlooked or misapplied in the application of flood risk reduction strategies.

The first problem which emerged during the application of flood perception research which had been developed in the US and then applied to the UK, was that the emphasis on the individual varied, both for practical and political reasons. Practically, the size of drainage basins and associated flood plains in the United States is far larger, this means that enforcement of development control is disproportionately problematic. This difficulty in regulating flood plain development is amplified by the comparatively extended length of time which people own properties in the US which means that individuals are both more directly responsible for increasing damage potential and more susceptible to loss caused by that damage (Parker and Penning-Rowsell, 1983). In comparison the UK has much stronger authority over the regulation of land use planning, which is brought about both by the comparatively small size of political districts and the strength of institutions in comparison to the individual.

The history of strong institutions in the UK has had a major impact on the applicability of US research on behaviour. Smith and Tobin (1979), researchers from the United States, developed the idea of 'social feasibility' of Flood Risk Management strategies. Social feasibility is the assessment of how readily solutions to Flood Risk Management imposed upon flood users will be adopted as a result of behaviour and perceptions. However, during the 1960s the strength of the Institution of Civil Engineers and local planning authorities in the UK meant that solutions predominately came in a form which overlooked the need to take into account 'social feasibility', i.e. the solutions were structural, large scale, and aimed to separate a flood plain from the users. Especially in areas where the land is of high value, flood plain development was seen as providing

greater economic and social benefits to communities than losses from flood risk. As Parker and Penning Rowsell (1983) describe:

> "Flood protection can play an important role in freeing areas for development, particularly where land is valuable. Increased potential flood damage costs from encroachment following flood protection to a high standard may be insubstantial on an average annual basis. Such encroachments may be acceptable and even desirable where the community losses from not using flood plain land exceed the costs of encroachment in terms of increased damage potential." (p.188)

In the UK, flood defences and water management were seen as public infrastructure necessary for social and economic development. Institutions had authority over land, with planning and water authorities working together (Ministry of Housing and Local Government, 1969) to enable flood plain encroachment which would benefit society without increasing flood risk. For example, the 1960s saw the development of many new towns. Milton Keynes was one such town with the planned creation of of 250,000 new houses. David and Woods (1978) discuss how with many of these home to be located on a flood plain, there were fears that Newport Pagnell downstream on the River Ousel would suffer increased flooding. To prevent this, planners built flood defences into the infrastructure of the city, with balancing lakes set within linear parks which ran the length of the city. Flood hazard mitigation was seen as part of the public infrastructure necessary with any new development, and development seen as a solution to alleviate the main source of social blight in the UK; over crowding (Richardson *et al.*, 1983). American behaviour research which focused on individual social feasibility was inapplicable as flooding in the UK was conceptualised as an infrastructural problem or

market failure which could only be rectified by service provision at the expense of the State.

Institutions were also seen as bodies which had the memory and expertise to deliver collective rationality. Rationality requires the development of long term goals with the resources to follow these through, a memory in order to gain accurate concept of probabilities of return events, and a holistic vision to apply the distribution of these probabilities across space. Yet, research has shown that the public live in a 'prison of experience' (Kates, 1962, p.132) with imperfect perceptions of flood hazards and flood loss reduction options (Parker and Penning-Rowsell, 1983). Individual flood users behaviour was informed by the magnitude of past flood events they had experienced (Parker and Harding, 1978), which created problems for individual management of high magnitude flood events or flood events varying in character. From these patterns of behaviour the assumption was made that individuals are not rational agents in the neoclassical sense, with this assumption reflected in the management strategies applied up until the late 1990s.

Institutions were therefore assumed to be rational bodies, which could develop and execute strategies with a long-term vision for the good life (Miller, 2009). However, as the UK's market economy strengthened over time both the public's priorities and ability to drive social change altered (Johnson *et al.*, 2008) The result was the relative power of institutions which had been strong at the emergence of flood hazard research as a topic of national interest waxed and waned, with highly influential bodies of the 1960s completely disappearing by the turn of the Century. As will be discussed later, this change in the relative strength of institutions versus individuals has left a legacy for a now publicly orientated Flood Risk Management policy, which can neither support

the growing costs of maintaining legacy Flood Risk Management infrastructure, nor the encourage the public view that the provision of flood defences is the responsibility of the State alone.

4.1.2. The public as participants in Flood Risk Management services

This section examines why the public became an integral participants in the management of flood risk today, and how this transition has increased the viability of providing flood defences as "club" goods as well as private and public goods. The period between 1998 and 2010 is unique due to repeated large scale flood events which has led to extensive policy change, and the new Flood Risk and Water Management Act in 2010 (Commencement No. 2, 2011). Revised policy has strongly encouraged Partnership Funding of flood defences, and the encouragement of public awareness and participation. It is important to note, that many of the changes in public responsibility were already in existence prior to 2010, yet were unofficial in policy and under exploited in practice.

It was not until the late 1990s that the extensive research on individual perceptions of flood risk and social feasibility of an increasing variety of flood defence types was applied in the UK at a wider scale than local level. The stimulus behind this inclusion was severe flooding in 1998 which highlighted the human vulnerability to phenomena traditionally managed as a geomorphological hazard (Bye and Horner, 1998a; 1998b). At the time, the floods of 1998 were considered the worst flood of the century and followed a period of relatively few floods which left people and authorities unprepared. The widespread damage which totaled approximately £300 million (1998 prices) to a large extent was unavoidable as floods in many places exceeded the capacity of flood defences (Saunders,

1998). Defences, though criticized for not withstanding flooding, protected many of the 5 million people living on flood plains with greater destruction inescapable without their presence.

However, the failures of flood defences led to catalytic policy change, opening a 'window of opportunity' (Johnson *et al.* 2005) in which current political and social preferences gained attention and an opportunity for application in future Flood Risk Management strategies. In 'Floods as Catalysts for Policy Change: Historical Lessons form England and Wales', Johnson *et al.* (2005) explore how the relationship between flood disasters and policy response led to the emergence of specific policy ideas. Specifically, this section shall examine how the political context at the time led to a shift in responsibilities and encouragement of flood defences to be considered as club goods as well as private and public goods.

Johnson *et al.* (2005) describe how the catalytic shift in the emphasis of Flood Risk Management policy was accelerated by a number of other events occurring simultaneously. First, a new Government had recently been established and wished to shake-up the way departments were run. Thus, at the time of the 1998 floods the Ministry of Agriculture, Fisheries and Food (MAFF) was already undergoing a review into flood policy and expenditure in the UK. Though this did not lead to drastic changes in Flood Risk Management, it did encourage an environment of debate. The second event of importance was the recent establishment of the Environment Agency in 1996. Until the floods of 1998 flood control and land drainage in the UK had been largely in the hands of the National Rivers Authority, with the Environment Agency to that point predominantly focusing upon wider regulatory responsibilities. As such, during the floods of 1998 warnings and information dissemination had been poor, opening the Environment Agency up

to particular scrutiny which would lay the foundations for a changed landscape of Flood Risk Management in the UK.

It was the Environment Agency which first emphasized the need for inclusion of the public on a wider scale in Flood Risk Management policy, and had the resources and support to implement a change in the focus of Flood Risk Management strategies. Following the 1998 floods, the Environment Agency agency set up a review team, and from the outset the public were involved: Peter Bye, one of the leaders of the review team and a former local authority chief executive, set a new standard visiting flooded locations and talking to flood victims (Johnson *et al.*, 2005). This process was markedly different from previous enquiries, and sought to identify the social issues which amplified the devastation caused by flooding. The result was that the public were to be included in the management of flood risk, bringing about a new era in which flood risk became more than just a function of hazard magnitude and probability, but also a product of human vulnerability (Wisner *et al.*, 2004).

The first wave of public inclusion to emerge as a result of this transition was the development of early warning systems at a national level with four clearly defined warning codes with associated behaviour advice (Johnson *et al.* 2005) and extension of the warning systems beyond areas of high risk. At these early stages of public involvement, the individual was not expected to actively participate in Flood Risk Management planning, but to receive information, which they would then understand and be able to act upon. The public were still seen as largely irrational in their ability to make calculated decisions in response to flooding, and were not expected to be involved extensively in the planning stages of Flood Risk Management. The public were to be involved in the reactive stage of a Flood Risk Management strategy, i.e. Once informed of a potential risk, acting

upon those warnings appropriately depending upon the level of emergency.

Yet, it is the second wave of public involvement which began to shape the extent to which the public priorities drive the provision of different services as Flood Risk Management goods. From here we turn from historic analysis to explore current patterns of public participation in England using the results of interview data discussed in the Methods Chapter. We will find out how the public now perceive their role in Flood Risk Management - as recipients or a contributors - and how these perceptions influence changes in the provision of Flood Risk Management today, particularly the source of contributions for flood risk management projects, and the distribution of benefits expected from new flood risk management schemes. We look at how this relates to perceptions of public behaviour in scenarios of flood risk, and as a result, we do not just ask 'are the public involved in flood risk management, and how?', but also to what extent does public competency in calculating and understand risk limit the activities the public can be efficiently involved in. I now present this data.

4.2. Results

4.2.1. What are the drivers of public participation?

To understand the current role of the public in Flood Risk Management, we need to understand how and why civic engagement in flood risk areas has emerged or, in some cases, has not (See Figure 4.1; hereinafter groups are identified as numbered there (e.g. 'R11' or [R11] for the Alney Group). Our results show this emergence was dependent upon the scale of the flood 'disturbance' (Rykiel, 1985), the form of governance and

the existence of pre-existing action groups, and the location involved and its levels of economic deprivation.

The scale of the flood disturbance

The scale of flood disturbance had a large influence on the extent to which flood defences should be provided as having private, club or public goods. All floods led to some form of public engagement by the groups we surveyed, but the smaller floods were more likely to lead to the treatment of services as public or private goods as, at this scale, floods were predominantly caused by faulty infrastructure. The public response was to uphold the social contract between themselves and Authorities - be they the State or private water companies – with their participation focused on utilizing community representatives in residents' associations in order to pressurize the Authority into continuing the original agreement of provision of goods in exchange for taxes or water bills. Larger flood events led to the formation of designated flood groups, although all groups had varying priorities and approaches. These groups often treated the goods provided by defences as 'club' in nature, and demonstrated willingness to contribute beyond taxation as a reflection of their acceptance that they would be the primary beneficiaries of any scheme. Flood risk management goods at this scale were seen as beyond the capacity of daily infrastructure, and were considered to be emergency measures.

For groups 15, 18 and 20 flooding had been minimal: including heightened river levels, blocked drains or a heightened Environment Agency warning. These residents were concerned about the threat of increased flooding and joined together to seek to forestall any rise in insurance premiums. Group 15 became interested after the Environment Agency suggested their flood risk might be upgraded, but indicated they would only

take real action following a flood: "It's only when your feet get wet that it gets your attention". These groups viewed the management of flooding as a market failure, with the provision of Flood Risk Management as a necessity for the public good. In the case that groups did not receive the services which they believed they had paid for through their taxes or water bills, they used residents' associations to put pressure on the provider of that service in order to ensure that the other party met the terms of their agreement. However, such a view is not necessarily conducive to the provision of club goods, but in many ways it does not have to be as these goods are naturally private in their excludability and rivalry, and may, therefore, be most effectively provided as market goods.

Groups which emerged as a result of smaller more frequent flooding had a contractual, relatively binary view of the distribution of responsibility for flooding - responsible authorities versus irresponsible citizen - with this impacting the longevity of related action, the promotion of resilience and preparedness to future risk. For example, group 22 viewed unresponsive authorities as the cause of the flood problem, with the water company not considering overtopping of toilets as a flood event and therefore remaining inactive: contrasting definitions of a flood event separated the consumer and water utility. In response residents collectively approached the authority through the local residents' association, thereby pressurizing the company to review its flood definition and associated contract with consumers. This situation supports the post-Marxist belief that Authorities and public must be separate as at any point in time the Authority can define the boundaries of a problem, and without collective pressure the public are in a weak position to challenge that Authority.

For smaller flood events public participation emerges in the form of pressure groups,

with the aim of persuading an Authority to take responsibility for a flood, but without necessarily encouraging community-wide participation:

> "I wouldn't want you to think that all the residents are active. As with so many of these things, we have a nucleus and then the other residents here are kept informed and then if something significant does come up that affects a lot of people, then you get more people playing an active part" [20].

We found a designated flood group is more likely to emerge following flood events large enough to obtain local press or wider media attention. Participation here is dependent upon the location of the area flooded, and the reaction of the relevant authorities. In comparison, groups in rural areas felt that their villages would not have a high enough priority:

> "After the 2007 flood.. me and a neighbour decided to find out . . . who was responsible for those things. And then it turned out . . . . that a lot of the resources were obviously going into the . . . Oxford and Abingdon. So a small village like ours would get pretty low priority. So we decided that we would try and do something ourselves" [13].

The groups we refer to as direct action groups did not attempt to pressurize authorities, but instead chose to replicate authorities tasks; including clearing the river of vegetation (seen as inhibiting drainage), creating emergency plans, and installing river gauges. These hands-on groups took on the role of authorities, but did not necessarily accept responsibility for the impact of their actions or the occurrence of future flood events. The Partnership Funding scheme could potentially benefit the rural groups who would like support, with at least some grant aid to complement pre-existing resources:

> "At the end of the day it got us a few pennies from the council to buy tools and equipment and so on for the village and regularly, well annually I suppose or biannually, twice a year, clean the river through with the waders and everything" [12].

Such groups percieve Flood Risk Management projects in their localities as club goods. Members do not expect funding as they understand benefits would not be felt by the wider authority, yet appreciate all households within the area could benefit to a greater extent if a community scale solution is developed.

Governance enhancing issues: conflict, responsibility and mediation

Many groups emerged in a context of conflict with the authorities regarded as in charge of Flood Risk Management in their locality, exacerbated when these authorities judged that the public would blame them for a breach of some form of social contract. Initially Flood Risk Management goods were seen as a public priority to be provided at the expense of the general taxpayer. However, this public belief did not necessarily mean that in reality the local flood issue was the responsibility of the State, and/or could mitigated through structured defences. As a result groups formed, and with the help of a third party, the nature of the flood issue was in cases redefined.

Groups contacted by a neutral party such as the National Floods Forum (NFF) fared best in terms of managing conflict with other stakeholders, followed by groups contacted by their local councils. Those not contacted at all had turbulent interactions both with authorities and amongst themselves, often leading to the group disbanding. Group 23 was among the first category:

> "Within 24 hours my wife had been contacted as the chairman of the

> residents' association by an outfit called the National Flood Forum... [The NFF] said we needed help... can we... help you put together a flood action plan to prevent this sort of thing from happening again?"

With NFF assistance, a meeting was held between residents and the Environment Agency, Southern Water, the Highways Agency, and Havant Borough Council. The neutral chair made it clear the meeting would not be a 'finger pointing' exercise of blame allocation, but a way of collectively developing strategies for flood alleviation within Emsworth Borough:

> "[The experience was] a sort of a eyeopener because so often you get a situation in a public open meeting, particularly where everybody stands up and says it's all your fault."

Groups described positive experiences when they felt that the problem had been agreed by all stakeholders in initial meetings, and then saw success when authorities displayed an equal commitment to tackling the flood problem, giving the groups freedom to contribute to a solution. Managing to raise £50,000, group 3 saw the Environment Agency as being equally committed as themselves:

> "The Environment Agency... have been supportive of the group as it was set up, they've been supportive all the way along and certainly they moved heaven and earth to 'get the steam for us'" [3]

In contrast, in Cockermouth, it was the local authority which initially promoted its group's emergence, although this was not always unproblematic:

> "What happened after the flooding is you get all these people coming in from the top... telling you what you do. And you're thinking no, you don't know my community... and that was one of our big things about working

> with the Environment Agency and everybody. . . .We are the people who can solve it. So I think this local flood action group was important from that point of view."[2] .

Despite initial conflict, group 2 was a success, raising £340,000 to part-fund new flood defences, but even as a success story and a beacon for Partnership Funding, the group described continuing conflict with their local authority:

> "We've not been impressed with our own County Council, we've done the most and they're distant towards us .... Why did we need to form a pressure group to make things happen? Surely the Town Council should have thought of that. They're just interested in car parking costs and things like that."

Public involvement – aided by third-party support – pressing an authority to take up 'its' responsibility appears to be effective in the short term in promoting the emergence of cohesive groups. But this 'watchdog' approach means these groups are generally unlikely to contribute funds. Instead they perceive the problem as being with the relevant authorities not honoring their responsibilities and local contributions as an unwelcome new tax:

> "I can't quite see residents around here putting their hands in their pockets unless it was a really grave risk, and probably even so, I think the reaction of a lot of people would be "well, this is what we pay our rates and our taxes for"" [20]

Furthermore, the scale of resources necessary for significant risk reduction is seen as potentially beyond the residents:

> "It would've been prohibitive for the local residents. . . we'd have definitely

> struggled to try and get funding from people that were being protected if you know what I mean."[1]

In such instances the public are unlikely to raise funds for Flood Risk Management, and percieve flood defences as market failures, with their provision only achievable via the State. However, where there were smaller floods caused by surface and groundwater flooding, alleviated at relatively low cost, then perhaps a clearer analysis of causation could be promoted by the authorities concerned to encourage a suitable form of participation and cost-sharing.

The location and its deprivation: the non-emergence of groups

In some cases, despite the correct ingredients - a large flood, a neutral party, and good governance - public engagement did not emerge. The cause appears to be poverty, as with those interviewed on Merseyside [7] and at Kingston-Upon-Hull [5](chosen because they are in the top deciles for deprivation in England).

Group 7 attempted to create a resident's association to deal with future flooding:

> "We did try and get the locals to make a residents group. One of our trustees ... was quite prepared to go over there and show [residents] how to start a [residents group] up but I think at the time it was just one thing too much... The reality was they had no money, they had no money to get their kids to school. If you are living on the edge of poverty all the time ...." [7]

These residents could not afford to invest themselves in such groups, but the Red Cross and the local Council provided significant help. However, in Kingston-Upon-Hull a

different scheme was established in the absence of the emergence of active flood groups. A residents' association - the Goodwin Trust - was purchased by the local Council, employing its staff. Following the major 2007 flood, the Council used the Trust to survey which residents needed most support: for the Council, many flood-affected parts of the city were "No go" areas and using Trust workers meant help could be given to those difficult to approach:

> "When I was doing the case work out and about on the streets, knocking on the doors, some of the people I went to see, I have seen before through my job anyway. They see me round and about or through community groups... straight away there was already a rapport ... so I think it put a bit of trust in there."

In such areas, it would appear that engagement with Flood Risk Management will be reliant upon charitable organisations and local councils, and any local funding sourced by parties other than the general public. In regards to the provision of goods, it is considered that the protection of areas of deprivation provides a national benefit, and, as such, under Partnership Funding, areas of deprivation are awarded an additional weighting for their inclusion in any scheme. As such, within areas of deprivation goods are considered as public due to the non-excludable, non-rival positive externalities by assuring that the poorest members of do not become victims of social blight due to income gaps across the population.

4.2.2. How does the public influence service provision?

The way groups emerged gives some insight into how they then operated and the benefits they wished to receive. Pursuing these *modus operando* we also identified two broad

categories of relationship between the public and Flood Risk Management authorities.

The first displays 'contractual' characteristics, with a level of protection provided by the authority in exchange for taxes or similar support (Adger *et al.*, 2013). This kind of perceived necessity for a separation between society and state is explored in a contested collection (Giddens, 1998; Prugh *et al.*, 2000) of post-Marxist literature (Young, 2000; Gauthier, 1977): the only way the public can avoid becoming 'puppets' of the State is through such a social contract (Powell and Geoghegan, 2004). Contracts between society and Authorities / service providers were often perceived to exist when goods of a service were thought to be public – rendering them uncompetitive in the market economy – or private, in which case specific goods, e.g. effective sewerage, had already been purchased at an agreed price. For the public, a flood represented a breach of contract, with recipient of that good either forming pressure groups to challenge this breach, or taking over the neglected role of the authority; the latter implying an acceptance of that contractual breach.

The second category displays a 'collaborative' relationship between authority and the public. The public thereby view their knowledge, social and financial resources as equal and complementary to those of authority, in the search for 'collective security'. Reflecting the relevant international relations research (Tammen, 2000; Organski, 1968), the pre-requisites for collective security against flood risk would include all stakeholders agreeing on the flood problem, an equal commitment to tackle that problem, and identical freedom to join in to act collectively upon decisions. The concept contradicts the idea of state and society being separate, requiring collaborative interaction between stakeholders from the outset in order to formulate 'club' goods.

Lobbying in relation to some 'social contract'

Many groups perceived themselves as pressure groups, rather than action groups, aiming to persuade authorities to invest in Flood Risk Management, rather than contributing their own resources to limit their flood risk: the authority is the 'target', with the groups role perceived to be as separate or additional to authority. The pressure group form of public engagement raised a number of concerns, which are discussed below.

The initial concern was the phenomena of 'fiscal rent seeking' where a particular group pushes it's own agenda at the expense of the overall population. When the writing of this thesis began, Partnership Funding had only partially begun to roll out, and only flood defences deemed to be of national significance or with a high cost benefit ratio were supported by the National Flood Risk Management fund. It was the concern with the increasing number of pressure groups in existence in the period of time prior to Partnership Funding that groups with high social capital and monetary resources would push their own agendas at the expense of others. The result would be householders could use flood defences – paid for by the public purse – to keep their house prices inflated, mortgages accessible, insurance affordable, in addition to a number of other potentially negative externalities. To an extent this did occur, however, and as will be discussed further in Chapter 5, Partnership Funding has limited this trend by using measures to counteract the impacts of an income gap.

The next issue of concern was that the lobbying groups we interviewed focused on decreasing the flood hazard, not the flood risk; the latter mitigating vulnerabilities exacerbated by flooding, the former focusing on the reduction of flood probability and magnitude. If the cause of flooding was easily identifiable (Pahl-Wostl and Hare, 2004), a flood group with the ambition of reducing flood probability or magnitude, and po-

tentially omitting vulnerability focused measures, could be effective. However, lobbying groups were surprised to find that despite their efforts in pressurizing an authority into building a flood defence (to a particular standard), flooding still continued due to additional sources of flooding, such as ground or surface water flooding. Thus group 1 had lobbied for new flood defences, which were later found to be inappropriate to future flood events, and which were breached again following our interview.

A lobbying role also meant that the 'risky' aspects of flooding (i.e. the uncertainty of timing, source, magnitude or spatial distribution of a flood) are not acknowledged or understood by the local population:

> "There was no need for anything like that. The things were sort of happening spontaneously from their [the Environment Agency] end; they realised that they were liable if anything happened again and they knew about it"[1].

Fragility is the third cause of concern: flood groups which focused their efforts on lobbying generally disbanded after new flood defences were provided, despite residual flood risk remaining:

> "They [the Environment Agency] were obviously keen that there was a group there in case there was another flooding issue...particularly while the defences were inadequate (but)... they've never put any pressure for the flood group to carry on."

A fourth concern was the number of cases of conflict between stakeholders. Repeatedly, lobbying groups described turbulent interactions with authorities:

> "I don't think our relationship [with the Council] is that good. But, we're trying to exert influence... (and) the only thing that we've got ... is ... a mass of people.. The leader of the Council wanted us to meet immediately,

> and we said "No", because one of the rules we made was originally was that we wouldn't play their game because they are winners at their game, we would have to play some other sort of game"[6].

Lobbying groups, unlike other flood action groups, were more likely to believe in a conspiracy behind the lack of action from authorities. Group 6 believed that there was a pre-existing agreement between the developer and local authority:

> "Whether they maintain their end of the bargain I've got no idea. Because they still don't trust us. But, we're still working with them ...we don't trust them but we think it's worth exploiting."

Such conspiracy theories may reflect the local authorities' antipathy with the public seeking a contractual, as opposed to a collaborative, relationship. But our lobbying groups frequently misunderstood their capabilities, stating that all they had was 'enthusiasm', or a 'mass of people', and not recognizing the knowledge, social and financial resources they also brought to collaboration. A local authority which shares this narrow view runs the risk of over-looking flood issues identified by the public, and facing disproportionate difficulties in raising the public support necessary for the implementation of partnership funded flood defences. Thus group 4 could not get the local authority to recognise or take responsibility for flooding. These groups disbanded and members individually lobbied for household-level flood protection, to which the local council contributed. However, the overall flood problem remains:

> "We were flooded in 2005, 2007 and again in 2010. And ... nobody was really taking much notice at all. It was flash flooding, there's no river; we're halfway up a hill....But we couldn't get anybody interested...The Environment Agency weren't interested because they were only interested

in rivers, river flooding."

Groups 1, 4 and 10 indicated the decision to become a lobbying group was not necessarily their own or seen as always successful. Also

> "It's not, not a partnership as such because there isn't a sense of equality there. [The Authorities] can always turn around and say "we've heard what you said but we're going to do what we want to do"...I think up to a point where if we hassle them to much they'll start to talk about things like, well, for example with our ponds if we hassle them on maintaining too much they would fill them in"[15].

However, the outcomes of lobbying for new defences were not solely negative. New networks were created within a community and with the Environment Agency, easing future transactions . Residents' associations' lobbing appears particularly beneficial, as they hold a community memory, already had key skills, and do not disband following the development of flood defences. Flood roles can therefore be reactivated in the case of emergency, leaving the community less vulnerable to future risk.

'Direct action' as the priority role

The second form of flood action group were those that recognised a social contract between state and society, but did not expect the relevant authority to mend the breach that flooding represented.Here there was effectively a 'missing market' with the gap in service provision being provided by volunteers as these groups took over the authority's role, managing the flood risk by maintaining the river themselves. Other groups felt that this form of participation was "no longer considered good practice" [21] with the concern that "it means that the Environment Agency doesn't feel the need to do it"

[10]. Demonstrating a reduction in flood risk following direct action was not our research aim, but the value of this approach could be gauged through examining changing accountability for Flood Risk Management, the ease of interactions with Authorities, and the uptake of novel methods of Flood Risk Management by participants.

In terms of demerits, the accountability of flood groups involved in direct river management was a cause of confusion and concern. Issues included the potential to move the flood problem downstream, and the immediate accountability in carrying out the work of local authority staff who were training and insured. Group 16 was frustrated by their local authorities' resistance to their activities, and ultimately were required to train members to use machinery and wear specific clothing before working in the river.

This encouraged two outcomes. First, the authority relocated accountability for clearing the river from itself on to the flood groups. Second, the public then undertook the exact same task as an authority's employee, unpaid and uninsured. The boundaries of acceptable action were defined by the authority (usually a local Council), and, as such, participants became unpaid workers. Many groups were concerned that the Council might consequently reduce its own staffing, potentially leaving the public more vulnerable than hitherto (groups 3, 10).

In only one case did the local authority act in a way which implied shared accountability for the actions of groups: group 25, established by the local authority, was granted Cornwall Council Volunteers' insurance, and received £4,000 from South West Water (the private utility) for training to clear their river.

A main source of conflict was the allocation of responsibility. However, where the groups' activities were perceived by the authority as informal (groups 12 & 13) responsibility was not raised as a concern and relations between authorities and the public appeared far

more amicable: these groups were in rural locations, with members often already in contact with key members of the authorities:

> "I have got quite personal with a lot of them [local authority representatives]. Nicely personal. Hello Tom, hello Janet, hello so and so, that sort of thing." [12]

The success of this type of flood group can be assessed by some demonstrable action. Groups were also seen as successful even if they had only improved their awareness, and potentially reduced the probability of flooding when otherwise their situation would remain unchanged:

> "Some flood groups are much more the lobbying types. . . they actually try and persuade people to do the work. And then there's the other groups that tended to have a fund raising part .... in order for another organisation to carry out it's flood defence work. And ours is the third type which is probably less common which is much more of we'll actually do work ourselves . . . We're a small village and so if we were expecting another organisation to come to our rescue we would be certainly be low on the pecking order" [13].

But 'direct action' is broader than active river maintenance, including targeting the vulnerability aspect of flood risk as well as flood probability. Both groups 12 and 13 produced booklets with key contacts and advice in the event of a flood, and had river gauges assessing river levels, in addition to hands-on maintenance activities. Greater awareness of flood risk is reflected in the increased number of residents investing in property level protection - "a lot has come about from people .... having designed equipment to go to doors and windows and so on" (Chair, 12) - and residents' support of their river gauge through community-derived finance:

> "Another thing that we did get, again through common sense really, was a water level meter that we installed, and, again we got that money from the council, but the future is ours" [12].

Groups embracing this kind of diverse range of activities were successful in developing a comprehensive approach to managing the different aspects of flood risk. Similar to the findings of Lane *et al.* (2011), the public is capable of gathering and disseminating data and are aware of the processes leading to hazard outcomes. Ostrom (1999) suggests that to be resilient a community must be self-regulating and able to survive without external support. The local groups' ability to decide a flood gauge was necessary, and share its results, indicates this independent ability to learn and adapt to changing flood risk.

Overall, the groups which believed they achieved a higher level of risk reduction were those which took on responsibilities traditionally held by operating authorities, gaining new skills and greater understanding of flood events by documenting river levels and targeting specific locations at risk, in addition to maintaining the river. They focused on both the hazard and vulnerability aspects of flood risk, identifying those who were most vulnerable, uninsured or at particular risk during a flood event.

The fundraising role

Many flood groups described raising funds to administer their group, but no groups considered the sums the Partnership Funding scheme suggested communities contribute were practicable: 'prohibitive' [1], and "this is what we pay our rates and our taxes for" [20]. Yet, groups 2 and 3 raised £300,000 and £50,000, respectively; a goal groups pursued through lack of choice and necessity. Despite this, groups described

their communities as positively changed by the experience:

> "It looked like the scheme was going ahead and then, of course, the economy sort of nosedived and . . . we then ended up with the Environment Agency turning to us and saying. . . it would help if the community could raise some money. So. . . I was not comfortable... but did manage in a matter of a few weeks to raise £50,000. A lot of it from . . . individuals, a number of whom were not actually flooded but were very supportive."[3]

Local fundraising to cover costs wider than flood group administration requires collaboration (especially with the Flood Risk Management authority concerned), abandonment of blame, and a sense of altruism so that a flood defence scheme benefits the community as a whole, not simply those who contribute. Indeed the funds raised were not predominantly donated by individuals benefiting from new defences, but by the general population (including through a Council Tax precept). Often, the members of the relevant groups were a mix of those who had and had not been flooded.

Once communities realised that they would need to raise money, the next problem faced was how this might be achieved. Group 2s leader described the challenge of initiating contact with authorities responsible for managing flood risk, especially when those authorities believed they would be held accountable by the public, had the group adopted a 'breach of social contract' approach. Initially our interviewee was unable to make contact with the responsible authorities:

> "I couldn't get them all to the table, so I went to see my local MP (Member of Parliament) and he wrote to them and got them all around the table, and . . . we've kind of grown from there. . . . . He's kind of my trump card, shall we say?.... I'd never even met him prior to that."

The flood meant that she had to establish new networks, initiating government and civil society partnerships, and beginning to make hierarchies more porous. But:

> "When we first started working with them [the Environment Agency] they were quite defensive, they were a little bit aggressive towards us, but when they realised that we weren't going to attack them.... then they treated us as team members and we are looked on as part of the team now."

In their partnership, group 2 was asked to raise £300,000 out of a total cost of £4.4m, and obtained large contributions from the Rotary Club, the Lions, and the Cumbrian Foundation Fund, followed by individuals' personal cheques and local school contributions: "a real community effort". However, a shortfall of £100,000 remained and a community-led initiate proposed a precept be added to the town's Council Tax bills:

> "What we did was we asked the Town Council if they would set a precept of the council bill and they ... said that's okay, but we're going to ask people in the town if they agree to that, so they did.... a vote.... It got something like a 70% 'yes' vote .... That raised £120,000."

Citizens paying compulsorily through their Council Tax bills could have been highly controversial if the local public had objected "that is what we pay our rates and our taxes for". Yet, the residents of Cockermouth recognised that the situation did not call for a simple contractual relationship, and that the need was greater than a normal local taxation situation. The groups Chair believed that if there were another flood the same effort could not be repeated: the situation was unique.

The methods developed by fund raising groups were novel and successful, although few in number. The necessarily diverse activities of fund raising redefined the relationship between stakeholders and established a new outlook for relevant authorities:

> "Before this I could not even get them to answer a phone... whereas now I've got personal contacts ... We're dead proud of what we've achieved here. We had the Under Secretary, I showed him that we have looked after ourselves and done a great job....The Environment Agency has never ever worked at that pace before and I think it has actually changed their culture"[2]

Importantly, the fundraising role also represent as acceptance that the benefits of a flood defence are predominately restricted to the local community, with limited justification for calling on the purse of the wider public. The attitude of local people demonstrates that the opportunity for other services currently considered as public to be treated, and funded, as club goods. Though the public resources should not be exploited by the State, as populations facing flood risk have limited room to negotiate as their homes and livelihoods are in danger if they do not contribute. The provision of Flood Risk Management services as a club good costs residents significant time, capital and effort, and such approaches may not be so readily adopted in deprived communities or where the issue is repeated surface water flooding rather than 'exceptional' fluvial flood events.

4.3. Discussion

Prior to the organised engagement of the public in response to calls for public-private partnerships in order to fund locally beneficial flood defences, civic engagement existed in multiple forms. This public interest, and, in cases, pressure, was received with varying enthusiasm across different Local Authorities, and was generally underexploited until the Flood and Water Management Act (Government, 2010) in 2010. Yet dedicated

flood action groups had begun to form following the floods of 1998, in addition to significant interest displayed by generic action groups such as residents' associations. These groups facilitated a shift in the boundaries of the limits to which authorities could ask the public to contribute to the funding of flood defences and formation of warden schemes, and provided inspiration and information for other groups to follow. Importantly, the behaviour exhibited by groups showed a great variety in the capability of public involvement, with some action potentially exacerbating the flood problem, while other behaviour significantly enhancing or even substituting the role of authorities.

The flood groups established engaged in far more complicated activities than expected in a discipline traditionally associated with certified experts. As groups, the public have made plans, and sought to execute those plans in collaboration with other stakeholders. However, public involvement at a community level was unsupervised and lacked official support during the late 1990s and early 2000s, and as such it is difficult to tell whether the impact of such groups was successful in the management of flood risk. In comparison, today civic engagement in flood risk management is actively encouraged, with idealised flood group activities promoted by the National Flood Forum. What can be said is that many groups who focused solely upon the flood hazard disbanded with the belief that flood risk was no longer significant, and as such made themselves increasingly vulnerable to future flood. The display of this behaviour raises the concern that it may be more difficult to encourage the public to act, but it may not be possible to educate the public to apply slow thinking (Kahneman, 2011) approaches to calculate risk.

Results have shown that the role of public behaviour in Flood Risk Management today is not a simple story. Within the generic term of 'public participation' there are many different motivations for engagement and activities carried out by supported groups and

unsupported group. The results have shown the extent to which public involvement has evolved since the floods of 1998; initially included in Flood Risk Management at an individual level in order to minimize flood losses prior to and during a flood event, by 2010 the role of the public had expanded into the planning and prevention stages of Flood Risk Management.

4.3.1. Community attitudes to Flood Risk Management as a public or private good

To reiterate, some social scientists consider a public good is a reflection of prevailing social values about the services that should be provided by non-market mechanisms (Deneulin and Townsend, 2007), and the goods are then termed 'public priority goods'.

We have surveyed attitudes towards Flood Risk Management via a sample of 25 "flood action groups" across England and Wales, building on previous analysis of their emergence and governance structures (Geaves and Penning-Rowsell, 2014), with these survey results providing more detail and insight here than in the preceding sections.

In regards to emergence, many of England's flood groups have formed over the last decade or so and are generally quite small, involving a handful of self-selected community supported activists seeking to promote risk reduction locally by either their own efforts directly or lobbying for major flood risk reduction measures implemented by the Environment Agency (Geaves and Penning-Rowsell, 2014). As always, context is important here: in order to understand emergence of flood groups, the incubating context must be understood: major flooding has occurred in England and Wales in recent years, including events in 2000, 2007 and 2013/14, provoking public disquiet. In response, there

has been a change in legislation, with the Floods and Water Act 2010, and thereby some shifting of responsibilities from central government to local authorities (Penning-Rowsell and Johnson, 2015). At the same time, as indicated above, funding is being sought from local communities (Defra, 2013; Thaler and Priest, 2014), while benefit:cost tests remain important for releasing central government resources, and there are moves as discussed above in the flood insurance field whereby at-risk property is formally subsidized so that insurance remains widely available and affordable: a special feature of UK's Flood Risk Management. All these changes have enhanced the intended role of local community actors, bringing into sharper focus their attitudes and perceptions of the good provided by or to them in terms of flood risk reduction, in a hydrological context where locally designed and funded Flood Risk Management schemes rarely enhance risk downstream owing to the absence of large rivers that can show this characteristic.

In terms of the understanding of the nature of public goods within these organisations, results have indicated the goods considered 'priority' or issues of 'concern' (Karlsson, 2007) by our respondents regardless of their purity as a public good, and those goods which display conflict in that their provision is inadequate or threatened. The presence of conflict (i.e. disagreement) in the provision of public goods is not surprising; as Tiebout (1956) describes, not all nationally accepted public goods can be provided across the entire nation – though concern exists, there is not the capacity – resulting in local level adjustments and variation in provision. Such adjustments can lead to conflict as the public do not agree with the delegation of priorities among themselves, or between other stakeholders. Thus, understanding both the concept of "public priority goods" and "public goods" is important as the area beyond public goods is often an area where conflict arises, due to deficit in clear capability and capacity (Karlsson, 2007) to fulfill

the local population's requirements.

For example, we have seen that that the public recognise that a wide variety of public goods can be delivered by Flood Risk Management interventions. The public goods noted for their importance by respondents indicate that the majority of groups are concerned about insurance, information provision, 'hard' engineering schemes, and infrastructural resistance[2]. These public goods also displayed high levels of conflict. This conflict was a product of lack of provision or encroachment of other goods upon the provision, but more importantly, often these goods could be seen to have traits of excludability or rivalry, leading to conflict as to whose responsibility it is to provide them.

Insurance displayed the highest levels of conflict among all goods considered as a priority by the public. Respondents felt that the government should take action in order to ensure that householders could obtain affordable insurance. In other cases, the respondents felt that insurance premiums might go up if action, such as property development, took place. The establishment of the Flood-Re 'pool' of subsidized flood insurance premiums (Defra, 2013) may indicate that the impact of high insurance premiums has a negative impact on society as a whole, and this externality therefore justifies the redistribution of consumer bills away from risk-reflective prices through the kind of market adjustment which Flood-Re facilitates. None of the respondents considered that an insurance policy was a public good, however, the affordability of that policy, (i.e. eradicating the exclusion posed by cost), and the guarantee that a claim would be fairly treated (i.e. reduction of rivalry) caused by an excess of claims, made insurance as an industry a public good.

Following insurance, 'hard' engineering and infrastructural resistance were, relatively, the most conflicted public priority goods. Here the most common cause of conflict arose

[2]Note: river dredging accounted for most citings regarding infrastructural resistance here.

as the relevant authorities did not provide flood defences or infrastructure standards to the satisfaction of the public. As discussed in Geaves and Penning-Rowsell (2014), this conflict indicates a misalignment in the social contract between authorities and public over the standards of protection expected. The breach in contract may have been brought about by pressures such as climate change, increased population pressure or change in infrastructure usage, which reduced the return periods of serious floods. In these cases the public pressurized Authorities to provide defences or increased maintenance. Where the Authorities did not provide these goods, the public equipped themselves to take on the tasks independently (Geaves and Penning-Rowsell, 2014). Interestingly, hard engineering is more frequently considered to be a "club good" due to the spatial distribution of risk reduction and the Environment Agency's claim that the average long-term value of being better protected is £20,000 per household (Environment Agency, 2009). By internalizing previously considered external benefits, engineered solutions have been transformed from public to club goods.

Forecasting and communication, and emergency response were both considered unconflicted public priority goods. These goods, as far as our respondents are concerned, can be designated as 'pure' public goods due to their non-rivalry and non-excludability. The position of these goods as 'pure' public goods may explain the lack of conflict in their provision; both the relevant authorities and the public were in agreement over their provision and societal benefits, with that provision being accessible to all citizens across England. In comparison, conflicted public goods displayed less-than national scale provision, and were excludable in the boundaries to which they provided benefits.

In general, the provision of pure public goods was the least controversial among respondents, whereas public priority goods which were either excludable or rival in their

nature, yet considered necessary by the public, displayed the highest rates of conflict. This conflict has had two notable public responses. First, the chasm between public priority goods and public goods has led to the emergence of flood groups. The form of these flood groups varies from pressure groups and fundraisers to warden schemes and hands-on groups, and is highly influenced by the level of support provided by authorities. The second output of conflict has been the growing space for the provision of "club goods", such as community level defences and community warden schemes. Thus, as culpability for Flood Risk Management realigns itself towards the homeowner, "club goods" may present a solution to mediate the increasingly controversial redistribution of funds between those suffering recurrent risk, and those whose susceptibility to risk is extraordinary and considered an emergency.

4.4. Conclusions

We have suggested there may be two ways in which the public might react to transitions in the goods provided by different strategies of Flood Risk Management: either as reflecting a breach of the states social contract, requiring public counter action (Young, 2000), or as collaboration to maximize the efficiency and amenability of response (Giddens, 1999), in our case to flood risk.

In our research the contractual interpretation of civic engagement dominated. This may reflect our interviews taking place in the early stages of Partnership Funding, or a result of the public's perception of a citizens role, or as product of initial poor relations with authorities responsible for Flood Risk Management. A contractual relationship is convenient as it clearly delegates blame, and, if a breach of contract is accepted by both

parties, the party at fault is obliged to rectify the situation. Contractual approaches thus emerged where flood events were smaller, with the source more easily identifiable and responsibility thus clearer.

Despite post-Marxist assertions of a need for separation between authority and public (Young, 2000), our research shows that such an approach is not always beneficial. Contractual models of social order adopted by the public or authorities limit the longevity of flood group activities and prevent good understanding of the probabilities and aims of Flood Risk Management strategies. Significantly, a contractual approach is less effective in deprived neighbourhoods than in wealthier areas, where deploying social and financial capital can effectively pressure an authority to take action.

A minority of our flood action groups did follow a collaborative approach in addressing the flood risk they faced but, as Giddens (1999) suggests, the formation of a community reflective of the 'third way' ideology was challenging and required a catalyst to initiate activities. This catalyst came in the form of either the request to raise more funds than the local population were willing to provide, or when a neutral agent became involved, such as a National Flood Forum representative.

In this second situation the neutral agent facilitated collaboration by redefining community resources and knowledge, overcoming traditional perceptions of public/authority power imbalances. But such collaborative approaches are time-intensive. Where there has been a high magnitude flood event which is likely to reoccur, such an approach is beneficial: the public are empowered with traditional flood defences, but also with an acceptance of a repeat flood event, and cemented by the formation of flood warden schemes. Thus, a public 'collective memory' is retained by individuals connected locally and able to communicate with both responsible authorities and the public. A collabora-

tive approach can thus mitigate both hazard and vulnerability dimensions of flood risk, although resource considerations may limit its appropriateness for all situations.

Our results show that the importance of participation does not only reside in the existence of civic engagement, but in the form that engagement takes. That form is influenced by contextual features determining, in our case, whether groups will or will not emerge. These features here include the magnitude of past flood events, the proximity to urban centres, previous interactions with authorities responsible for flood risk, and levels of deprivation. The form of participation in turn influences the expectations the public have of responsible authorities to mitigate flood risk, and their involvement in that process.

Our research therefore confirmed that both 'contractual' and 'collaborative' interpretations engagement can co-exist - in our case across flooded communities - but that different interpretations occur in different circumstances, supporting but extending previous theorizing. In terms of practical lessons concerning governance, authorities need to be more aware that the form of participation encouraged can have a significant impact upon the process of interaction. If a particular situation is wrongly interpreted, conflict is likely to occur, either because the public believe what they are being asked to provide is beyond the requirements of a citizen, or because the simplicity of blame delegation overlooks the complexity of the flood problem, meaning that underlying drivers of risk, such as awareness and vulnerability, are never fully addressed.

A dilemma, however, arises in the extent to which the public should be considered as a rational agent in the management of flood risk. As discussed earlier, institutions have traditionally been responsible for understanding flood probabilities, the processes by which flooding occurs, and the most appropriate methods of reducing risk. Despite the

inclusion of the public in an official capacity as part of Flood Risk Management, this does not mean that the public are now recognised as experts in the field. The roles encouraged by the Authorities for the public are 'non-scientific': fund-raising, payment-in-kind, and warden schemes. The engaged public are required to have strong social networks, local knowledge, and management skills. This may be problematic in the provision of flood defences under the Partnership Funding Scheme if these social resources do not exist within a community. This potential inequality gap will be addressed in Chapter 5 which focuses on Partnership Funding.

5. Partnership Funding: Community contributions to hazard reduction

The previous chapter introduced public priorities in flood risk management, and how these priorities resulted in and responded to the change in goods provided by flood risk management interventions. This chapter examines the efficiency and equity of Partnership Funding, a scheme which redelgates the cost of Flood Risk Management service provision in order to more appropriately recognise the excludability and rivalry of the goods provided by flood defences. In these chapters we assess the efficiency and equity of these instruments for achieving their desired aims. We then go on to examine the extent to which policy instruments are reliant upon public action in order to fulfill their aims, and whether the public can be relied up to play their part within such multi-stakeholder service provision.

A summary of the context of this chapter is that within England there is currently a paradigm shift in the way funds are distributed for flood defences. Prior to 2010 flood defences needed to provide a £8 benefit for every £1 spent. The flood defence projects which were awarded funding were considered to provide a public good with benefits accessible to all, however the structure of the cost benefit analysis led to exclusion of

benefits due to increased house prices and fiscal rent seeking which disproportionately benefited groups with the resources available to pressurize authorities. The new funding system, Partnership Funding, awards funding for Flood Risk Management projects according to national benefits over a number of criteria. National benefits are funded by a central pot, whereas local benefits are topped-up with locally sourced contributions. The aim of this revised source of contributions is to increase the range of recipients who might benefit from flood defences, increasing the number of projects per year, and re-delegating responsibility for flooding to the most appropriate level.

5.1. Introduction

Partnership Funding embodies the shift in perception that flood defences can provide private and community level benefits as well as wider public benefits. Under this scheme the amount of funding a flood risk management project might hope to receive is determined by the magnitude of benefits the scheme provides over a number of assessment criteria, including level of protection, duration of protection, number of houses protected in areas of deprivation, and environmental benefits. If a scheme has a high score it will qualify for full funding from the government, whereas in the case that the benefits do not meet the threshold required for the project to receive full funding the level of contributions awarded will be proportionate to project benefits with the recipients of the benefits expected to find means of meeting the outstanding cost. There is no one method by which these outstanding costs can be met; with precepts, private contributions, and even payment-in-kind considered as acceptable sources of capital.

The Partnership Funding scheme has been brought into place in response to the negative

outcomes of the previous funding structure. The previous funding structure gave full funding to all accepted projects, however, all projects had to have a cost: benefit ratio of £1:8. This meant that areas with assets of a higher value would be more likely to have a higher cost:benefit ratio, and that all projects under this cut off would not go ahead. First, this led to an increased, potentially risky, and certainly inequitable reliance upon the flood insurance industry in those areas which were unable to meet the cost benefit criteria. Second, projects which may have had local value would not receive funding, leading to flood risk communities forming pressure groups and even embarking in DIY forms of river maintenance (Geaves and Penning-Rowsell, 2014). Finally, areas which were protected saw disproportionate benefits at the expenses of the taxpayer, and, in turn, a financial restrictions upon those who could afford to receive those benefits in that they were unable to afford the housing premium in these areas.

Thus, the previous scheme only funded those flood risk management projects which were deemed to be of national public benefit, whereas the Partnership Funding scheme would fund all viable projects proportionately to the public benefits they provide. In essence this transition demonstrates the multiple scales of benefits that flood defences can bring; not only of national significance, but also community scale, from towns to a collection of houses. The rate of change has been gradual with a transformation in funding expenditure by government from 98 % in 2010 to 85% in 2015 (Environment Agency, 2010; Defra 2010) (Geaves and Penning-Rowsell, 2015). Today flood defences, therefore, should not only be considered, and provided as, public goods, but also as club and private goods. Partnership funding, in theory, should widen, and cater for, the perception that flood defences can provide many scales of goods by allowing the funding of that project to be paid for by the beneficiaries, be they public or private.

Here we assess (1) the mechanisms by which the transition of flood defences from public to private, club and public has taken place; (2) the readiness with which this transition has been adopted by the newly involved public, and barriers to the implementation; and (3) the extent to which the aims of Partnership Funding are being fulfilled, and the distribution of the proposed benefits. These overall objective of fulfilling these aims is to identify the extent to which Partnership Funding is an appropriate mechanism through which the multiple scales of benefits can be equitably distributed, and, given social constraints, flood defences should be treated as a public, club and private good.

5.1.1. The public as contributors to local flood risk management services

An increasing disconnect exists between the scales of flood risk and the distribution of community networks and social activities. Yet, as we saw in the previous chapter, the flows of information, knowledge and associated hierarchies of responsibility which form social networks are highly influential in improving resilience against flood events and forming collaborative solutions. The United Kingdom is historically diverse in its landscapes and culture, and as such different modes of social interaction between the public and authorities should not just be expected, but reflected in public policy and methods which target flood risk. Recent changes to Flood Risk Management policy, namely the implementation of Partnership Funding, provides an environment in which this diversity could be catered for. Yet, what also exists is the opportunity to easily overlook groups who are stereotypically "less connected, less civically engaged, and less well equipped to compete in the mainstream process" (Portney and Berry, 1997, p.633). In a political environment which promotes strong local governance, a policy which delegates com-

munity contributions according to national versus local benefits is in danger of defining membership criteria of Citizenship, and thus inadvertently marginalizing communities. Social capital exists in some form in all tiers of society regardless of deprivation; the important issue is to understand how, or through what institutions, social capital can be mobilized to increase the productivity of Partnership Funding.

In this section, I address the extent to which successful implementation of Partnership Funding will require community collaboration, and examine whether Partnership Funding infringes upon the rights of a citizen. I look at urban zones of deprivation and low social cohesion, as to date public participation has held its focus upon white, middle class, mainly rural communities which often have established flood groups and stereotypically are more connected to their localities socially and environmentally. Almost no research has investigated attitudes of less-cohesive, marginal communities regarding local ideals of responsibility and risk, with the general assumption that minorities will be less active within their neighborhoods. As a result, it is the assumption that deprived areas are more vulnerable to flood hazards, requiring harder approaches and full funding to manage the flood problem.

The opportunity to revise policy and implement existing political ideas in Flood Risk Management has never been greater. This is due in part to the flood risk policy arena being particularly malleable following a series of unexpected, large scale flood events occurring across this past decade and preceded by half a century of no notable flooding (for example, Easter, 1998; Autumn, 2000; Boscastle, 2004; Carlisle, 2005; Summer, 2007) (Johnson and Priest, 2008). The sudden and repeated disturbance to the socio-environmental system led multiple parties to question, challenge, and reframe previous and existing Flood Risk Management policy, allowing existing ideas to surface (Penning-

Rowsell *et al.*, 2006) and ultimately culminating in the new Government twenty year strategy, Making Space for Water (MSW) (Defra, 2004; 2005; Johnson and1 Priest, 2008).

Penning-Rowsell *et al.* (2006) argue that rather then leading to new idea development, catalytic flood events bring "forward existing ideas that were already the subject of widespread professional or public discourse" (Penning-Rowsell *et al.*, 2006, p.323). Regarding Flood Risk Management policy change since 1998, this has has undoubtedly been the case; leading up to the turn of the Century there had been an "increased recognition of the importance of environmental values, flood warnings and awareness raising, development control and emergency planning" (Johnson and Priest, 2008, p.515). At the same time, a general climate of uncertainty increasingly surrounded natural resource management (Pahl-Wostl, 2007; Brugnach, 2011), resulting in a move towards integrated and adaptive approaches to targeting issues. To cater for this new landscape of connected concerns, uncertainty and accountability, it has been "necessary to build the capacity for collective action, favouring the consultation and engagement of multiple actors in decision making processes" (Brugnach *et al.*, 2011). This increased capacity was delivered through policy changes manifested in MSW (Defra, 2005) and the Flood and Water Management Act (2010).

The main aim of the Flood and Water Management Act was to strengthen the developments made in MSW. This move represented "a comprehensive, integrated and forward-thinking strategy for managing future flood and coastal erosion risks in England" (Defra, 2005) created as a direct result of the 1998 and 2000 floods, and the Foresight Future Flooding report (DTI, 2004). The four main themes of MSW define (1) a holistic approach at a catchment or shoreline level, taking into account stakehold-

ers at all stages of development, in order to (2) achieve sustainable development with a balance between social, economic and environmental priorities, while (3) increasing resilience to flooding, and (4) expanding funding with other bodies (Defra, 2004). These themes ultimately shift "emphasis away from the previously state centered approach towards one in which 'other' organizations, agencies and individuals take an increased role" (Johnson and Priest, 2008, p.516) or more succinctly, shifting "risk responsibility both 'downwards' and 'outwards'." (Johnson and Priest, 2008, p.516).

The transition to more collaborative forms of governance brings a new challenge to public service provision as actors whose opinions previously would have either not been heard, or may have held different weights are brought together. As Brugnach *et al.* (2011) describes, "The presence of multiple frames may go unnoticed when frames remain separated in different social contexts (e.g. expert versus laypeople communities). However, when different actors meet, either in the form of protesting interest groups or consulted actors in a participatory process, what they provoke is an encounter of different frames. This situation results in ambiguity: it is no longer clear what exactly the problem is" (Brugnach *et al.*, 2011, p.78). Such complexity will have to be dealt with head-on under the new Partnership Funding scheme which embodies the ideals of MSW (Defra, 2005) and the Flood and Water Management Act (2010) to proportionately split the costs of flood defense projects according to their local versus national benefits, and in doing so transform the stakeholders responsible for flood risk management.

Prior to the Partnership Funding Scheme public contributions were almost non-existent: 95 per cent of flood defences were paid through general taxation, with the rest of contributions being made up from Local Authorities, large land owners and public elites (Parker and Penning-Rowsell, 1983). The revised approach to funding Flood Risk Man-

agement reflects no less than a U-turn in the involvement of the public, and marks the transition of the perception of the public as being irrational agents, excluded from the development of flood hazard mitigation strategies until the late 1990s to a rational agent able to understand flood risk and contribute to community level flood risk management schemes of up to £50 million (Defra 2010, p.10). Partnership Funding also marks a shift away from a reliance on limited Exchequer funds that reflect national priorities and budgets, towards public-private funding of flood defences, which should enable more local choice on what and when flood defences are implemented (Defra, 2011).

In the general political context, this transition to public-private funding is timely; the policy of the Conservative Government encourages central defiscalisation with the aim of empowering communities, strengthening local Government, and shifting power, plus the associated responsibility, to the individual. However, due to the expansive spatial scale of flooding an individual cannot efficiently protect themselves from a high magnitude flood event. Community cooperation is required, but, mobilizing, directing and maintaining civic engagement is not always easy, with the question of how promoting authorities approach flood risk communities be-coming increasingly determined by local socio-economic conditions.

The challenge of approaching communities is highlighted by a strong consensus that individuals are disengaged from environmental risk. Increasingly we live in isolation from our natural environments, preferring to relate to friends but paying little attention to community (Barber, 1984; Putnam, 1995), and environmentally being disconnected from local resources and natural extremes (Vickers, 1968, p.91). We have prided ourselves on our ability to shape the natural world to suit us, and the challenge we now face is to adapt this emergent "environment of other human beings" (Vickers, 1983, p.87; Blunden, 1994,

p.19) to fit our growing and increasingly diverse requirements. The major instrument available is Government (Vickers, 1968), yet Government faces a difficult task; it is asking us to modify our entire ideals of progress, reassess the limits of Government, while designing public policy so that we can make multivalued choices as responsible citizens.

However, encouraging civic engagement in flood risk management service provision is not as simple as improving values, trust and goodness of individuals within a community (Seldon, 2012). As Minkoff (1997) describes, there are two looming barriers which threaten the initiation of localized community participation. Firstly, traditional face-to-face social relations have been diminished (at least in the initial stages of meetings) in favour of virtual relations (very similar to economic capital) due the wide increase in available methods, e.g. internet and mobile phone. Secondly, the style of meetings within action groups are very different from what they were. For example, in the 1960s gatherings were in the form of groups traditionally "receded from the public eye.. [who put] direct pressure on the Government" (Minkoff, 1997, p.607). Since that time action groups have been increasing in number and diversifying in type (Jehnin, 1987), and rather than pushing changes from outside of Government, they are internally active (or at least have representatives who are) on the political stage (Berry, 1989). The combination of these two changes (the nature of information flow and the characteristics of groups) has meant that the exchange of ideas has become more interactive, frequent, and malleable in its implementation on the ground. In regards to flood management these changes are of importance both in terms of making Partnership Funding acceptable to communities, and in the establishment of flood groups and communications between stakeholders beyond those groups.

Bearing in mind the increased interactivity between the public and authorities, the introduction of Partnership Funding suggests that methods of Flood Risk Management have adapted to changes in social interaction. Partnership Funding gives individuals who are 'informed and capable' the opportunity to work bottom up, while prescribing solutions top-down to those who do not or cannot get involved. This approach clearly has the potential to encourage both positive and perverse outcomes. Demographically, these informed and capable citizens are typically middle-aged or retired members of white, middle or working class rural communities (Coates, 2010). They utilise both virtual and face-to-face networks, and are highly connected to the mainstream public sphere, they are able to confidently define the problem, propose a solution, and put their ideas across whether subtly through existing contacts, or publicly at local council meetings. Local Authorities have adapted their decision making to these groups and, with the exceptions stated in the earlier chapter, generally embrace their activities. However, the attitude of helping those who want to be helped and nannying the others runs the risk of further isolating those communities who do not have, or do not care to support, Partnership Funding, and in doing so could marginalize already vulnerable communities and perhaps even labeling them lesser-Citizens. Public activism originally aimed to support and give a voice to those "receded from the public eye" (Minkoff, 1997, p.607), but it is now used by those who already are able to speak in order to make their communities more comfortable.

The second barrier to initiating civic engagement to fulfil the requirements of Partnership Funding is the emergence of diffuse networks within social groups. This trend, dubbed by Robert Wuthnow as "loose connections" (1998), results in community attachments and interests changing, with an increased likelihood of individuals attaching themselves

to specific issues rather than longstanding groups, and preferring individual choice to collective obligation (Lichterman, 2009). As Lichterman (2009) goes on to describe:

> "They address public problems— urban decay, gang violence, homelessness, for instance—through loosely connected networks, coalitions of volunteers and paid, professional experts from nonprofit groups or state agencies. These networks prize efficient, knowledgeable connections. They that mobilize members' social or professional ties to summon volunteer labor, boost attendance at a public event, raise money, or secure congenial decisions by community leaders or policy makers. They value efficient, task-oriented volunteering, because many loosely connected networks depend partly on free volunteer labor alongside professional, paid efforts." (p.848)

In terms of protecting flood risk communities, these loosely connected networks may have both positive and negative implications. The Home Office Citizenship Survey (HOCS) (2010), illustrates how the predominant reasons for people from all backgrounds not taking part in voluntary work is (1) that they do not have time due to other commitments, or (2) because they do not know that they can have an input on decisions or even that the decisions are being discussed. Diffuse networks offer a platform which individuals can voluntarily step on or off depending on other commitments, which means that if they have a particular concern they can get involved to make a change. In the context of flood groups, the benefits are obvious; when they need support or advice they have a port where they can receive it, temporally attaching themselves to the networks they need. Yet, it can also lead to knee-jerk reactions as people who are not normally involved in decision making can 'hop-on' add their opinion and demand a result in political 'windows of opportunity' following a flood (Johnson *et al.*, 2005), then 'hop-off' once the media

hype has quietened down. For example, Wilkins (2000, p. 84, quoted in Johnson *et al.*, 2005, p. 562) observes that:

> "If federal response to disaster relief is driven by the immediacy of an event, rather than by rational decision making, the effort to put everything back to the way it was may in-crease future risk rather than relieving it and finding a long-term solution to risk reduction. In the wake of some disaster relief, and under the pressure of the media effect, the nation may have subsidized some poor decisions and penalized some sound proposals, forgoing opportunities for change."

As such, networks of 'loose connections' (Wuthnow, 1998) can be positive for providing flexibility and support in times of need, yet they must be managed so that they do not lead to short-term solutions, specifically following a flood event. Diffuse networks also harbor a problem in tackling spatially geographic risk, such as floods, as they are not limited by area. As Minkoff (1997) describes, "because these organisations are less likely to involve face-to-face social relations and more likely to generate societal conflict, they are not thought to contribute positively to the stability or growth of civil society" (p.606). Flood groups do appear to mobilize social capacity within communities, but these groups are not the result of policy, they have come about due to problems not addressed by policy. How, therefore, can Partnership Funding function within areas which have diffuse social networks?

Increased civic engagement is clearly the desired goal; this has been reflected in the mood of the nation since the 1960s (Berry and Portney, 1997), public policies (generally, such as MSW and the 2010 Flood and Water Management Act), and previous public participation flood projects (e.g., Whatmore, 2009; Lane *et al.*, 2011; Whatmore and

Landstrom, 2011). However, the main challenge for encouraging public participation is in changing what people perceive as their responsibilities, and the scales and distribution of these responsibilities. As has been seen, people now pick-and-chose their involvement in voluntary work, preferring informal groups (Home Office Citizenship Survey, 2010) and acting out their relationship to the State through public services, such as doctors and Teachers, rather than politicians.

What is required to promote civic engagement is 'systematic responsibility' by re-establishing rights and responsibilities. If social capital is "not just the sum of the institutions which underpin a society, [but] the glue that holds them together" (World Bank, 1998), then systematic responsibility describes the strategic positioning of that glue in order to provide the most strength to the structures. If individuals cannot autonomously create structures that support their diffuse lifestyles within the context of a solid, physical reality, then that glue must be reset and repositioned; people must change their expectation of themselves and of the State. Vickers (1968) describes this as appreciative processes, requiring individuals in partnership with Government to review (1) which information they discriminate and separate, (2) how organized patterns and interactions are created and modified, and (3) developing methods of harmonizing disparate ideas. However, this requires communication, and to some extent persuasion, from the State, and investment of 'self' from the Citizen (Adams and Catron, 1994). Whether this is a universally realistic concept is debatable, yet to understand if societies could ever be responsible for flood risk management, we must investigate what their rights and responsibilities should be.

Rights are the domain of the victim, and for many the last line of defence between life and death. In concept, rights are instruments to ensure equality of regard, to

precipitate fairness in the equality of outcome (Nettler, 1972). In the context of Flood Risk Management in the UK, the concept of rights and their ability to restrict or enable civic engagement in public service provision is most definitely a dilemma. In the UK, especially when compared to other countries, flooding is rarely a matter of life and death, it is a question of recovery, stagnation or erosion socially and economically. A debate of rights and responsibilities in the provision of flood risk management goods should therefore focus on the extent to which a flood incapacitates an individual or family to the extent that they are unable to function economically, socially or politically within their community.

Partnership Funding offers the opportunity for individuals to expand their political, social and economic activities, yet it could also undermine the ability of an individual to act as a Citizen if they are unable to contribute. In neighborhoods which are already politically active the opportunity to partake in Partnership Funding utilizes often pre-existing links to local councilors, Environment Agency members and, in some cases, academics. In inactive neighborhoods, Partnership Funding's ability to increase civic engagement may be reduced if communities do not actively work together to find a solution to flooding as this will be done for them, but it could also be argued it is being given the opportunity to increase as communities limited existing capital can be directed at more pressing issues, such as crime, urban decay, gang violence, homelessness etc. The issue is open to debate, and brings me back to by previous argument of tackling flood risk in these areas, not simply through the Environment Agency, but as part of a general social initiative, such as the Big Lottery. Such schemes are able to provide an interdisciplinary, holistic approach of entering communities, rather than the uphill struggle designated institutions who are isolated from the main issues of that community, would witness. They are able to tap

into what these communities believe to be their responsibilities and work on apparently isolated issues as part of a portfolio of neighborhood aims.

Participation in the provision of public services rests on the belief that a person "must somehow be knowledgeable or capable before he can morally or legally responsible" (Nettler, 1972, p.363). However, deprivation alone is not an indication of competence, deprived communities are not somehow disabled, irrational, or uneducated, and an individual without qualifications, without money in their pocket or without refined articulation is not incapable of turning up to a community meeting and making a positive contribution. In the results section, I investigate the introduction of Partnership Funding into communities, seeking to understand whether Partnership Funding has become the realm of civic engagement for the wealthy, or whether communities regardless of wealth can reap the benefits of increased awareness which comes hand-in-hand with collaborative Flood Risk Management.

In summary, the last five years have been a period of transition as perceptions of the distribution of benefits brought about by flood defence schemes are reviewed, with new perceptions often stimulated by the introduction of the Partnership Funding scheme. This transition has influenced how the public should be involved, and the behaviour that the public need to adopt in order to achieve this involvement. The result has been that there are now many hundreds of flood groups active across the UK, and with accessibility to the internet many of them can share information with other flood groups and generic groups with interests in flooding. The question that remains is whether this public involvement at a community level can be put into practice across the nation as part of the Partnership Funding Scheme, or will the primary beneficiaries of flood defences seek to transfer financial responsibility for service provision on to the shoulders of others?

5.2. Results

5.2.1. How has Partnership Funding influenced service provision?

Figure 5.1 shows the Partnership Funding Scores[1] of projects delivered between 2012 to 2013, and 2014 to 2015. The comparison between the two is significant, predominantly due to the large increase in projects which deliver club benefits (highlighted in green). In the earlier dataset, flood defences are categorised as either private or public, with only a very small minority of projects being considered for a partnership score which would require equal contributions from the government and other sources. Comparing the 2012/2013 dataset to the 2014/2015 dataset, there is already a significant increase in the number of projects where the benefits are split between public and private with these being considered as 'club' benefits. The increase in this later dataset of private projects is quite staggering (in yellow), with very few projects delivering less than 10% of benefits privately.

Figure 5.2 displays these results as histograms, which provide an alternate visualization of the data in Figure 5.1. The histogram demonstrates three patterns of interest. The first is that in the most current dataset the majority of projects all just above the number required to get grant-in-aid from central government. The second comparison is the number of projects which fall in between 0% and 100%, specifically when comparing the number of projects below 20%. Finally, the increased range of scores above 100%,

[1]Partnership Funding Scores "describes the proportion (%) of costs that can be justified against national budgets. Funding contributions from other sources can be used to adjust and boost the Partnership Funding score. The adjusted Partnership Funding score must exceed 100% before FCRM Grant in Aid is allocated and a project can proceed." (Environment Agency, 2014, p.14)

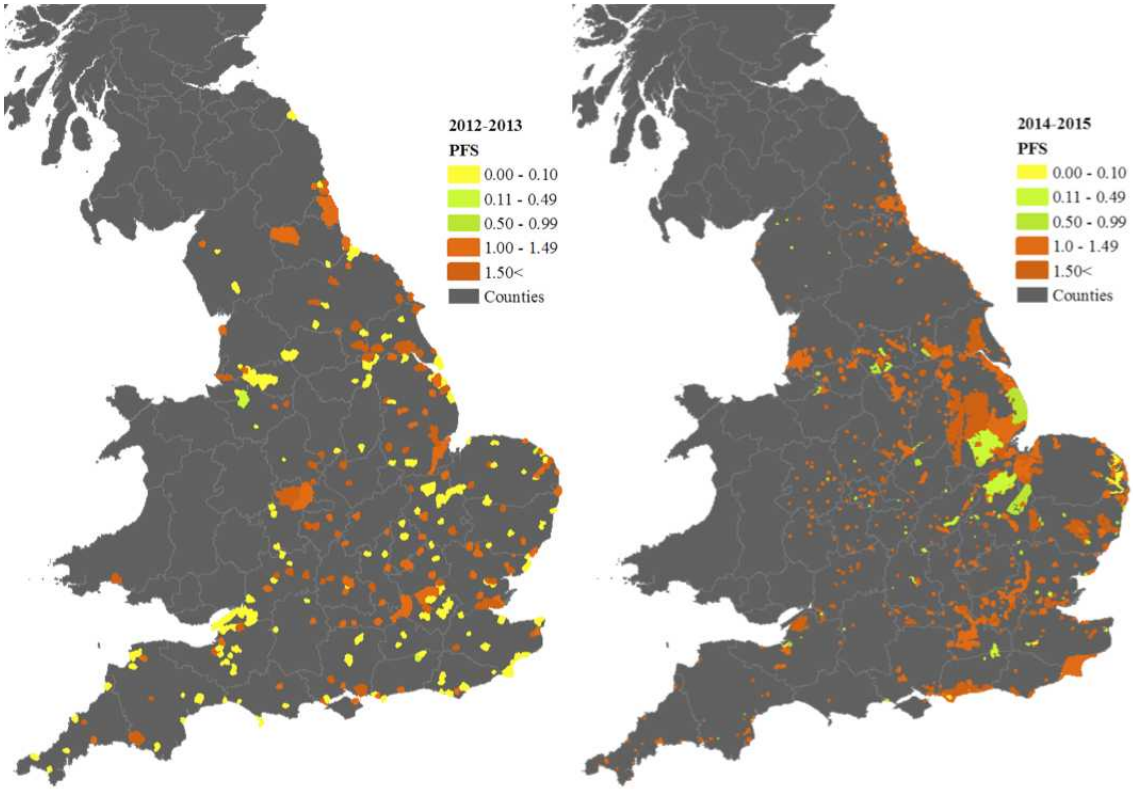

Figure 5.1.: Spatial comparison of Partnership Funding Scores between 2012/13 and 2014/15. Those with a range of 0-0.1 are interpreted as providing mainly private benefits, between 0.1 and 1 projects are funded in partnership, and, therefore, categorized as club goods. All projects with a Partnership Funding Scores above 1 are awarded full Government funding, and, as such, are perceived as public goods.

which for the most recent dataset is broader than that of earlier years. Of note, any projects which had the Partnership Funding score of over 150% were not included in this histogram, because some reached over 600%, which implied that there was some error in the dataset. However these results were included in Figure 5.1, with their omission not changing the pattern of results overall.

That there is a significant increase in the number of projects which fall just above the 100% mark to get government funding between 2012 and 2015 could be the outcome of two processes. In order to understand these processes the Outcome Measures (OMs) which contribute to the Partnership Funding Score have to be introduced. Partnership Funding Scores are the output of a number of indicators of success, with these indicators split into OMs to demonstrate the range and comprehensiveness of benefits brought about by Flood Risk Management interventions. The OM range from 1 to 4. OM1 concerns all economic benefits brought about by protection of property, infrastructure and businesses. OM2 and OM3 are judged by the number number of permanent dwellings protected by the scheme, with OM2a representing houses in the top 20% areas of deprivation, OM2b counting the number of houses in the top 40% of deprivation, and OM2c covering all other properties. OM4(a, b and c) measures the environmental benefits. Using the Partnership Funding Score Calculator (Environment Agency, 2015), the OMs from each category are used to inform the overall Partnership Funding Score.

Therefore, the increase in the number of projects falling above the 100% mark could be a reflection of the inclusion of non-flood risk management benefits which would be categorised under OM4, which may not have been taken into account under the previous funding scheme. The second possibility is that Local Authorities are adapting their flood risk management projects so that poorer communities in deprived areas are included

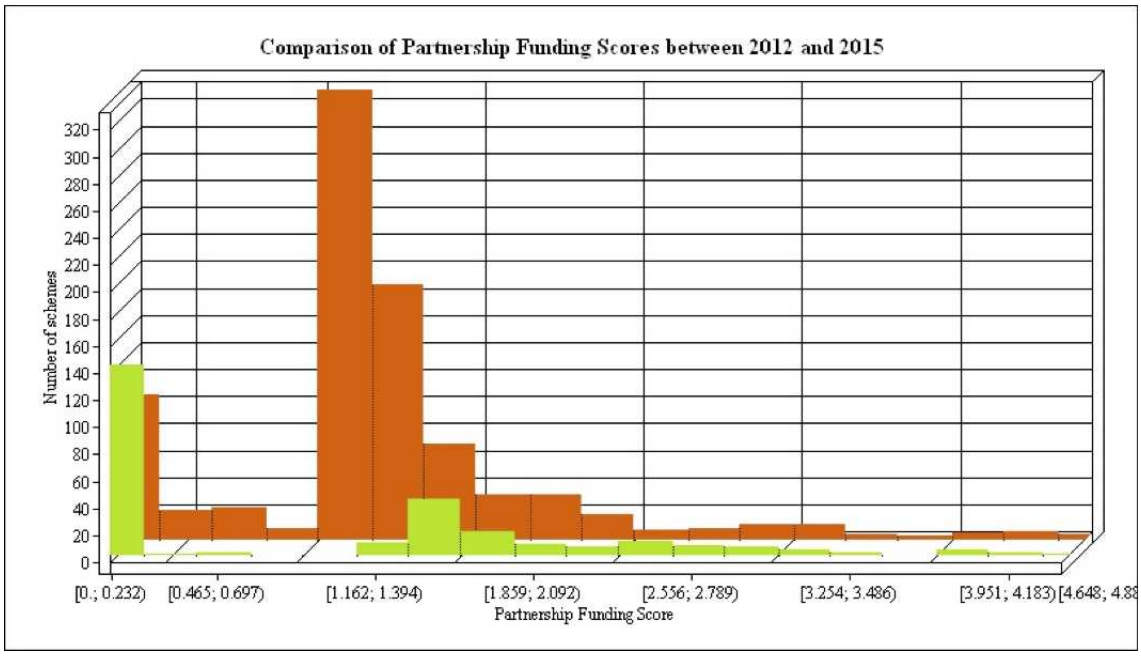

Figure 5.2.: Comparison of Partnership Funding scores of flood projects planned between 2012/13 and 2014/15. Schemes planned in the 2012/13 RFCMP are in green and schemes planned in the in 2014/15 are in red.

because their inclusion adds a weighting to the Partnership Funding score. From Figure 5.3, which shows the OM2 scores where OM2a projects in the top 20% of deprivation, OM2b projects with houses in the top 40% of deprivation, and OM2c are those projects which have houses in the lowest 60% of deprivation, there is indication that it is inclusion of other projects under OM4 which account for this increase in projects fulfilling a 100% Partnership Funding score. This is because Figure 5.3 indicates very little change in the number of properties protected in each OM category.

Figure 5.2 also shows a large chasm in the earlier dataset of projects which have a Partnership Funding score between 20% and 100%, with more projects falling under 20% then the 2014 to 2015 dataset, and the majority of all projects between 2012 and 2013 scoring under 20% on the Partnership Funding scheme. In total however the

number of projects which are under 100% is around the same for both sets of data. There are multiple possible reasons for the lack of club projects in the years 2012 to 2013 the most likely cause being that Local Authorities were unaware of the new scheme and unsure of how to implement it. Also of consideration is the concern a number of Local Authorities and the Environment Agency felt at having to ask the public to contribute to projects when previously no such contribution was required. However as time passed projects with these very low Partnership Funding scores were able to both understand Partnership Funding, and tailor and improve their Flood defence schemes in order to meet more criteria of the Partnership Funding scheme.

Finally, the 2014-2015 dataset had a significantly broader range of project Partnership Funding Scores than those in 2012-2013. The predominant cause for this is most likely that:

> "Where the total FCRM Grant in Aid contributions for projects proposed in a year is greater than total grant available, the Environment Agency (EA) will use Partnership Funding scores to help prioritise projects. For this reason, promoting Risk Management Authorities will be able to increase confidence in FCRM Grant in Aid allocation if they can increase the Partnership Funding score for a project above 100%. This can be achieved through reducing costs or securing additional contributions." (EA, 2014)

Therefore, it is in the promoting authorities benefit to not only ensure that their project secures above 100% on the Partnership Funding score, but also that the project scores highly in comparison to all other projects. By doing this the promoting authority secures funding even in the case that FCRM Grant in Aid contributions for projects proposed are greater than the total grant available. It would seem likely therefore that as more areas

realise that they can now apply to some funding, where in the past they could not, the number of overall projects will increase and, resultantly, there will be more competition for granting aid funding, and more pressure to ensure that they projects Partnership Funding score is not only above 100% but high in comparison to all other projects above 100%.

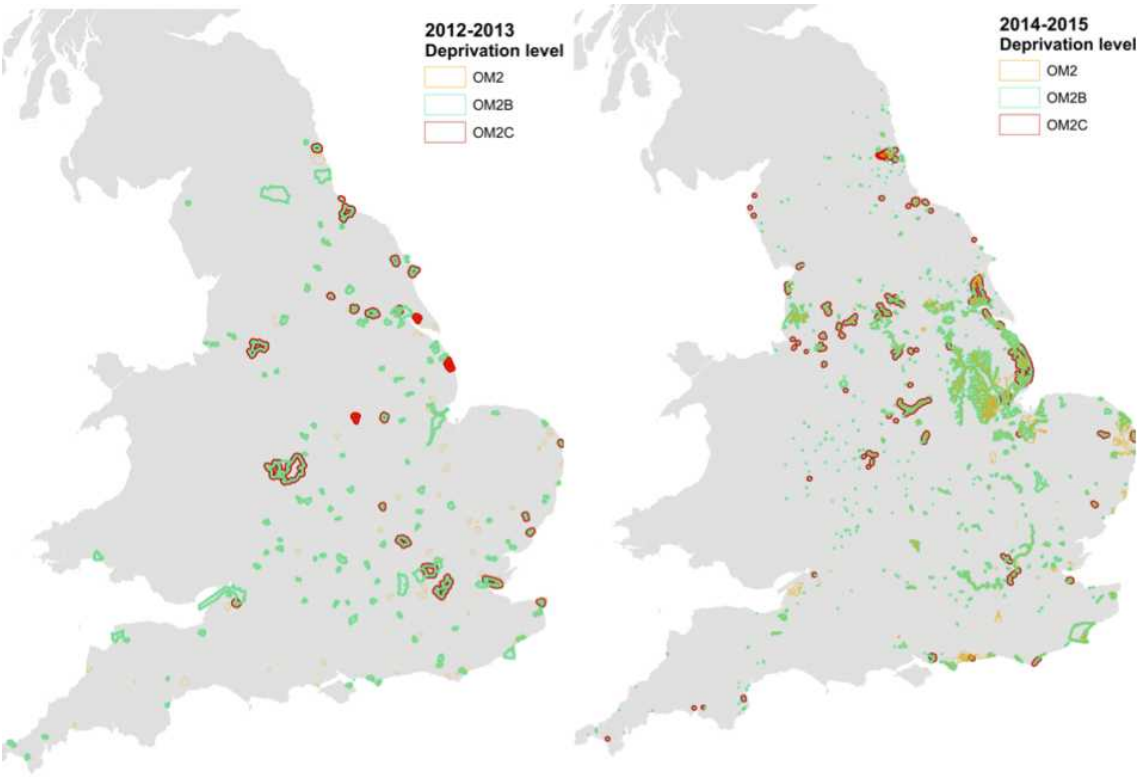

Figure 5.3.: Comparison of OM2, OM2b and OM2c scores between 2012/13 and 2014/15. OM2 indicates areas in the top 20% of deprivation, OM2b indicates areas in the 20-40% of deprivation, and OM2c indicates areas in the bottom 60% of deprivation.

The comparison of Figure 5.1 and Figure 5.2, does provide some insights into the change that is occurring. Specifically we can see that the Partnership Funding scheme is being

resulting in club goods becoming more popular in certain regions than others. This could be interpreted in many ways. However with a contextual knowledge from the Adaptation Sub Committee progress report on "Managing climate risks to well-being and the economy" (2014) that some Local Authorities are being quicker to take the benefits of the new funding structure than others, and the extent to which the edge of flood risk management schemes match constituency boundaries, we wish to interpret this pattern as a reflection that Partnership Funding is currently being used better by some Local Authorities than others, which is of importance if the government is to make Partnership Funding the scheme by which there is more equitable access to flood risk management funds.

Overall, these results support that flood defences provide private, club, and public benefits, and that Partnership Funding can facilitate this change from flood defences only being considered as public goods to them being provided proportionately as public, club, and private goods. However, despite the pattern seen in these datasets we cannot be sure that those stakeholders previously left out of the fundraising process are going to be willing to contribute to top-up schemes where the Partnership Funding score is less than 100%. It is for this reason that we now move on to investigate public reactions, in order to understand how these changes are playing out on the ground.

5.2.2. Does the public support the Partnership Funding Scheme?

This section focuses on the experiences of two groups who are part of the new Partnership Funding scheme; Keswick and Cockermouth Flood Action Groups. Providing context to these case studies are the experiences of a number of other groups, in cate-

gories previously discussed. Unfortunately, there were no case studies available of groups that had been approached to raise funds but had not agreed. However, we posed the hypothetical question to groups not included in the scheme to see how they would receive such a proposal. Yet, it is difficult to definitively say whether in a real case scenario the interviewee's responses would be the same as their response to a hypothetical question.

Most flood groups had described raising funds to help out with administration costs of running the group, yet as seen in earlier cases, when asked, no groups had felt the sums the 'payment for outcomes' scheme suggested communities contribute was suitable. The respondent from Haydon Bridge described the scheme as 'prohibitive', whereas in Hinchley Wood Residents' Association the interviewee protested that *"this is what we pay our rates and our taxes for"*. Yet, Cockermouth Flood Group had to raise £300,000 and Keswick Flood Action Group raised £50,000. This section tells the stories of those groups who have raised funds as part of the Partnership Funding scheme.

Did groups involved in Partnership Funding find the outcomes successful?

Of those groups interviewed that were part of the new funding scheme, all of them were successful. However, the Partnership Funding scheme does not have a set approach for initiating work with local people or a defined method by which they should raise funds. The result was that the process by which groups were contacted and funds were raised could be difficult for the groups, and required a significant amount of effort from unpaid community volunteers.

Keswick Flood Action Group Keswick Flood Action Group (KFAG) was formed following the serious flooding which occurred in the town on January 2005 and the

again in November 2009. Following these flood events Keswick Flood Action Group was asked to raise funds of £50,000 to contribute to new flood defences. Here is their experience, as described by respondent [3]:

> "It looked like the scheme was going ahead and then, of course, the economy sort of nosedived and as we went through to 2010 we then ended up with the EA turning to us and saying, look we're about to change the funding system, it would help if the community could raise some money. So I set myself on to something with which I was not comfortable with but did manage in a matter of a few weeks to raise £50,000. A lot of it from organisations, particularly a big slice from the local Lions who had some money left on their regional fund, including a number of local individuals, a number of whom were not actually flooded but were very supportive of what we'd done.
>
> My wife and I found it very moving. We'd put ourselves in a position we'd not expected to be in...When you are setting off to do this thing, you think how on earth are you going to get any credibility? But we did. We've moved on and we've increased our volunteer base and people that we have asked, in general, particularly afterwards, have been only too delighted to be involved. There's a certain panache to it. So that's the system. The EA, we have worked incredibly closely with. They have been supportive of the group as it was set up, they've been supportive all the way along and certainly they moved heaven and earth to get the steam for us, the local EA. I, as a quip, commented that if we hadn't got the funding as we did in February 2011 that I reckon they would have been up and said, "Never

mind we'll do it at the weekends in our own time."

In order to raise the funds so that the community could benefit from flood defences the community developed an innovative way of sourcing funds:

"After the flood, the group put on an exhibition of photos and stories and also did a really very successful book which was a mixture of some 40 stories together with pictures... There were two prime reasons; one of them was it acted as catharsis for the people who had been involved. The second thing was that it acted as publicity, one of the things that Keswick has managed to do very successfully. There was an awful lot of local organisations getting together and one of the reasons for publicising that was here is a town that's helped itself, it's acted as a model, surely we are a good candidate for something to be done about improving our defences.

And in fact we made sure that when it had an official opening, we tried our best to invite the great and the good, the people who might have some impact. It was actually very, very successful in terms of raising the profile. We had the chairman of the EA came up about a year ago to talk to us. We took him through what was needed and what was planned to be done and that was a very, very successful meeting. And in fact one of those things that made me realise the book had been effective was that my wife and myself were walking along the riverbank with him, we'd not mentioned the book and he did turn to us and said, "I did enjoy that book." We thought, yes, that's had the impact.

Because it was a mixture, we had stories from people who had been flooded, we had stories from people who had helped, form the EA control

> room, the police sergeant, Silver Command, the guy from Fire and Rescue, all the way across. And that was something else that we wanted to say to the people who had been flooded, here are other people who are involved as well. The ownership of the event, if you like, had gone much wider than just those people who were survivors of the flood themselves." (Respondent [3])

The books were sold at just 50 pence higher than the price it cost to make, and as respondent [3] described, "they sold about 300 in two or three weeks which is just amazing", with the Local Authorities "overcome by the professionalism of what had been put together". The book brought the community together, including locals and experts, and, importantly, has made a lasting legacy of the community's achievements. Despite, the initial reservation of raising funds the overall feeling has been one of success, and appropriate distribution of responsibility:

> "I was actually phoned by one of the presenters from Newsnight, and he said, "We're about to do an expose on the Environment Agency and their shortcomings, is there anything you can help?" I said, "Well you're speaking to the wrong man, they have been so helpful to us before, they've been incredibly helpful during the event and they've been incredibly helpful afterwards." It's not the fault of the EA, it's not the fault of United Utilities or the government or whoever else it might be. It's a nature event." (Respondent [3])

The experience of Keswick demonstrates how the treatment of Flood risk management is at times best considered to be a community issue. The goods provided by the flood defence were limited to a specific spatial region, and as such should be considered as club

goods. Here, despite initial reservations, a successful transition was made allowing local people to get the flood defences which they needed, while also proportionately funding this project as to the national need on a limited budget. Alongside the achievement of a transition from a public good to a club good, there were also positive externalities, including the development of a warden scheme which promotes awareness, reducing vulnerability, which is an important addition to the reduction of overall risk.

Cockermouth Flood Action Group In 2009 around 900 properties were damaged by flooding in Cockermouth. As a result local residents were asked to raise £300,000 to contribute to new flood defences. The entire scheme was £4.4 million, including contingency money, with £3.3 million contributed by Defra. The flood group initially had large contributions from the Rotary, the Lions, and the Cumbrian Foundation Fund, and followed by personal cheques and local school contributions. However, despite this community effort, it was not possible to raise the funds through fundraising alone, and subsequently the Flood action group had to apply for a council tax precept which was then voted on by all residents. This case study describes the experiences of the Cockermouth Flood action group when they found out they were to raise these funds, the approaches they took to raise such funds, and the barriers that they had to overcome to achieve this aim, and their opinions of the scheme in hindsight of raising the required money. Respondent [2] describes her feelings when she was initially asked to raise funds:

> "It's a hard one. For me it's simply to pay for this, okay if that's what's going to make it happen, then that's what we'll focus on. But for me it was important that we actually got the town protected and if that's what we need to do, then that's what we'll do... We're not all waiting for handouts are we? There are places within this country who are prepared to look after

where they live and it should be celebrated."

Once it had been realised that the community would have to raise money, the next problem groups faced was of how these funds would be gathered. Respondent [2] had a challenge trying to initiate contact with stakeholders who might assist them, especially with when the actors thought they were going to be held accountable by the public. At first respondent [2] could not even make contact with stakeholders, so sought support from the local MP:

> "[2]: I couldn't get them all to the table, so I went to see my local MP and he wrote to them and got them all around the table, and that was the start of it and we've kind of grown from there. If somebody gets a letter from a MP they're more likely to action it rather than from a member of the public. . . .I go to him when I'm desperate. He's kind of my trump card, shall we say?"

For respondent [2] the transition from public to club good it was not the acceptance that funds had to be raised which was the primary issue, but the level of persuasion that was needed to convince the authorities who had traditionally been in charge of raising funds that Cockermouth Flood action group were serious and should be paid attention to. As described below, meetings between stakeholders were difficult initially, but eventually became a point of collaboration:

> "When we first started working with them [EA] they were quite defensive, they were a little bit aggressive towards us, but when they realised that we weren't going to attack them, that we were all working towards the same goal, then they treated us as team members and we are looked on as part of the team now."

However, despite that the group formed a cohesive team with multiple authorities, it was not possible to raise the funds in the manner that they set out doing, with the group then applying for a council tax precept to make up the shortfall of £100,000:

> "What we did was we asked the Town Council if they would set a precept of the council bill and they actually went out and said that's okay, but we're going to ask people in the town if they agree to that, so they did, that's the one thing they did do, they did a vote. They delivered forms to every house so they could vote whether they were happy to pay for that. It got something like a 70% yes vote on that one. That raised £120,000." Respondent [2]

This move to pay through the council bill represents the boundaries of the good being provided. The good provided is not of national significance, but it is also not so small that the only beneficiaries would be householders. Therefore the good that is being provided is most definitely a club good. Even if residents were not one of the 900 homes which were flooded, they chose to support those people that were flooded through a council tax precept, and in doing so recognise that the flood problem is not a household flood problem, but a community flood problem. The Partnership Funding scheme has been highly appropriate for this particular scenario. However, the level of effort that was put into achieving this aim of raising £300,000 should not be underestimated, and the cost of future management may not be considered as providing the same community scale of benefits as the initial scheme, with respondent [2] describing how funds could not be raised the second time:

> "It's taken a long while to recover, but I think you've got to at what it's done for the town. We've done fantastically. We've got it all back, but we need to protect it because it will never come back that way again, if it

happens again." [2]

The approaches groups adopted were novel and successful. They led to a new relationship between stakeholders – *"Before this I could not even get them to answer a phone to be able to even speak to me, whereas now I've got personal contacts"* [2] –, pride in achievements – *"We're dead proud of what we've achieved here. We had the Under Secretary, I showed him that we have looked after ourselves and done a great job."* [2], and a new culture for authorities – *"The Environment Agency has never ever worked at that pace before and I think it has actually changed their culture"* [2].

Would other areas raise funds for flood defences?

Keswick and Cockermouth are examples of groups who were able to raise funds. This section gives examples of responses which were given when respondents were asked the question of if they would raise funds in the case that it was necessary. This section is split into those which would provide additional funds for flood defences, and those which would not. Of interest, is that in some areas where focus groups were interviewed different respondents had different answers to each other.

In Little Stour and Nailbourne, there was a feeling that funds would not be raised if requested because of the rural nature of the community which meant that there were limited funds, and the perception that raising funds was the role of the Environment Agency:

> No, I don't think we'd do. I think we would lobby, that's our responsibility. In fact, I'm sure we would really. We are not an action group either in that we don't get into the river or cut weed or pick up litter or do any of that, that does happen but it doesn't happen through our group. . . .We

> have finally got it resolved but we wouldn't have put up any money for that, no. Our expectation would be that that is an Environment Agency job and they would pay for it. I think that even with the new Floods and Water Management Act I think we would continue to take that stance really because rural communities don't have any source of funding in that way.

In Little Chester which is a small region of a large urban area, the reason that funds would not be raised was because of the scale of the scheme and the amount of money that would have to be found:

> "Because here it's very different. The lion's share of it has to come from private developers. And, this project is very expensive. I imagine for this stretch it's possibly £30 million, something like that. Now, Keswick and Cockermouth, you're talking about 10 per cent coming from other sources. Here it's the other way round. We're looking at maybe 5 million being available out of it, because I'm sure the project will cost about £25 million" [9a]

However in the same focus group, different members had different opinions with another respondent describing:

> "Yes, if it's necessary. And I think these are issues which have not been resolved and whether even what they're proposing is going to be effective" [9b]

In another urban area which had been severely flooded, the response question of what they raise funds if requested was also negative due to, first, the amounts required being prohibitive (the area had high levels of deprivation), and, second, that the cause of the problem was down to an Environment Agency fault with the original design of the wall

and therefore it was not up to the local population to pay out for that mistake:

> "Because the Environment Agency basically admitted they were at fault so there was no need for anything like that. The, things were sort of happening spontaneously from their end; they realised that they were liable if anything happened again and they knew about it." Respondent [1]
>
> "No because the, this work here, I never actually asked point blank how much it cost but it was very, very expensive. It would've been prohibitive for the local residents to; we'd have definitely struggled to try and get funding from people that were being protected if you know what I mean." Respondent [1]

In a suburban area of London, where the history of flooding was very small and confined mainly to surface water flooding the response of the interviewee was as follows:

> "I can't quite see residents around here putting their hands in their pockets unless it was a really grave risk, and probably even so, I think the reaction of a lot of people would be, "well, this is what we pay out rates and out taxes for, and we shouldn't have to be putting our hands in our pockets for things which we are contributing to anyway through taxation." [20]

In comparison, Binbrook flood action group represents the community at the edge of Cambridge, which has frequently been subject to flooding. When asked whether they would be willing to raise funds for the Partnership Funding scheme, they responded that in the past they had wished to raise funds but will not given permission by the Environment Agency:

> "We did talk about whether we could pass the hat around locally and contribute some of the cost and we were told that was absolutely forbidden

> and we must stick with the cost benefit..... if things had been different, I don't know whether the residents would have come up with a significant amount, but it's quite likely that they would.... In some ways it's worth it, because if your property is at risk from flooding the value of your house goes down dramatically." [10]

The overwhelming response of all of these groups has been negative in regards to fundraising, with a small minority who have experienced very severe flooding suggesting that they might consider a proposal to raise funds. This diversity of response is not necessarily unexpected, because Partnership Funding is aimed at proportionately granting funds to projects of national to local significance.

In the case of Hinchley Wood the flood problem was caused by poor drainage, which is arguably the responsibility of water companies. This flood issue would be private, not local public. However, other rural schemes may be misinformed as to the purpose of national funds in defending them from flood risk. This is especially the case, in areas where the water course is not the responsibility of the Environment Agency, because it is a lesser water course. These areas, might benefit from a small grant which can be topped up by the activities of the flood group, but unless they can prove themselves to have a larger level of public benefit they will not score highly on the Partnership Funding score.

5.3. Discussion

5.3.1. Civic engagement in Partnership Funding: altruism or individualism?

Community involvement in public service provision is on the rise, driven in part by changing Government priorities and revised approaches to service provision. However, despite the existence of widespread support of collaborative flood action groups, in many areas only a small proportion of the population are engaged in Flood Risk Management activities, and when posed with hypothetical situations of contributing to service provision beyond taxation respondents have stated they would not engage in such activities. These observations are of importance as they may reflect the public's perception of the need for their individual involvement to produce a community solution, which in turn influences the form and longevity of civic engagement in Flood Risk Management. In this section, I match observations of participation in Flood Risk Management to academic theory to understand why such behaviour emerges, and how motivations associated with this behaviour could impact the long term outcomes of Flood Risk Management projects. The aim is to test whether under conditions of strong individualism in a population, Partnership Funding might still prove as beneficial as it has done in areas where community responsibility is valued highly.

A major role of Government is to enable "people to pursue activities of their own choice with the minimum frustration" (Oakshotte, 1991, p. 424). Yet, could a society which prioritizes individual liberty support the reduction of flood risk? In the previous results section we examined evidence that supported arguments both for and against the potential for civic engagement to thrive within communities that had a strong sense of

individualism, with respondents both supporting and objecting against civic engagement in Flood Risk Management service provision. Exploring the theoretical conflict between individualism and civic engagement is of importance as Partnership Funding requires individuals to engage with their local community in order to raise funds for flood defences, and raise awareness to reduce vulnerability. However, a focus on preserving individual liberty might not compliment community activities for a number of reasons. First, in an individualistic society, the exercise of authority can be experienced as a limitation of freedom and sovereignty (Adams and Catron, 1994). Partnership Funding could, therefore, be seen as the public being made to do what they otherwise would not. In a community where there is a strong sense of belonging and membership, it may be more likely that an individual within an area would empathize with the plight of other community members which will contribute to effective co-operation towards shared goals (Vickers, 1965). However, in communities which do not share a sense of membership, and have social networks which are diffuse (Minkoff, 1997) the drivers which stimulate public engagement derive from a wish to secure individual gains rather than improve the wellbeing of the community as a whole. Bearing in mind the UK's heterogeneous social landscape, understanding whether Partnership Funding can work in both scenarios is of benefit to those promoting authorities wishing to raise funds for flood defences from the public.

Hampton (1988) in her book 'Hobbes and the Social Contract Tradition' demonstrates how successful civic engagement is possible even with prioritization of individual liberty. Hampton (1988) describes that an individual will participate in community service provision if the increment of security that they receive from their activities exceeds the costs of them joining, and if they believe that the group will be effective at mitigating the

risk. This theory is much the same as the Prospect Theory (Kahneman and Tversky, 1979) in that the value of the gamble is weighed, and the probability of the activities achieving their aim is also estimated. However, the theory is applied predominately to groups as opposed to individual decision making.

Applying Hampton's (1988) example, if the community is asked to raise £400,000 for flood defences, as was asked of the flood group in Cockermouth, and each residence on average is expected to receive £8000 worth of benefits (EA, 2014) it would be expected that at least 50 donors would be required to meet the costs of building a new flood defence:

Total cost of project / Gross benefit to individual = Quantity of individuals required

£400,000 / £8,000 = 50 donors

Let us say that in this case there are only 30 people within the community who have in the past been flooded and an additional 100 people that are at risk from flooding but have yet to be flooded. Assuming there are no privileged donors, even if all 30 people who have been flooded made a full contribution there would not be enough resources to cover the costs of flood defences, and as such at least 20 individuals from the rest of the population will need to be persuaded to contribute to the collective action. Any fewer members means that the risk to each involved in the group is greater than if the group was not formed. Each group member knows that they are better off taking the financial risks than not doing so. But, 20 of those people know that they would be better off if someone else took their place, such that they get the benefit of the flood defence at the expense of other people's efforts. Therefore, if a person believes that others will join in the flood group instead of themselves, they are in a better off position not joining. However, if the community member believes that their joining the group is critical to

the group's success then it is rational for that person to join.

The role of the State in this situation is to select these 50 people or to select the chair of the area to find 50 people (or monetary equivalent). Let us suppose that people do not realise that by contributing £8,000 they will save £8,000, especially as they may not see the benefits in a real way in the case the flood does not re-occur or they move location before a repeat flood event. In this case the group leader can use the prospect of future selective incentives to help resolve the conflict of situation and diffuse the dangers of shortsightedness, such as persuading members that the product of a public good will lead to receipt of private good, e.g. increased social status and respect in the community. The group leader cannot ensure this private good, yet even if some of the population refuse, according to Hampton (1988) there should be enough rational actors to volunteer. According to this theory it is, therefore, likely that the State would succeed in it's goal of raising funds outside of taxation, challenging the belief that community engagement to fulfil individual gains is some how less desirable for the community than participation driven by altruism.

However, in collective decision making another threat exists to securing community involvement, and that comes in the form of free riding. In Cockermouth, for instance, prior to the implementation of a Council Tax Precept the group fund raised for the £400,000 required to build flood defences. Despite their best efforts, the group fell £150,000 short of their target, which within this section on individualism is quite profound as the majority of donors were privileged or had been victims of flooding. The remainder of the population did not contribute until the requirement for them to contribute became official through the Local Authority[2]. Hampton (1988) argues that this trend of free-riding

[2]That the community voted in favour of a Council Tax Precept, but did not raise adequate funds through an unofficial donation supports an argument for the co-existence of social contracts and

can be overcome by either increasing the group size, or by making it rational for people to join the group through offering selective incentives, such as popularity or acknowledgment, so that the total benefits exceed the costs. This argument is supported by an observation by the respondent for the Par and St Blazey flood group who stated that the side of the village which had not been flooded had felt isolated from the community building activities and had sought to involve themselves further with the flood reduction initiative. As such, there may exist cases were selective incentives can reduce free-riding, however, this may not be as successful in larger towns and cities where diffuse networks prevail (Minkoff, 1997).

Within this thesis another trend was observed where groups disbanded once the funds for a flood defence had been raised. Olson (2009) describes the potential causes of this. After a flood defence has been built one person decides that the group can do better without him, or achieve the same goals. Yet, simultaneously other group members think the same, leading to a danger of doing nothing. The driver of this transition is the transformation of Flood Risk Management from a 'step good' to an 'incremental collective good'. By this what is meant is that prior to the flood defence being built a certain threshold had to be met in order to raise enough funds to gain the benefits of a flood defence. Once the flood defence was in place, Flood Risk Management becomes an incremental collective good in that a minimum standard of protection can be achieved with a reduction in the number and / or efforts of volunteers. Within our case studies this was demonstrated as groups shrank and disbanded. In other cases, where groups had been educated and made aware of residual risk, a band of flood wardens often remained, or knowledge was kept within residents associations, and the members of these groups often gained selective incentives in the form of social standing or recognition of their

collaborative engagement, which shall be discussed later.

contributions towards the community. If we assume that Olson's (2009) theory is correct, then we can surmise that despite a societal focus on securing individual liberty, collective action may still take place within a community. First, this collective action will need a larger proportion of the population to contribute so that a step good, such as a flood defence, can be purchased. After this point, the flood group can reduce in size as the task of raising awareness is an incremental collective good.

The results of our study do not fully support Hobbes' (1651) individually motivated models of public participation, with observations supporting altruism as the predominant driver of civic engagement. For example, much of the volunteer work was driven by non-flooded residents, and in areas such as Kingston upon Hull and Merseyside where there was no civic engagement by those who had been flooded neighbouring communities worked to support poorer communities. In many areas, respondents reported that their villages and towns had been made better for the increased sense of community from their flood group activities, and instead of being bound by a sense of duty (Selbourne, 1994), many community members used the flood action groups as a way to forge local social networks which they had felt had been missing from their community previously. Minkoff (1997) describes an increasing move towards geographically diffuse networks which weakens local bonds, but from this study, which has demonstrated that people have a desire to know their neighbours and local community, I hypothesize that diffuse networks are in many ways a substitute for a reduction of local neighbourhood networks, and that flood action groups can act as catalysts to create and enact an idealised notion of community. Partnership Funding has, therefore, changed the behaviour of the public as much as it has allowed the public to adopt lines of action which it had previously wished to pursue. This study has given example of groups were seeking to manage flood

risk well before the implementation of Partnership Funding, with cases of groups even asking to contribute money to flood defence schemes. Partnership Funding therefore represents an improved mechanism to express collective choice, facilitating increased collaboration between different stakeholders concerned with Flood Risk Management, and in turn producing symbiotic affiliations which improve social integration across a broadening spectrum of service provision.

A strong sense of social responsibility and community membership has undoubtedly contributed to the successful initialization of Partnership Funding. Bearing this in mind, Partnership Funding is likely to have been implemented at the opportune moment. Hayek (1945) argues that social responsibility can be strengthened by shrinking the units of governance to the smallest possible scale, and Partnership Funding has coincided with a shift towards local governance. It is difficult to hypothesize whether Partnership Funding would have been as successfully implemented 20 years ago, however, even in a society which values individual liberty highly, a move towards localism means that individual interests are more likely to coincide with local interests, and in turn foster an environment which is conducive to public-private partnerships. An individualistic society with weaker local governance may not have been as successful at this task regardless of the frequency of flooding, with the likelihood of the Post-Marxist type of pressure groups forming in favour of cooperative action groups due to the existence of fewer links to Authorities and fewer levels of governance.

Tracey Coates built on this notion of individualism within communities, exploring the concept of collective public involvement in her doctoral thesis 'Conscious community: belonging, identities and networks in local communities' response to flooding'. The results of her study showed that the public did have a sense of belonging and responsibility

towards their communities, however, the idea of community was not geographically constrained. Resultantly, Coates dubbed the spatially transient concept of public collectives as 'conscious communities'. Importantly in regards to research in Flood Risk Management, Coates showed that as a result of a more conscious and less physical community, the ways in which the public sought to involve each other in the management of flood risk was diverse, a trend supported in results presented here. The concluding thought of the thesis was that:

> "...local community has the potential to offer a way to help people cope more effectively with flooding and other disasters, but only by moving beyond idealized notions of the 'traditional community' which fail to adequately reflect these complex and diverse communities."(Coates, p.188)

The involvement of the public in Flood Risk Management at community level therefore involves challenging the traditional conceptualization of a geographically static community, and catering for collective behaviour which may be transient and diffuse.

The observations we have made into public-private funding of flood defences has demonstrated that self-interest can be balanced by a commitment to community, especially when strong local governance exists. The cases of Partnership Funding that have been explored have demonstrated that community involvement is driven by a desire to solve the flood problem as much as it is driven by a wish to forge greater bonds across the local community. When dealing with local communities, promoting authorities should bear this in mind, and highlight community based incentives as much as risk reduction incentives, and in doing so may promote longer term civic engagement once a flood defence is implemented. Yet, what also must be considered is that for Partnership Funding to be effective there is an initial requirement for people to be aware of the risk they

face, for the community to have the funds between them to meet the required amount (though the Partnership Funding weighting towards deprived areas assists with this in the case that community funds are lacking), and for selective incentives to be provided to volunteers.

5.4. Conclusion

This study has brought together a number of sources of information to understand if the benefits provided by flood defences in England are predominantly public, club or private, whether a revised funding scheme which allocates public funds proportionately by the scale of benefits the defence provides is appropriate for delivering these goods, and the barriers faced in the transition of flood risk management from providing a public good to providing private, public and club goods. The new funding strategy has been adopted rapidly; in 2012/2013 36 % of Flood Risk Management schemes had some form of PF by 2014 this had risen to 71 % for new entrants (McNally 2014). It appears from our data that the new funding scheme has also been adopted successfully. Groups interviewed who had not been part of the Partnership Funding scheme predominantly stated that in the hypothetical situation that they were asked to raise funds they would not do so, with perceptions that it was primarily someone else's job or that it would be prohibitive. However, there has yet to be a case that those groups contacted and who are part of Partnership Funding scheme have not attempted some formal fundraising.

We conclude that Partnership Funding is highly suitable within England where the sources of flooding are heterogeneous, social and financial capital is not evenly distributed across the country, and increasing climatic and development pressures can pose threats to

individuals, public services, the tax base, and the economy (Wilby and Keenan, 2012). The previous funding system was efficient, but not as equitable as the revised approach, with negative externalities which meant that, despite all projects funded being considered as public, the benefits were distributed very narrowly leading to exclusion and effectively the creation of a 'club good' at the expense of the wider public. Figure 5.1 has shown that already there is a significant increase in the number of projects planned for the future as a result of Partnership Funding, and that these projects are deliberately including areas of deprivation, because by doing so they are more likely to be awarded full funding. Though under the previous funding structure there was an incentive to protect houses of mid- to low-income due to a weighted priority scoring towards these, the system was more easily manipulated by pressure groups which were more often than not in wealthy areas. In contrast the Partnership Funding does promote civic involvement, but where public participation does not emerge due to deprivation, the weighting of the OM means that it is in the benefit of the wealthy neighbourhoods who will most likely wish to pay lower contributions to ensure that poorer local communities are benefited by any scheme.

An important feature which was found in this study was one that could not be perceived through examination of statistics. This was the enhanced levels of collaboration between stakeholders, the benefits of which were not only felt the duration of the flood project, but also across other local initiatives with communities amicably communicating with water companies, property developers, and other stakeholders of significance in the area. Those communities involved gained increasing social capital and awareness of the political processes which shaped the environment which a live in. Under the previous funding system, all that was required of local residents was to be aware of flooding.

With the new Partnership Funding scheme residents feel a level of obligation not only be aware, but also contribute, and help other vulnerable members of the community, with all flood groups involved creating warden schemes which identified vulnerable people in the community and helped them with issues such as insurance and evacuation. These positive externalities were not expected, but have led to significant community improvements, and the support the expectation that the public must reconsider their position and possible role in relation to the changing risks they may come up against (Defra, 2004).

The biggest test that Partnership Funding will face might not be whether funds can be raised initially, but instead whether funds can be raised a second time in the case that a project is unsuccessful or not adequate to the level of flooding the community may witness in the future. Partnership funding is expected to last for decades into the future, and within this time it is likely that communities who have raised funds will be flooded again. Communities struggled to raise the initial funds, and their feelings towards raising a second lot of capital is yet to be seen. It is suggested that Local Authorities overcome this barrier by working with long-term nodes of social capital, such as residents associations and other generic groups (Geaves and Penning-Rowsell, 2014).

Overall, the first point of investigation, of whether flood defences should be seen as private and club goods in addition to the traditional perception of them providing public goods, has shown that there is a significant demand for medium scale flood defences which fall in between the definition of private and public goods. Just in the space of two years the number of projects which are seeking partial funding for flood risk management has increased significantly, and as projects seek to gain a grants, it is likely that more projects will be recognised for the locally-based benefits that they provide.

Partnership funding has proven, at least initially, to be a highly effective mechanism to translate this change in perception of the benefits that flood defences provide, and to circumnavigate fiscal rent seeking by groups that wish to claim benefits at the expense of other taxpayers. There are many barriers in the way of Partnership Funding, such as the potential longevity of the scheme, and barriers put in place by groups who perceive their project to be valuable for the wider public when its benefits do not necessarily extend that far. An open mind of the promoting authorities, and the assistance of third parties will support the clarification of these issues during the transition period that flood risk management in England is currently undergoing.

The next concern was that areas with households that were considered deprived would not be able to contribute to any Partnership Funding scheme. As was described by one respondent, such fundraising would be "prohibitive". When combined with Figure 5.3, it can be seen that Partnership Funding may actually be an improvement for these communities. Even though the project may not be of wider public benefit, the increased weighting given to these areas means that they would still be able to get government funding. Importantly, this also persuades the promoting authority of the Flood risk management scheme to ensure that more houses in higher levels of deprivation are protected by a flood risk management scheme. In doing so the scheme is awarded more for values 0M2 and 0M2b, increasing the likelihood that the project will score over 100% Partnership Funding.

Still of concern however, is the level of interaction between authorities and the public. Figure 5.1 demonstrated how projects were significantly constrained by constituency boundaries, and a number of the case study areas interviewed described limited opportunities for interactions with authorities in their area. This asymmetry between areas where

there is a high level of collaboration between local people, authorities, and other stakeholders is starkly contrasted against those areas where not only does this collaboration not exist, but there is also hostility towards flood group members.

That such conflict exists, is hopefully a mere hangover of the previous flood risk management funding scheme whereby which communities who needed funds could not get them and therefore formed pressure groups. Such an approach, created a typical post-Marxist narrative between authorities and the public with the legacy of these interactions still informing the behaviour of stakeholders today. The Partnership Funding scheme in these scenarios when introduced may initially lead to conflict, however if handled sensitively with the presence of a third party, such as the National Flood Forum, it is likely that, like in Cockermouth, the repertoire between authorities and the public improves disproportionately, not only in issues of flood risk management, but also in other issues of community engagement.

6. Flood Re: Household management of flood losses

6.1. Introduction

Insurance is an integral component of flood risk management in the UK. Uncertainty of flood events caused by intense, heavy rainfall, and an increasing level of acceptance that engineered defenses cannot always prevent flooding, means that consumer demand for insurance is only set to rise, yet simultaneously renders its provision as risky for insurers. However, this demand for insurance can be problematic both for consumers and providers. Providers face the challenge of "ensuring fairness, economic efficiency, political feasibility and public acceptance" (Surminski and Eldridge, 2015, p.2), whereas consumers battle will the dilemma of whether to insure amid other daily financial concerns. Despite these challenges, the ABI has stated their desire to work with Government to develop a mechanism which allows "flood insurance to remain widely affordable and available, while allowing a sustainable transition to risk reflective pricing over 25 years." (ABI, 2015).

If it is the UK Government's ambition to use insurance as a nation-wide tool for flood risk

mitigation then access to insurance needs to be treated as public good; the insurance pool should not run out and the opportunity to purchase insurance should be widely available to all, including the poorest in our population. However, in reality insurance is rival if too many claims are made simultaneously, and can become excludable by price when premiums are too high or compulsory excesses exceed the funds immediately available to an individual (Geaves and Penning-Rowsell, 2015). Since the 1960s, potential rivalry within the flood insurance pool has been mitigated by cross-subsidizing those most at risk by those at low risk, resulting in artificially low insurance premiums for some consumers, and artificially high for others. In 2013 this cross-subsidy was formalized through the creation of an insurance "pool" termed Flood-Re (Defra, 2013). Within this pool the risk of rivalry is reduced by introducing a statutory levy agreed between Flood Re and Government. The current level of this levy stands at £180m per annum for the first five years of Flood Re's operation, which is equivalent to a cross subsidy of £10.50 for each UK insurance policy holder (Defra, 2013).

The next transition required if access to flood insurance is to become a public good is to ensure that consumers cannot be excluded by price. There has been considerable pressure placed on the UK government by householders to ensure that the price of insurance is kept affordable (Geaves and Penning-Rowsell, 2015). However, even though insurance premiums are priced at less than risk reflective values the uptake of flood insurance among those currently uninsured is still low across the UK, with ABI estimating that without a scheme such as Flood Re 300,000 to 500,000 households will struggle to purchase insurance cover (ABI, 2015). The development of Flood Re indicates an assumption that cases of poor uptake of insurance are a product of affordability and, resultantly, implements a maximum insurance price for the first 15 years of Flood Re, the level of

which will be determined by Council Tax Band (an indicator of wealth calculated by property value and used to inform the level of tax paid to a local authority). After this time the cost of insurance will gradually become risk reflective over a period of 10 years.

This Chapter introduces the concept of social feasibility for household level loss mitigation options, presents the outcomes of the models developed in Chapter 3, and then goes on to assess the implications of results in light of the current structure of the British insurance industry. The results are split into two sections. The first section addresses whether agents could afford insurance during the model runs, and how affordability varies across Council Tax Bands. The second section examines the difference between the absolute risk value and perceived risk value of purchasing insurance and property level protection under Flood Re in order to get an indication of the social feasibility of loss mitigation options within these scenarios. Again, these results are split across Council Tax Bands in order to assess the distribution of benefits of Flood Re across the agents society. Overall, the results answer the questions of whether agents can, should and will purchase loss mitigation options under Flood Re. [1] Having demonstrated the significant difference the addition of behaviour makes to perceived value of purchasing loss mitigation options, I conclude this chapter by discussing the relationship between insurers and consumers. Specifically I examine how Flood Re influences the relationship between consumers and insurers, and examine opportunities for increased collaboration between insurers and consumers which could change public behaviour to reduce risk at household level while improving the uptake of insurance.

[1] The reader should note that the model outputs are a product of an idealized environment where no other risks exist and agents are not obliged to purchase insurance as part of their mortgage agreement. Despite this, the model does provide an important insight into the significant difference in consumer demand for loss mitigation options when observed behaviour is integrated into simulations. The model also provides an opportunity to hypothesize the impacts of Flood Re when, due to the fact Flood Re had not been implemented at the time of writing, it was not possible to observe the outcomes of Flood Re in reality.

6.1.1. The public as consumers of household flood risk management

This section addresses the feasibility of the inclusion of the public at an individual level in the management of flood risk. Feasibility is assessed from the examination of both academic arguments of individual involvement, and empirical evidence demonstrated in results. The reasoning of why decision makers now chose that it is feasible to include individuals in Flood Risk Management policy is explored, and the reality of this inclusion examined.

Frederick Hayek, a major political thinker of the twentieth century, extensively explored the use of knowledge in society (1945) challenging the leading questions behind theories of rational thinking. As Hayek describes:

> *If* we possess all the relevant information, *if* we can start out from a given system of preferences and *if* we command complete knowledge of available means, the problem which remains is purely one of logic. . . . This, however, is emphatically not the economic problem which society faces. (p.519)

Hayek goes on to argue that the fundamental problem is how to redistribute resources most efficiently taking into account the ideal level of resource delivery mitigated by inefficiencies at different levels of society. As such, any successful flood risk management plan must not only be responsive to information availability, logic and available knowledge, but also the distribution of those features across society which may hinder implementation at certain scales. A model of behavior must therefore include behavior which deviates from traditional rationality or otherwise face continual systematic errors which emerge as extreme economic costs following flood events and the development of

areas of social blight over time.

The answer to the question of 'social feasibility' of individual scale flood protection in the UK therefore rests on the ability of either the public to gain a more even distribution of rationality across society, or the ability of flood risk authorities to cater for 'irrationality' within the promotion of individual Flood Risk Management strategies. However, those wishing to promote the adoption of individual Flood Risk Management strategies will face a significant challenge as the research of today agrees much with the research of the 1960s; the public do not understand flood risk:

> "There is empirical evidence that many individuals exhibit behavior that implies they are either unconcerned or extremely risk averse when deciding whether to purchase insurance against events that have a small probability of occurring... The unconcerned individuals are not willing to pay a penny even if premiums are subsidized, whereas those who appear to be highly risk averse opt for premiums that are more than 10 times the expected losses." (Kunreuther *et al.* 2011, p. 6)

Echoing Penning-Rowsell's 'Prison of Experience' developed in 1972, research developed today continues to show that the public will rarely chose act until after a significant flood event; "Only after a catastrophe occurs do the decision makers express their regret at not undertaking the appropriate safety or protective measures." (Kunreuther and Michel-Kerjan, 2011, p.6).

Today the Environment Agency promotes six stages an individuals needs to follow in order to achieve flood protection. 'Understand flood risk' is the first of six stages. Yet, if the public have an 'imperfect perception' of flood risk, how will they ever hope to achieve this initial understanding? Research suggests the answer may lie in the role of

'worrying' rather than 'understanding'. Back in the 1970s fear was considered to be an important adjustment catalyst (Tobin, 1977) in encouraging individual flood protection, and this belief is still supported today. Schade and Kunreuther (2012) explore the idea of fear further in their article 'Protecting Against Low-Probability Disasters: The Role of Worry'. The results show that individuals will not comply with expected utility models if the probability of risk is ambiguous, and were willing to pay far more than the potential damage costs when driven by worry.

Tim Harries, an academic involved in researching the impact of behavior in flood risk adaption, examines the role of worry building upon the findings of researchers in the States. In his article 'Feeling secure or being secure? Why it can seem better not to protect yourself against a natural hazard' (2008) Harries discusses why in areas where 60 per cent of respondents know they are at risk from flooding only 6 per cent of those not flooded have taken moves to protect themselves from that risk. Harries argues Anthony Giddens' case for ontological security, i.e. people feel more secure not investing in mitigation strategies as by doing so they mentally deny the presence of risk. As Harries describes:

> "People's apparently irrational refusal to prepare for flooding is functional when seen in the context of their own motivational priorities. Preparatory measures against hypothetical future flooding are eschewed...when they are seen to threaten the fundamental human need to feel secure." (2008, p.479)

Harries showed that the concept of living at flood risk for many respondents threatened the idea of home; a belief supported by research of flood victims who only felt they could fully recover from flooding after moving property (Tapsell and Tunstall, 2008). People did not want their house to appear anything but the typical homely image, and

rejected adaptions even such as steps upwards or water proof entrances to the cellar. As one respondent described, "They put in a door [to the cellar], the sort of thing they use, you see in a submarine" (Harries, p.483, 2008). Such beliefs are rational in the behavioral economics sense, but do not fit in with neoclassical definitions of rationality, posing problems for ideas of implementing social feasibility and methods of promoting awareness of flood risk.

Harries' research also shed light on another important barrier to the uptake of individual flood risk protection, and in doing so showed the big difference in the situations experienced by renters in comparison to mortgage holders or property owners. As Harries described, those that rent "are unlikely to have the right to make the structural alterations necessary for measures such as drainage-improvement or floodgates and have less incentive to do so because they are not financially responsible for structural damage." Renters have also been shown to have lower uptake of contents insurance, with 60 per cent of people in social or rented housing lacking contents insurance in comparison to 10 per cent of owner-occupiers (Aldridge *et al.*, 2012). With a rise of 1.3million people renting homes in the UK in the past decade alone (ONS, 2013), a figure set to grow under increasing house prices and inflation rates, tighter lending requirements and a widening house price to wage ratio, strategies to promote the uptake of individual flood protection must take into account the varying situations of renters and householders, which currently is not high on the management agenda.

At this point, I would like to return to the earlier information examined; that in the 1960s research showed that the public were trapped within a 'prison of experience' with "imperfect perceptions of flood hazards and flood loss reduction options" (Parker and Penning-Rowsell, 1983, p.189). The public were excluded in the management of flood

risk due to the belief that flooding was a primarily geomorphological hazard, and that social welfare could be improved by managing water for greater economic productivity. Behavior research of the time was not side-lined from application in management strategies because of a lack of credibility, but more that the research did not suit the British problems of the time (Parker and Penning-Rowsell, 1983), those problems being the need to meet the UK housing shortage and increase agricultural productivity. Capital intensive, large scale flood defense projects were more suitable to the UK context: with massive new housing developments, design of flood defenses could be integrated into the infrastructure of the new town.

It is also important to emphasize that management strategies which influenced public behavior were not unheard of in the UK. Water Authorities had identified and mapped flood problems during the 1970s (Parker and Penning-Rowsell, 1981), development control had been applied since the late 1940s, and flood warning and planning had been extensively applied throughout the later half of the century (Smith and Tobin, 1979). At an individual behavioral level there was still significant scope for improvement of flood insurance, however, flood proofing had many years of application (Harding and Parker, 1976). As such, in many ways, the individual aspect of flood risk strategy today is more about unifying and awareness raising of these options, rather than creating anything new.

The UK has significantly changed since the 1960s, and the problems of today may well be more suited to the flood perception research of the past. The size of single housing developments has decreased significantly with new towns such as Cranbrook planned in Exeter aiming for 2,900 homes, and Pinhoe in Devon aiming for 7,500 new homes, this is a far cry from the housing developments of the 1960s which planned for 250,000

homes in a single development. Building Flood Risk Management infrastructure into new developments today is more an add-on to complement and sustain existing flood defenses rather than the primary flood defense strategy of the area.

The second important change in the UK population which makes flood perception research of the 1960s more applicable to today's context is the lifestyles of the current population. The increasing desire to improve quality of life and the access to amenities which facilitate this means that the cost of flood damages has increased at household level. As Parker and Penning-Rowsell (1983) predicted in the early 1980s:

> "Flood loss potential may be rising in real terms, not so much because of building encroachment, but because of wealth accumulation in existing flood prone properties: this is largely unavoidable." (p.188)

Thus, individual flood perception research developed in the 1960s now has a place in the UK due to relocation of the flood problem to household scale and a more piecemeal approach to housing development. Yet, the targeting the flood problem at an individual level still has a major hurdle to overcome: will the public adopt the solutions, or, as Smith and Tobin asked in the USA back in 1979, is the adoption of individual Flood Risk Management remedies 'socially feasible'?

6.2. Results

The result are split into two sections. The first links Council Tax Bands with the notion of affordability in order to understand if people could purchase insurance under different scenarios if they had the desire to. The second section looks at the risk value of purchasing different option for each agent, if Flood Re makes the purchase of insurance

and / or property level protection an attractive gamble (Expected Monetary Value) and how this gamble feels to different agents across multiple Council Tax Bands. Ultimately, I hypothesize whether Flood Re will be efficient and fair when taking into account how consumers make decisions in the purchase of Flood Risk Management options.

6.2.1. Does Flood Re increase the affordability of flood insurance?

Within the assumptions described within the model development, on average the majority of agents could afford insurance under a risk reflective insurance pricing scheme. However, the cap on insurance premium is low enough in Council Tax Bands A, B, C, and D to provide support and reduce the costs of an insurance premium. This pattern indicates that the majority of those agents in Council Tax Bands A, B, C, and D would be able to afford insurance under risk reflective pricing, but do not benefit substantially from the cap on insurance premium pricing. On average, with the normal frequency of average damage, those in Council Tax Bands E to I do not benefit from a cap on insurance premiums because the cap is higher than the risk reflective insurance pricing. Yet, as the results show that in these groups there are no agents who are buying nothing (with the assumption that people will purchase insurance if they have the funds to do so), it can be assumed that a high cap resulting in payment of insurance premiums which are risk reflective is not prohibitive in determining access to affordable flood insurance.

There is a small minority of agents in Council Tax Band A who gain access to affordable insurance from which they would be excluded from under risk reflective insurance premium pricing. On average, under a normal damage frequency, a cap on insurance premium reduces the number of years an individual cannot afford insurance from six

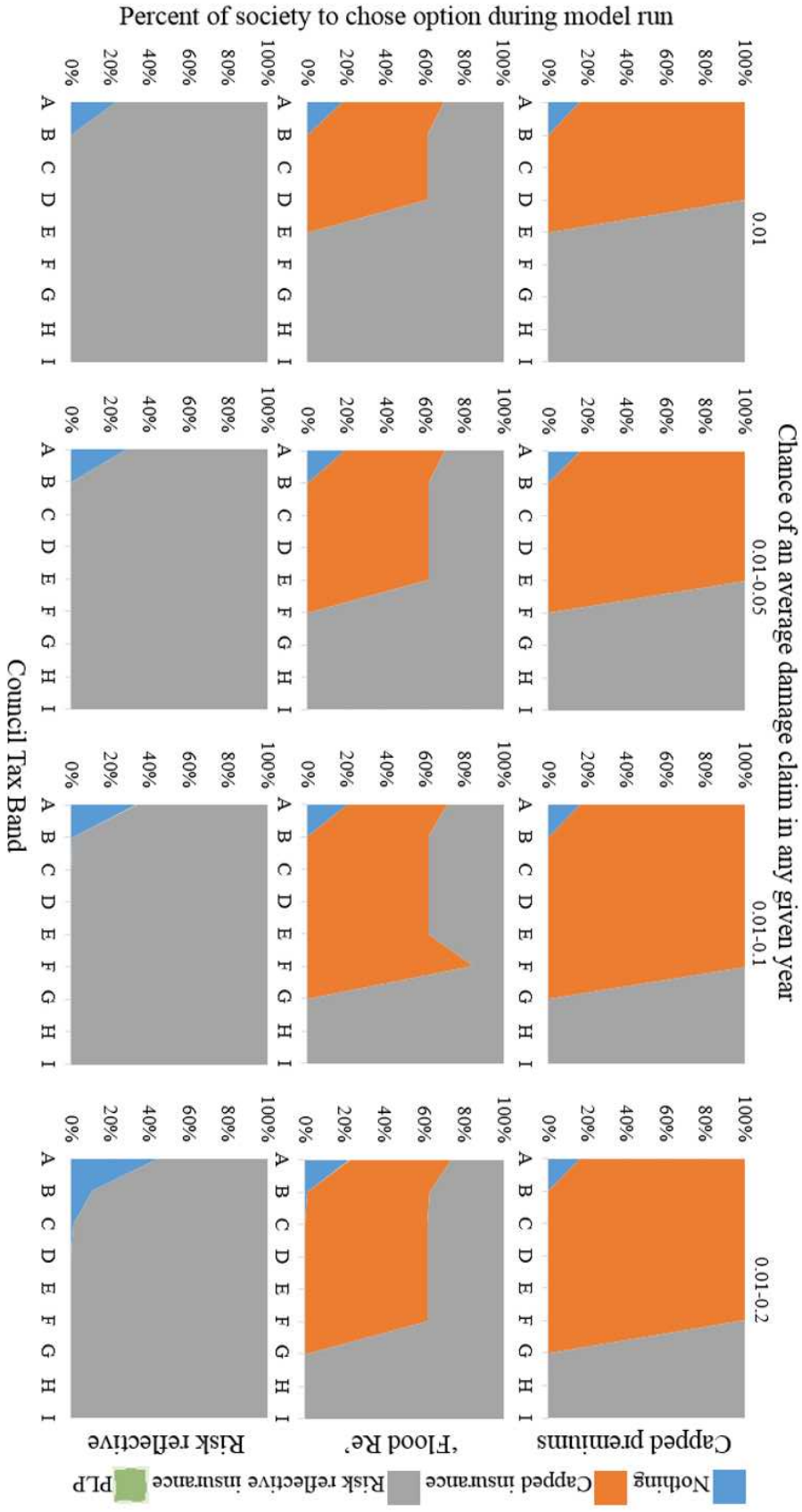

Figure 6.1.: Affordability of insurance under different insurance and damage frequency scenarios.

years to four years over a period of 25 years. As damage frequency increases, so does the extent to which a cap provides benefits for a broader range of Council Tax Bands, increasing from benefiting a minority in Council Tax Band A, to benefiting a growing minority in Council Tax Bands B and C. Under scenarios of increased damage frequency, the number of those households taking advantage of capped insurance also increases. However, the data shows that the majority of those benefiting from the capped insurance could afford risk reflective insurance premiums.

Overall, the main beneficiaries of capped insurance premiums are a small minority in Council Tax Band A. However, under substantial increase in damage frequencies these beneficiaries increase particularly in bands B and C. Without the Expected Monetary Value or behavioral additions Flood Re appears to be a good deal for lower income consumers, and should significantly increase insurance demand for those not currently insured or obliged to insure.

Figure 6.2 shows the inclusion of property level protection as an option for agents within the model run. The number of agents purchasing insurance, capped or risk reflective, remains the same to that in Figure 6.5 and Figure 6.6. However, the outcome is very clear; only those is Council Tax Band G, H, and I are able to purchase even the cheapest form of property level protection in any scenario.

The results, if supported when Expected Monetary Value and behavior weightings are added in the next section, have potential implications for Flood Re, which cross-subsidizes flood insurance premiums for at least the first 10 years of policy implementation with the justification that this will allow people to adapt to flood risk. However, if the policy does not free up enough capital to allow investment in property level protection, these results undermine that justification and raise the question of how will people afford to

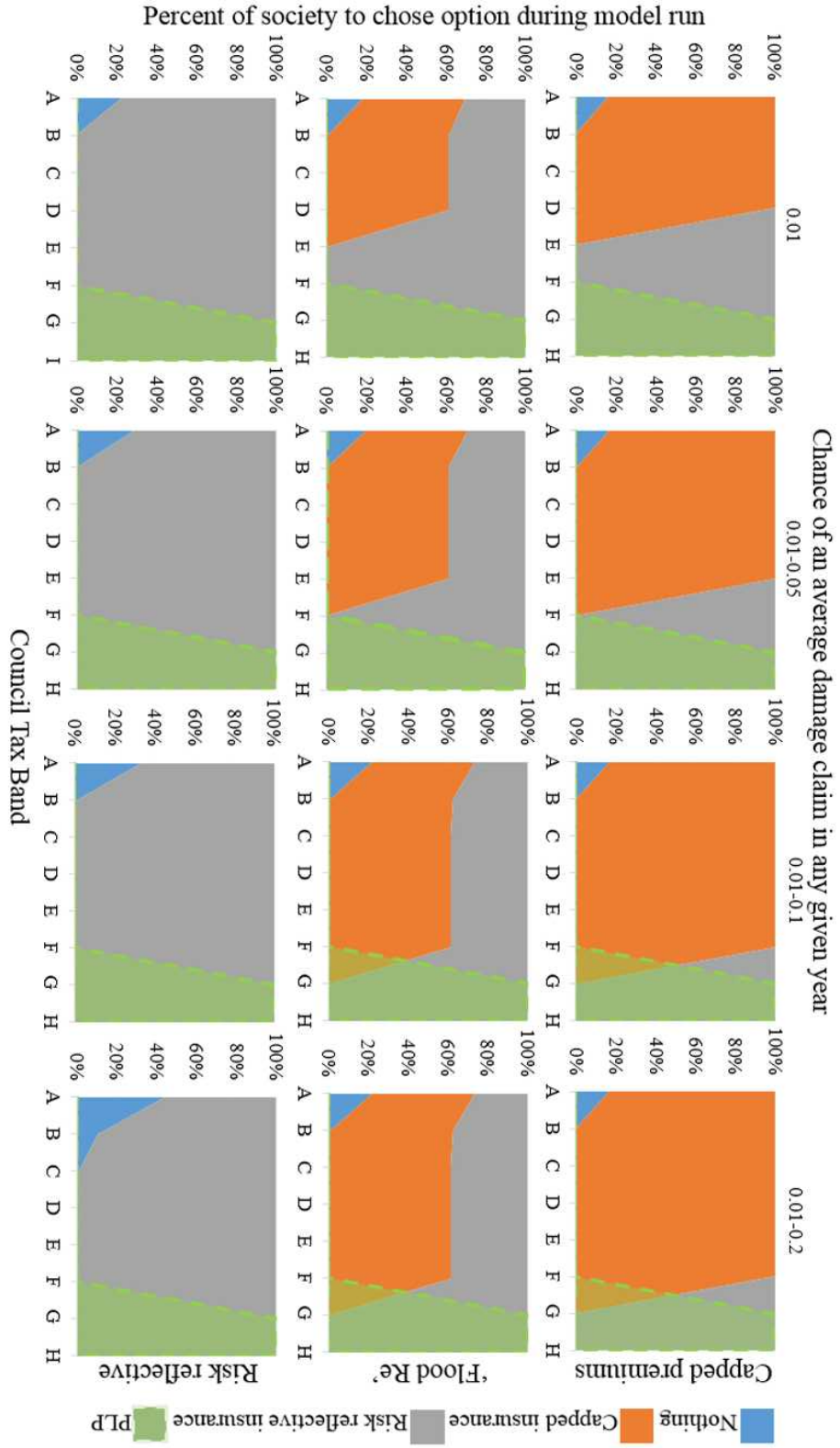

Figure 6.2.: Affordability of property level protection under different insurance and damage frequency scenarios.

adapt even if they have the desire to?

6.2.2. How might Flood Re influence public uptake of flood insurance?

Flood Re aims to improve access to affordable insurance and encourage uptake of property level protection through caps and pricing signals, the structure of which is fully described in Chapter 3. However, uptake of insurance is more than just a product of price: it is related to consumer behaviour, and, ultimately, social feasibility. In order to gain an indication of the social feasibility of Flood Re across different Council Tax Bands, this results section contrasts the outputs of an agent-based model where agents maximise expected utility with an agent-based model where agents conform to observed behaviour. The aim of contrasting these to models is to demonstrate how important it is to ensure that flood risk management interventions are socially feasible and that this feasibility is as much a product of behaviour as it is the price. By achieving this aim, we are able to test the extent and distribution of the benefits of Flood Re, and assess how successful the scheme is at improving access to affordable insurance across society. The other contribution of this section is to show that social feasibility can be tested within a model and that agent-based models are flexible enough to allow the agents within societies to adapt and change the way the make decisions.

The graphs in Figure 6.3 demonstrate how agents change their reference points from which they make decisions over the course of a model simulation. Results, separated by Council Tax Band, also indicate the relationship between wealth and the reference point which an agent typically adopts. Results do not support Flood Re as being a fair mechanism by which insurance can be made accessible across all of the public.

Whether this means that access to insurance should or should not be a public good is not answered through these graphs alone, however there is the suggestion that despite the public priority of access to insurance the practicality of transforming this good into a service that can be publicly subsidized may prove difficult and may not benefit those who are most in need of affordable insurance.

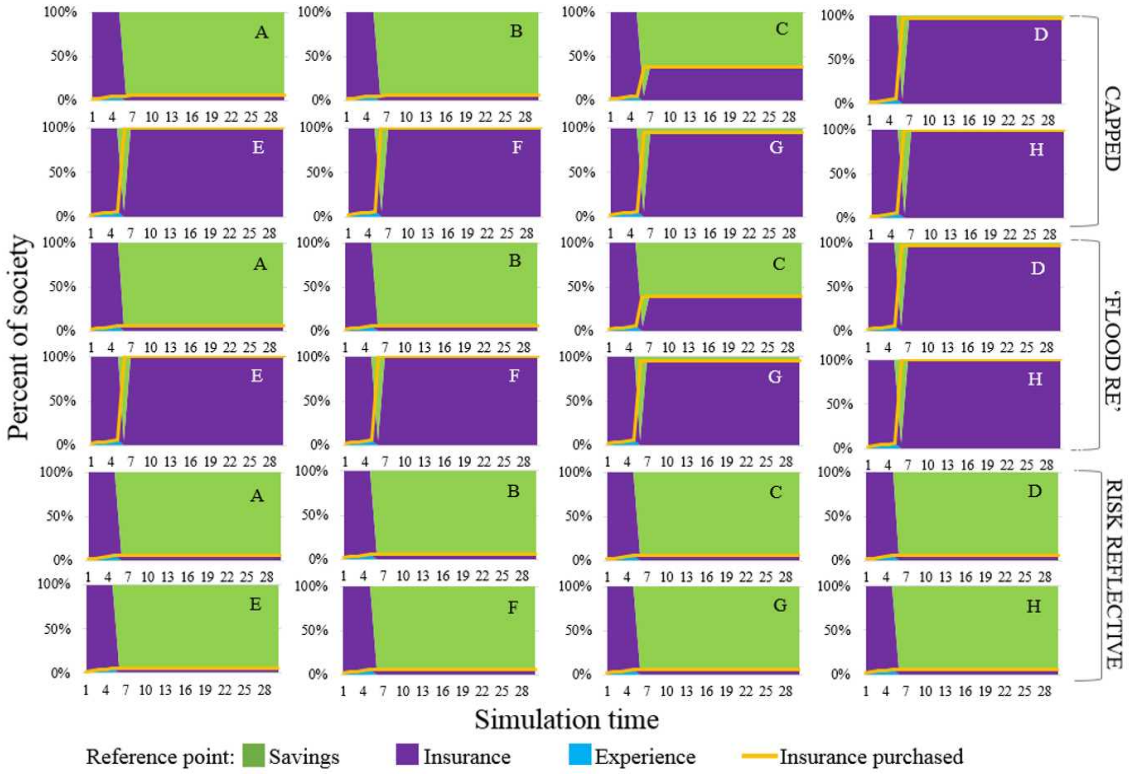

Figure 6.3.: THE CHANGE IN REFERENCE POINT OF AN AGENT OVER THE DURATION OF A MODEL RUN. The results are split into Council Tax Bands, and the percent of society who purchase insurance in any given year. Reference points are the agent savings, average price of past insurance purchases, maximum damage occurred in past experiences.

The next point of note in Figure 6.3 can be seen when we look at Council Tax Band F. Council Tax Band F is the tipping point at which consumers begin to consider the average price of insurance as a more dominant reference point than the amount of savings

the agent has available. That this tipping point indicates the wealth level at which an insurance subsidy is most beneficial is of importance, but is not what is most interesting about these results. The point which I would like to draw the reader's attention to is that despite an increase in flood insurance price following the transition at year 15 of the model run the consumer continues to purchase insurance and continues to hold insurance as their reference point. If we compare this result to the insurance scenario where the cost of insurance is limited for all time during the model run the increase in purchases of insurance is actually greater under the Flood Re scenario.

That consumers continued to purchase insurance even after a cap upon the maximum cost of insurance is lifted is of importance in regards to how long is it necessary to manipulate the insurance market. That the cap upon insurance is too high to be of benefit for Council Tax Bands A, B, C, D, and E is clear, however Council Tax Band F demonstrates that there is a point at which insurance only needs to capped for a certain period of time in order to change behavior in the longer term. For both lower and higher Council Tax Bands if an optimum ratio between and availability of funds can be identified then it may be possible to see a long-term change in behavior brought about by a policy instrument such as 'Flood Re'. Though further experimentation is required to see the extent of this reduction, especially in Council Tax Bands A and B where disposable income and savings may be non-existent and the purchase of a loan to get insurance would prove prohibitive if not disproportionately expensive, in comparison to the costs incurred by other Council Tax Bands, in the longer term.

In Figure 6.3 it is clear that a Flood Re scenario can influence the reference points by which agents make their decisions. This can be seen when comparing the Flood Re and capped scenarios against the risk reflective scenarios. When viewed with Figure 6.4

which shows agents average reference point over the model run a number of notable patterns emerge, which shall now be discussed.

The first pattern of note in Figure 6.3 and 6.4 is the distribution of reference points across different Council Tax Bands. Despite an overall increase in average insurance price as a reference point for making future decisions, the distribution of this reference point is not universal, being heavily weighted towards Council Tax Bands G, H, and I. Council Tax Bands A, B, C, D, and E showed little if any change in the reference points. Yet, it is of note that under an increased frequency of an average magnitude flood event this variation does reduce with almost universal usage of insurance as a reference point across all Council Tax Bands.

That consumers continued to purchase insurance even after a cap upon the maximum cost of insurance is lifted is of importance in regards to how long is it necessary to manipulate the insurance market. That the cap upon insurance is too high to be of benefit for Council Tax Bands A, B, C, D, and E is clear, however Council Tax Band F demonstrates that there is a point at which insurance only needs to capped for a certain period of time in order to change behavior in the longer term. For both lower and higher Council Tax Bands if an optimum ratio between and availability of funds can be identified then it may be possible to see a long-term change in behavior brought about by a policy instrument such as 'Flood Re'. Though further experimentation is required to see the extent of this reduction, especially in Council Tax Bands A and B where disposable income and savings may be non-existent and the purchase of a loan to get insurance would prove prohibitive if not disproportionately expensive, in comparison to the costs incurred by other Council Tax Bands, in the longer term.

From Figure 6.3 and 6.4 it is shown that there is a possibility of fiscal rent seeking

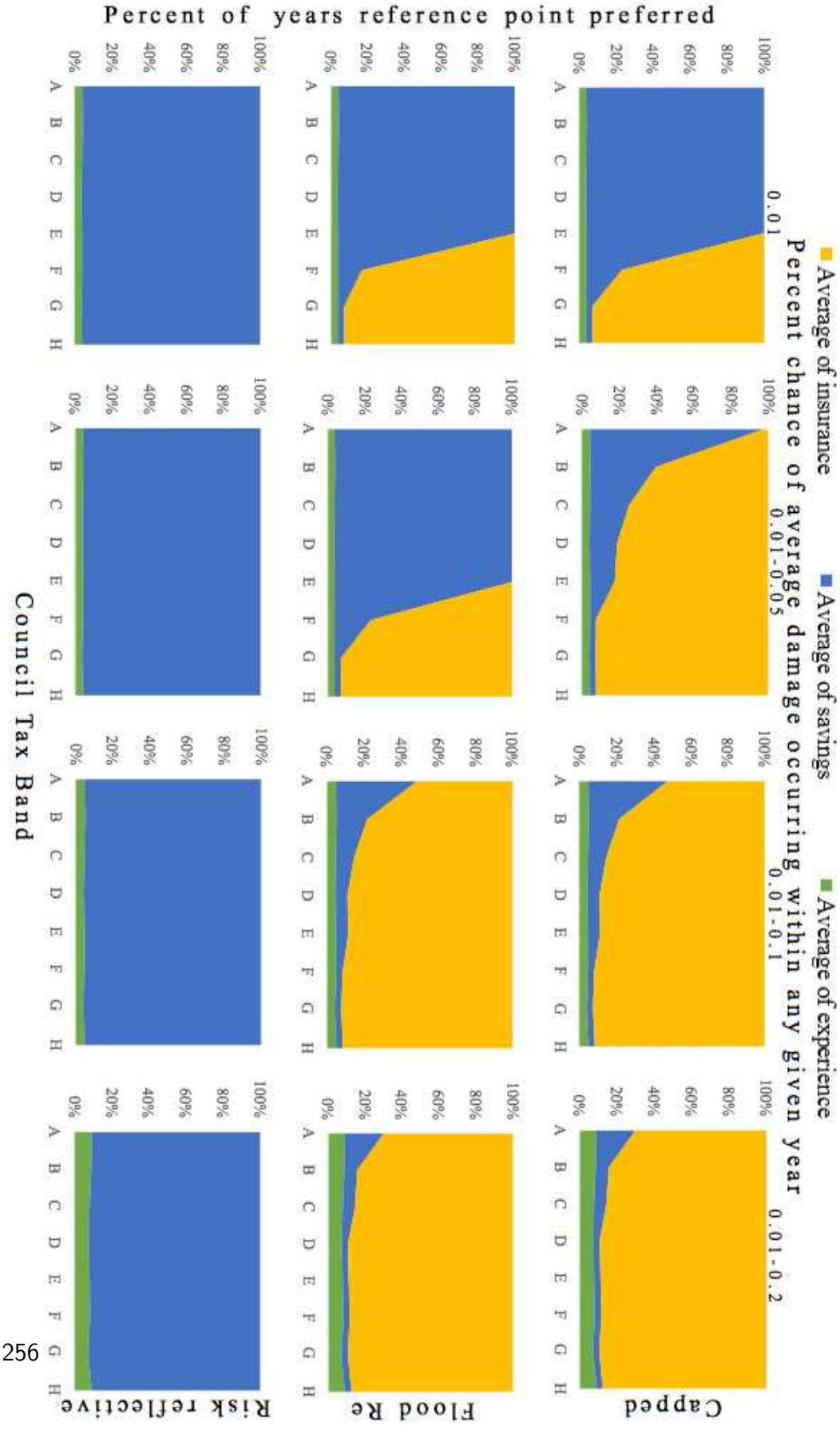

Figure 6.4.: The average reference point held by agents in different Council Tax Bands.

occurring in a higher Council Tax Bands when applying a policy instrument such as 'Flood Re' because there is the disproportionate benefit given to those who already purchase insurance. Those that already purchase insurance are those that are already able to afford insurance prior to the policy instrument being implemented. However the reference point does not determine that a purchase of insurance will definitely be made, and the following Figure that we discuss would demonstrate the extent to which actual purchases of insurance vary under-insurance scenarios and under Council Tax Band.

The second set of graphs (Figure 6.5 to Figure 6.10) demonstrate how different scenarios of insurance (Capped, 'Flood Re', and Risk Reflective) influence the demand for insurance and improve the affordability of property level protection by freeing up funds, and raising awareness which in turn will change behavior in purchasing other risk management options. Figure 6.5 to Figure 6.6 show the average demand for different options across society, and Figure 6.7 to Figure 6.10 show the same data from a different perspective by presenting the exact outputs of the gamble under both prospect theory and expected monetary value. For both options results are presented for damage when it is flat rate across Council Tax Bands, and for damage when it is proportionate to the ABI's rebuild calculator estimates. There are a number of key trends which I shall now discuss; first, the overall increase in the uptake of insurance under a 'Flood Re' and Capped scenarios, second, the increase in the purchase of risk reflective insurance under 'Flood Re' and Capped scenarios despite no decrease of the risk reflective price, third, the distribution of uptake across Council Tax Bands, and, finally, the comparison to the results from the expected monetary value model runs.

The overall uptake of insurance under a 'Flood Re' and Capped scenarios is visible across all damage frequencies. In the risk reflective insurance scenario only around 2% of society

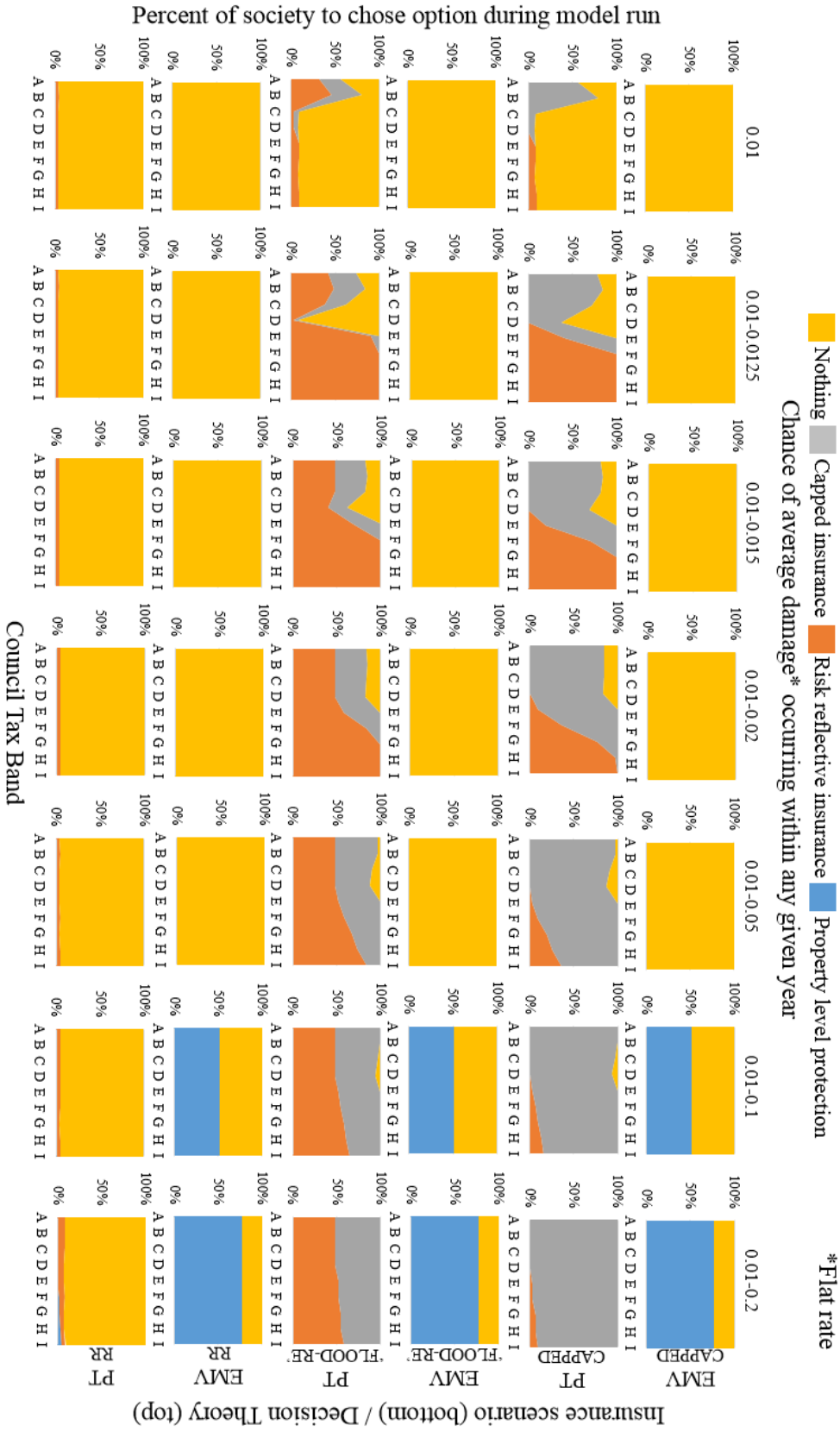

Figure 6.5.: The purchase of flood risk management options when damage is a flat rate. The average number of purchases of different flood risk management options over the duration of the model simulation when damage is set at a flat rate. Prospect Theory (PT), Expected Monetary Value (EMV), risk reflective (RR).

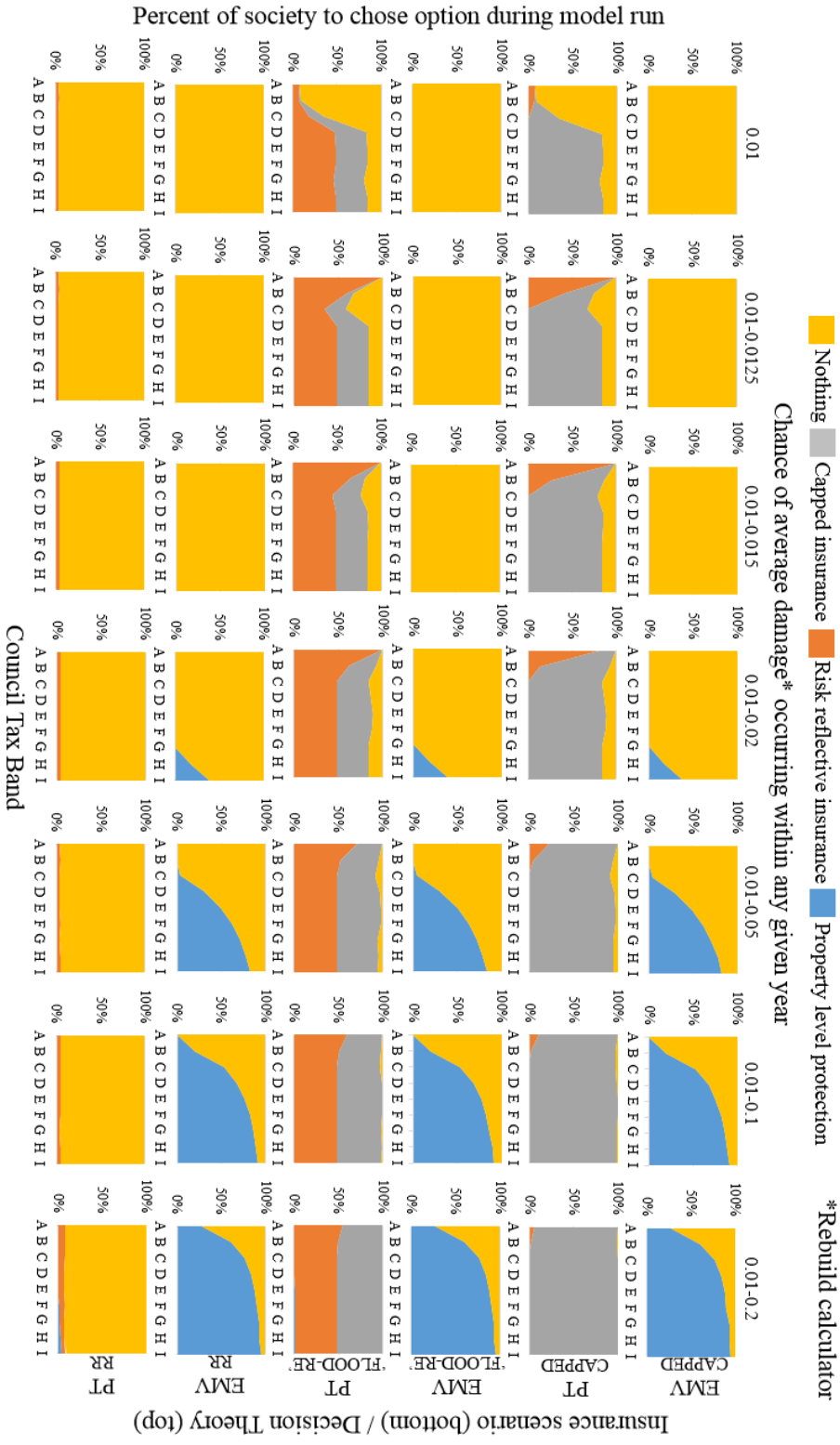

Figure 6.6.: The purchase of flood risk management options when damage is correlated to rebuild costs. The average number of purchases of different flood risk management options over the duration of the model simulation when damage is informed by the rebuild calculator. Prospect Theory (PT), Expected Monetary Value (EMV), risk reflective (RR).

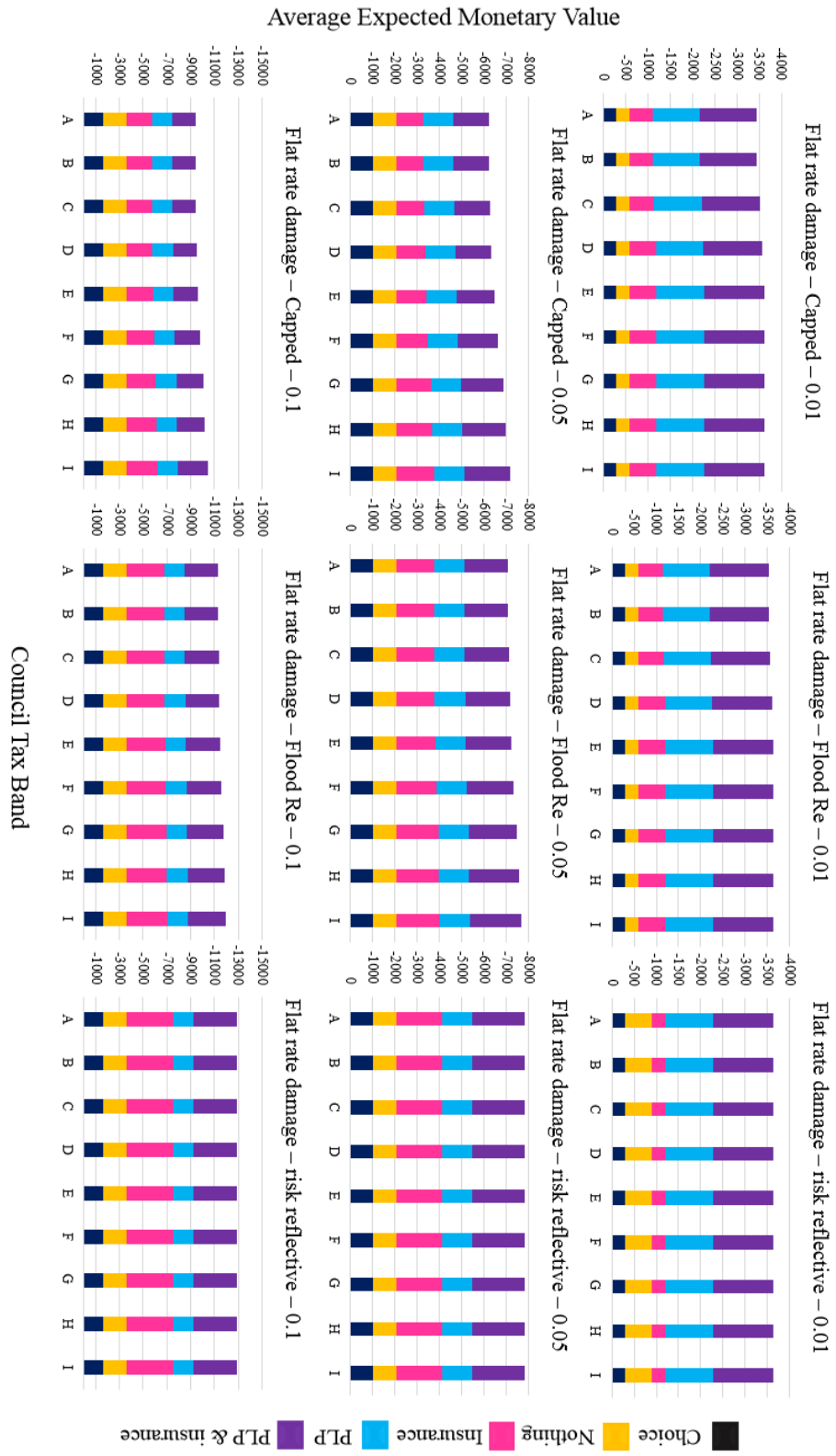

Figure 6.7.: The risk value of purchasing different options (flat rate damage, expected monetary value). The 'Choice' option is the value of the option the agent choses. PLP is property level protection.

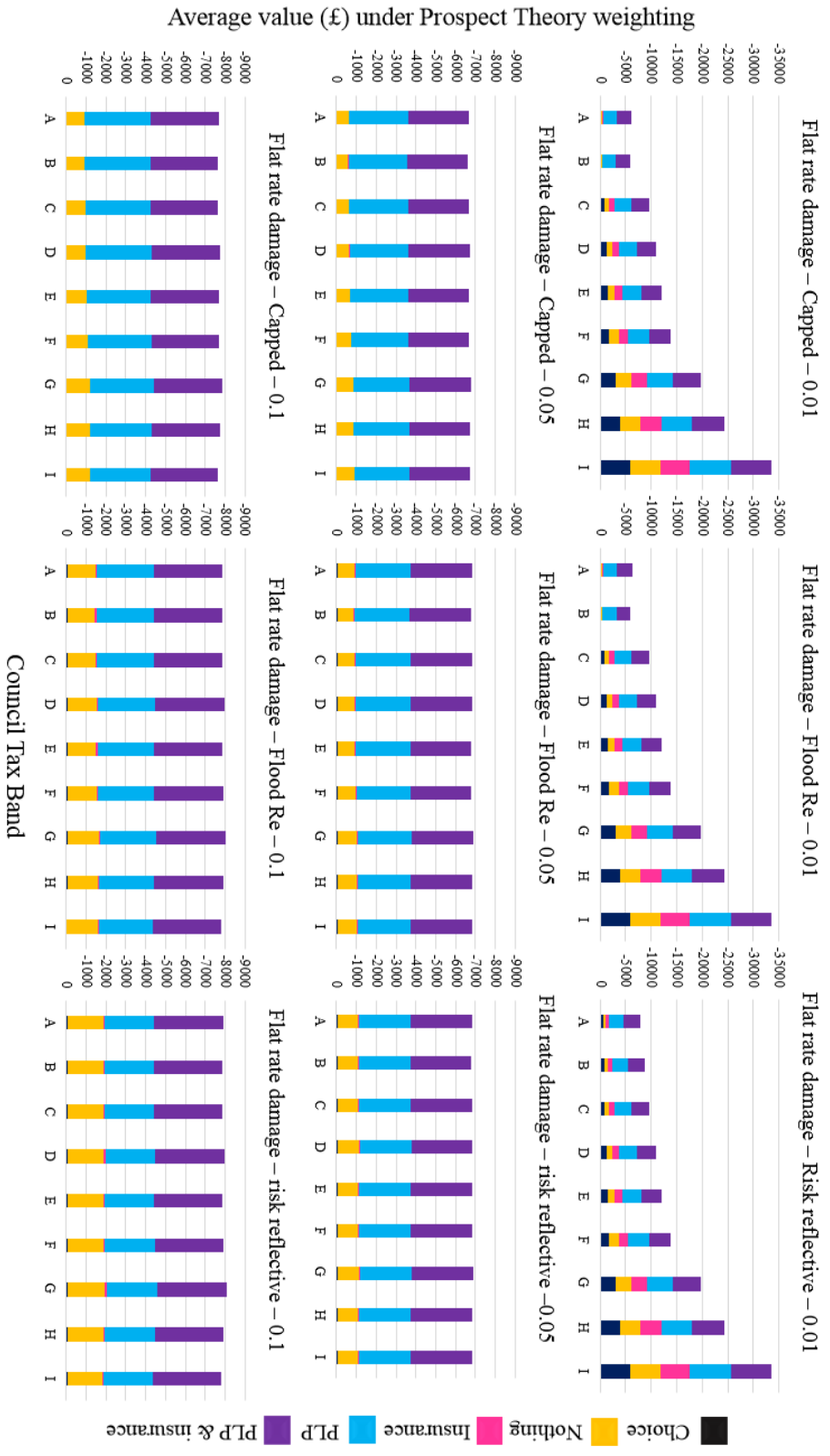

Figure 6.8.: The perceived risk value of purchasing different options (flat rate damage with observed behaviour included). The 'Choice' option is the value of the option the agent choses. PLP is property level protection.

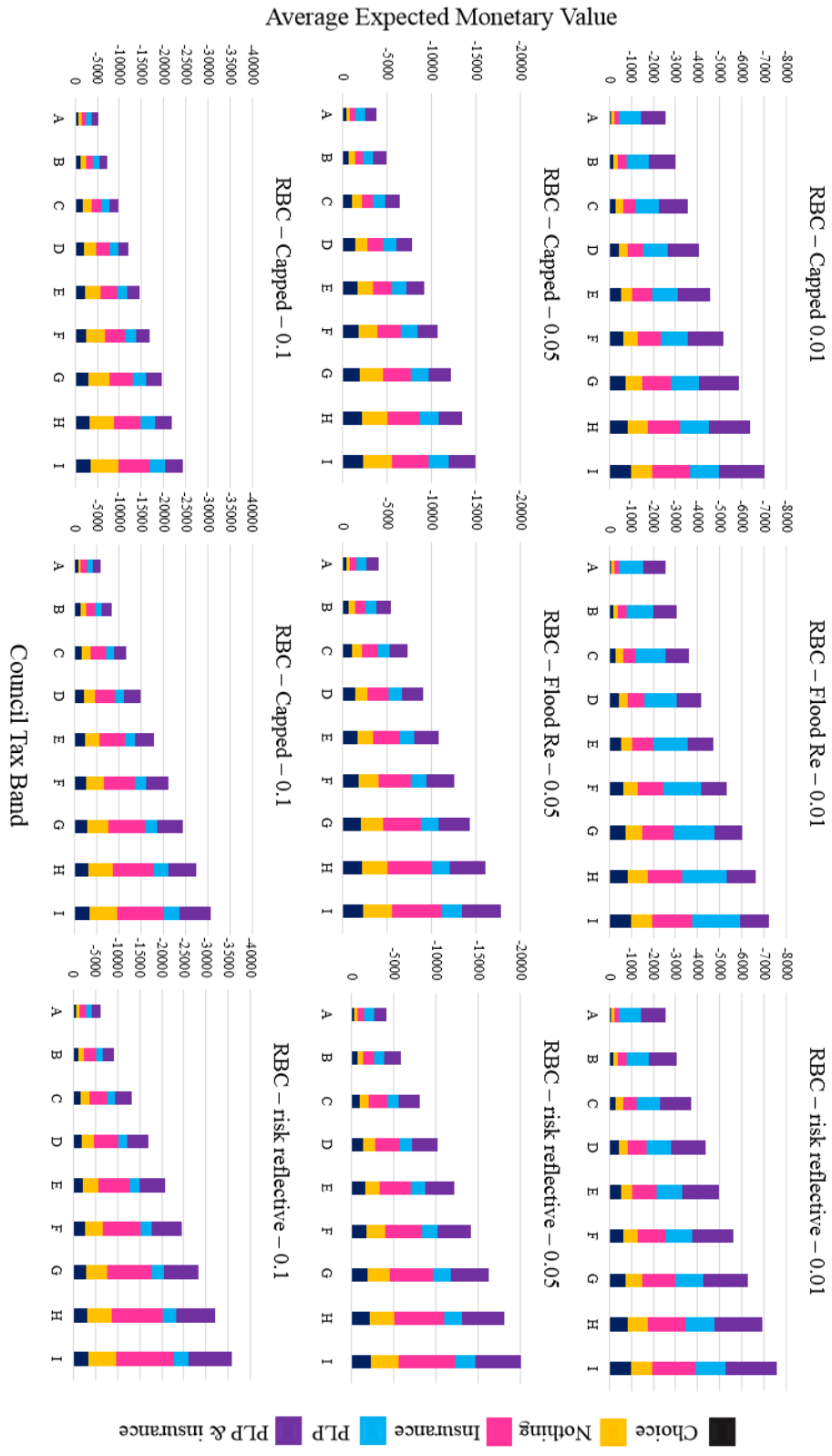

Figure 6.9.: The risk value of purchasing different options (rebuild cost damage with expected monetary value). The 'Choice' option is the value of the option the agent choses. PLP is property level protection.

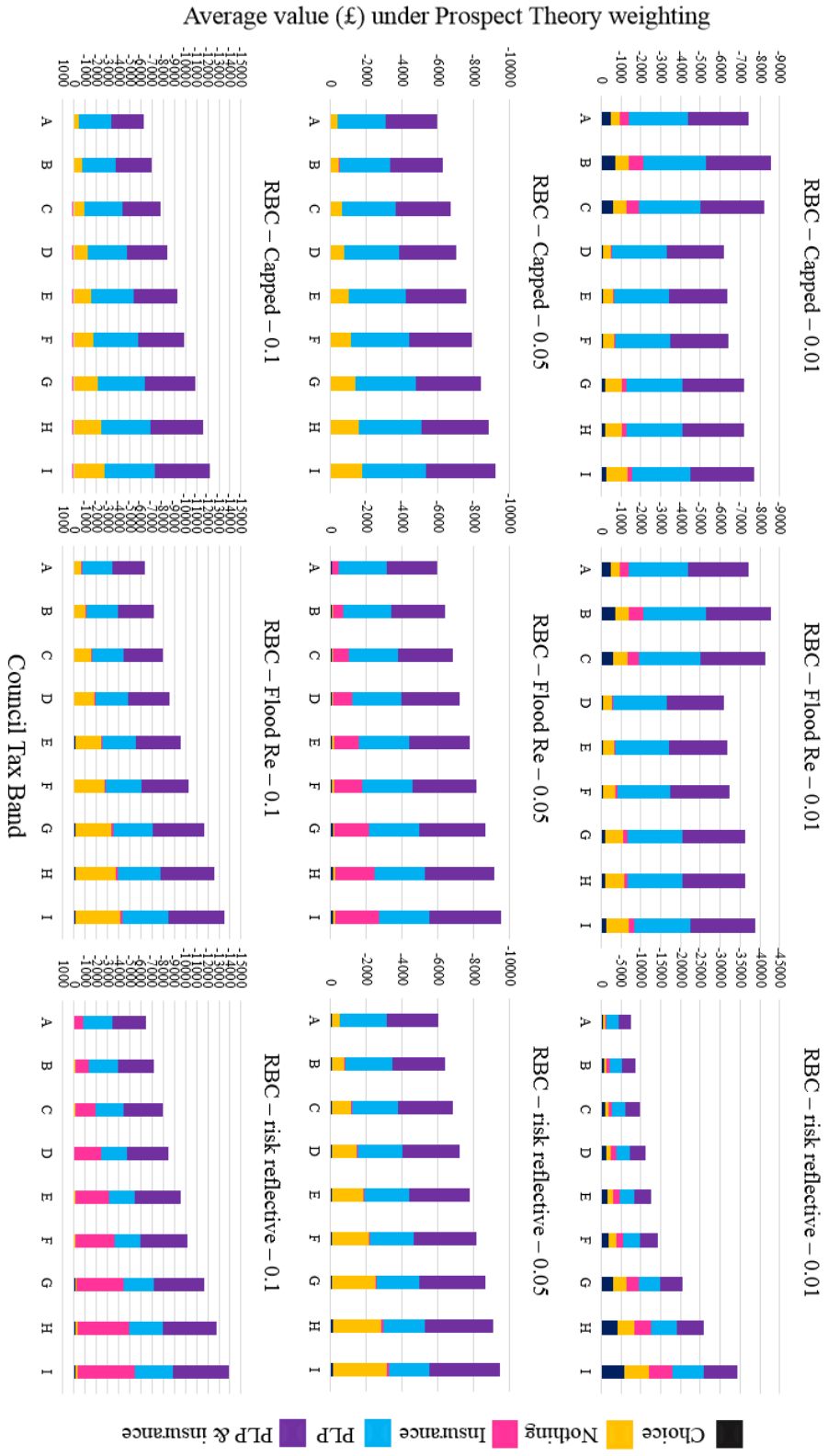

Figure 6.10.: The perceived risk value of purchasing different options (rebuild cost damage with with observed behaviour included). The 'Choice' option is the value of the option the agent choses. PLP is property level protection.

ever purchases flood insurance regardless of increase in damage frequency. This trend is not surprising as the insurance scenario modeled has no other risks outside of flooding, insurance is not obligatory, and, as described by Kunreuther and Pauly (2012), when modeling risk reflective insurance using Prospect Theory or Expected Monetary Value this pattern is expected. However, it is true to say that in comparison to the expected monetary value model runs for risk reflective insurance more agents are buying insurance and that increase is over a wider range of Council Tax Bands. In the expected monetary value model runs only Council Tax Bands H and I ever purchase insurance even at high risks.

Both damage costs informed by average claims and by rebuild costs were modeled and presented here as 'rebuild calculator' (Figure 6.6) and 'flat rate' (Figure 6.5). The model runs produced strikingly different, though perhaps predictable, results. In the rebuild calculator simulations, when there was a low chance of damage, higher Council Tax Bands benefited most. However, as the chance of damage occurring increased, the benefits were felt more keenly Council Tax Bands A and B, though benefited the society as a whole. In comparison, under a Flood Re scenario when there was a low chance of damage, under a flat rate scenario Council Tax Bands A and B benefited most. However when the chance of average damage increased Council Tax Bands E to I benefited most. Such results are to be expected when damage is calculated as a flat rate across all households, because for lower Council Tax Bands the costs of damage are artificially high, and so a cap reduces these costs, and therefore benefits those sectors disproportionately.

The change in the attractiveness of purchasing insurance for Council Tax Bands A and B between a 0.01 and 0.0125 chance of average damage occurring is most likely a product

of the probability weighting in Prospect Theory (Kahneman and Tversky, 1979). That the model outputs hypothesize such a change in the perceived attractiveness of a gamble is not surprising: the public have been shown to be highly reactive to flood events, swinging from under-awareness to over-concern as demonstrated in Chapter 5. Despite the predictability of such results, this projection is still of importance as it indicates that with an increasing frequency of flooding householders may become more likely to purchase insurance.

In both sets of graphs there is a difference between the attractiveness of the gamble of purchasing different options under risk reflective insurance premiums, a 'Flood Re' scenario, and capped insurance premiums. Under risk reflective scenarios the venture of purchasing insurance is not very attractive to consumers. Interestingly, under the capped insurance scenario, and to a greater extent under the 'Flood Re' scenario, there is a high uptake of risk reflective insurance – which would cost the same as in the risk reflective scenarios. As noted previously, once the purchase of insurance becomes a regular purchase, householders perceive the annual cost of that investment as less and, therefore, continue to buy insurance premiums. Such results have important implications for the success of Flood Re as they indicate that when insurance premiums return to risk-reflective prices consumers are likely to continue to invest in insurance.

Figure 6.5 and 6.6 demonstrate the preferred choice of agents when faced with the decision of purchasing one of the presented options. In Figure 6.7 to Figure 6.10 we see the value of each of these options. From these results, it is possible to see the difference between the risk value of purchasing each option. For example, in many cases, the difference in the risk value of doing nothing or purchasing insurance is a matter of a few pounds. If we hypothesize the outcome of this similarity in the real world, there is likely

to be a great deal more diversity in the options people choose due to other influences, such as choosing to install property resilience during a refurbishment, experiences of claiming flood insurance, or influence from social networks and friends. As such, being able to see how similar the values of gambles are (as demonstrated in Figure 6.7 to Figure 6.10) is as important assessing the end choice of agents (Figure 6.5 and Figure 6.6).

Between Figure 6.7 to Figure 6.10 we are also able to compare the difference between the absolute value of a gamble (Expected Monetary Value) and how the cost of that investment feels to an agent (with observed behaviour incorporated into the model runs). If we compare Figure 6.9 and Figure 6.10, agents in lower Council Tax Bands feel like they are spending far more when they purchase insurance than agents in higher Council Tax Bands. For example, in the Flood Re scenario where there is a 0.01 chance of damage occurring within a year the gamble of purchasing insurance is worth -£228, but to the agent feels like -£481. However when flood risk increases and more agents come regular consumers of insurance, the cost of purchasing insurance seems proportionately lower. These results are of importance when considering the earlier section demonstrated that most agents regardless of Council Tax Bands could afford insurance – what is clearly necessary to make access to insurance non-excludable is to overcome the initial barrier of a significant change in annual expenditure for those not currently purchasing insurance.

Figure 6.11 shows the reduction in cap needed for Council Tax Bands A-D. As can be seen, there is no significant increase in the uptake of insurance until the cap of flood insurance premium is lowered to a third of its current level, and that benefit is not felt by Council Tax Band A until the cap is as low as one ninth of its current level. Once the insurance cap reaches one tenth of its current level, the benefits plateau and there

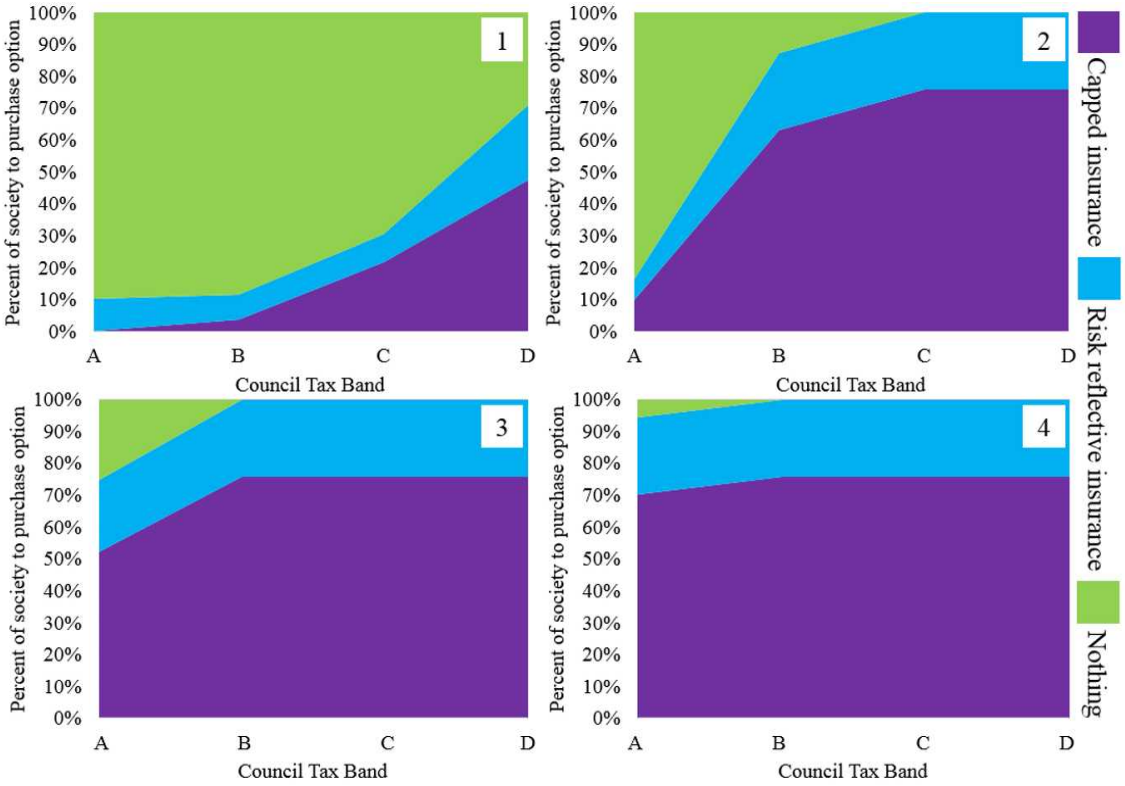

Figure 6.11.: The reduction in 'Flood Re' cap required for Council Tax Bands 1 to D to benefit to the same extent as E to I. '1'= current cap, '2' = current cap divided by 2, '3' = current cap divided by 3, '4' = current cap divided by 4.

is little improvement in the uptake of capped insurance. However, this stabilizing of the uptake of insurance is universal across all Council Tax Bands.

A concern exists that under 'Flood Re' and Capped scenarios those in Council Tax Bands A to E continue to purchase risk reflective insurance, in comparison to those in Council Tax Bands F to I who solely purchased capped insurance. A purchaser of insurance does not know whether or not they are buying capped or risk reflective insurance – here, the knowledge of whether capped or risk reflective insurance has been purchased is for the benefit of the analyst – and, therefore, there is the indication that the level of the

maximum cost for insurance for Council Tax Bands A to E is too high to be of benefit. This means that, referring back to the initial prediction of fiscal rent seeking by higher Council Tax Bands, those that are benefiting from a cap on insurance of those who have the most means to afford insurance.

The next point of interest is the increase in purchases of risk reflective insurance under the 'Flood Re' scenario in comparison to both 'Capped' scenarios and 'Risk Reflective' scenarios. The cost of risk reflective insurance premiums under the Flood Re scenario is the same as that in the insurance scenario where only risk reflective insurance premiums are available. This phenomena is of importance as there is the indication that insurance premiums do not need to remain capped for an extensive period of time in order to encourage a long term change in insurance purchasing behavior.

For the reader the assumption might be made that this long term change in behavior is an output of the model, and this assumption might be true for at most the first five years of non-capped insurance. This is because the memory length for which an agent determines their average cost of insurance is five years. However, the model is run for 30 years, and even after the cost of flood insurance has been risk reflective for five years under the 'Flood Re' scenario, agents do not return back to their original behavior, keeping average insurance costs as their reference point for decision making, despite that this will mean they are making an investment loss each year.

If further experimentation was to occur, a longer model duration would most likely show a gradual return to original behavior in the scenario that average damage frequency did not increase. However, under increasing damage frequencies it is possible that the behavior would not return to the starting behavior. Such investigations would require more time, and could be supported by a larger sample size which demonstrated the long

term patterns of purchasing annual insurance. Out of interest, it is of note, that theoretically when considering the structure of these reference points, despite the widespread academic push for >1 year insurance policies, these might actually reduce the long term uptake of insurance because consumers do not internalize the costs and decision making into their annual budget. However, I do not write off the benefits of a longer term insurance policy due to the incentives the security of such policies brings for the insurance company to invest in household resilience measures upon a householder making a claim following a flood event.

Under Prospect Theory, the only scenario where property level protection will be invested in is under the highest increase in damage frequency and where the only form of insurance available is risk reflective. To reiterate, all costs and probabilities between the Expected Monetary Value model runs and the Prospect Theory model runs were the same. Therefore, it can be assumed that the only variable which could make the difference is cost, with householders having little sensitivity to the changes in flood damage frequency which might be brought about by investment in property level protection.

If we consider the structure of Prospect Theory, specifically the reference points identified, under both the savings reference point and the average insurance reference point the cost of property level protection is going to be perceived as a loss. The only scenarios where purchasing insurance is likely to be considered a gain is if the agents reference point is maximum damage experienced or if the average cost of insurance exceeded the cost of property level protection. From the number of householders that consider experience as their reference point, demonstrated in Figure 6.3 and Figure 6.4, it is unlikely therefore that the purchase of property level protection will frequently be perceived as a gain.

The implication from the uptake of property level protection is that, though narrow, there is a small window of opportunity for the uptake of property level protection. Those with experience of flood events are most likely to perceive investment in property level protection as a gain, and it is here that insurers may be able to assist with adaptation; either through building in resilience measures upon an insurance claim, with the potential for longer insurance policy to ensure loyalty of a customer following an investment made by the insurance company or through a partnership between insurers and providers of property level protection who sell the property level protection after a flood event. The former option is not currently entertained by the insurance companies, while the latter case is already common place, with 'Flood Fairs' springing up following flood events. However, respondents from interviews note that despite their wish to buy property level protection at this moment in time they are baffled by the range of options available, and concerned about making inappropriate investments.

Overall, the results have shown that the inclusion of behavior makes a substantial difference to the output of models simulating insurance demand in response to different structures of insurance and increasing damage frequencies. If the behavior of consumers of insurance in the future is the same as past recollections of insurance behavior demonstrated in this and other studies, then we can hypothesize the following outcomes from the results:

- Flood Re does increase affordability, however, under some scenarios these benefits are most keenly felt by higher Council Tax Bands;
- Flood Re does not increase the uptake of property level protection, with minimal, but still higher than Flood Re, levels of uptake in risk reflective scenarios;
- If a cap is set to an appropriate level behavioral change will ensure insurance

remains in high demand;

- Longevity of insurance schemes can influence the uptake of insurance by encouraging consumers become regular clients, and in turn recalibrating the reference point by which they make decision;
- The lowest Council Tax Bands disproportionately feel the weight of investing in insurance, though this does not necessarily prevent them from purchasing a policy; and
- The lowest Council Tax Bands may benefit from support in initially purchasing insurance until the cost become internalised into their routine annual expenditure.

6.3. Discussion

6.3.1. Redefining consumer relationships in the flood insurance industry

The way in which commercial organisations interact with consumers is being reshaped as people seek to effect change as consumers, driven by the difficulties of achieving their aims as Citizens (WEF, 2016). This transition revises the expectations of the consumer, aligning them more closely with the modern ideals of a citizen in a Western democracy, meaning that issues such as transparency and the ability to influence operations and investment decisions become priorities. Some industries have embraced this change in their consumers and adjusted their business model accordingly. Despite this, there is limited collaboration or sharing of resources between insurance providers and the public, which runs contrary to the strong ethos of transparency and sharing of data between

major insurers in England and Wales, and Defra (Defra, 2011). From the results of this study, such limited collaboration with consumers could impact the social feasibility of Flood Re as it narrows the approaches and opportunities for an insurer to modify public behaviour – with issues such as risk perception, understanding of insurance, and the responsibility to modify risk having as greater influence on insurance uptake as the absolute cost of insurance premiums.

In the model presented as part of this Chapter, I took a number of variables which might influence the uptake of insurance, such as the absolute cost of insurance in comparison to savings, the amount of damage experienced by householders in the past, and the change in the cost of insurance premiums in comparison to earlier years. These variables were informed by the interviews as part of this thesis, however, there are undoubtedly more variables which could be deemed as important to influencing the uptake of insurance such as awareness of flood risk, understanding of contents insurance versus buildings insurance, prioritising of other expenses, the cost of excess (as opposed to only premiums), and the way in which an insurer treats consumers. All of these influential factors are supported by other academics, e.g. Harries (2009), and indicate the large influence non-cost factors have upon the willingness of the public to mitigate risk at a household level.

How then do insurers approach these issues, building them into their customer experience and modeling procedures? The answer is that, in general, they don't. As Ball *et al.* (2012) describe:

> "The shift from almost sole reliance on structural engineered defences to a whole series of non-structural measures including enhanced flood warning, promotion of community-based action, greater use of resilience measures and

> natural flood management pose major challenges to insurers. The insurers' high volume, highly automated, low transaction cost systems are, however, well suited to assessing risk reduction based on engineered defences. This is very clear in the way that the 1 in 75 or 1 in 100 year standards of protection are explicitly specified in the 2008 Statement of Principles. Insurers are less accustomed to assessments of flood risk that include a suite of non-structural measures. For insurers the key consideration is simply determining either the current risk of flooding or the residual risk once defence measures have been put in place. Ideally they wish to determine these with high confidence and at minimal cost." (Ball *et al.*, 2012)

The business processes highlighted in Ball *et al.* (2012) explains the motivation of insurers to focus on two issues; adjusting universal risk through working with providers of large scale flood defences, and attracting as many customers as possible to ensure they have a diverse portfolio of clients. In regards to the latter, this is achieved through adverts which focus on 'peace of mind' such as Santander, NFU mutual, Easier etc., not on learning about the risk a householder faces or on how a householder can modify that risk. The transaction is one that lays a clear contract between consumer and service provider; you provide us information about you and pay an appropriate amount, and we will give you protection from a bundle of household risks.

As this section argues, such a typical 'Business System' (Drayton and Budinich, 2010) relationship may not support the goals of Flood Re, and could be considered antiquated in regards to the future of consumer-service provider relationships:

> "Under pressure to deliver more proactively and effectively on corporate social responsibility (CSR), businesses are going beyond traditional and often-

> criticized CSR models to look for economic opportunities in socially and environmentally conscious business models based on innovative and people-centered partnership approaches." (World Economic Forum, 2016, p.43)

These people-centered approaches are known as Hybrid Value Chains (HVCs). According to Drayton and Budinich (2010) "Hybrid Value Chains represent a systemic shift in the way businesses and CSOs interact. They are collaborations that redefine value in game-changing ways, with each side clearly understanding (and willingly accepting) the risks and rewards" (p.3). HVCs have also proven successful in a vast array of industries from disease prevention to developing entire settlements (Budinich *et al.*, 2007), not to mention the success of collaborative approaches under Partnership Funding. Therefore, in this section I ask to what model does flood insurance conform, in light of results is this structure most efficient and equitable, how would other models of consumer-producer relationship function and what would be the limitations of these models?

To recap, two types of relationships between Authorities and the Public have been discussed previously within this thesis; contractual and collaborative. 'Contractual' models of civic interaction, which are most similar to 'Business Systems' as defined by Drayton and Budinich (2010), are marked by a clear cut agreement or contract which lays out the level of service provided in exchange for taxes or bill payment. Due to the way in which service is provided, the service provider (in this case the insurer) only needs to provide the agreed goods, i.e. cover at an agreed price, and is under no obligation to provide any other resources, such as information as to how the quote was formulated. Thus, information asymmetry is rife with contractual agreements, yet the existence of a contract provides certainty to both the policy holder and insurer, and simplifies expectation of both parties. Though limited in its interaction with consumers, a contractual

relationship between the insurer and the public is the norm within the insurance industry.

Collaborative relationships between a service provider and consumer, are most similar to the Hybrid Value Chain models earlier described, and are not common place in the UK insurance industry. In cases where the Hybrid Value Chain model has been applied to insurance, it has been predominantly to increase uptake within poor communities in newly industrialising nations, e.g. India and Mexico. Within these communities insurers identify and manage a distribution network of Community Support Officers (CSOs) who offer targeted, micro-insurance goods (Drayton and Budinich, 2010). Partnership Funding displayed some similarities with this model, having volunteers or flood wardens (e.g. groups 2, 3, 5, 12, 23, and 25) who identified the most vulnerable people in a community and helped them to set up an insurance policy. Fundamentally, however, this has relied on individuals separate to the insurer (acting on behalf of the community good as opposed to the insurer), meaning that no additional information was shared by the insurer and the relationship between insurer and consumer was yet again predominately contractual, and less 'hybrid' or 'collaborative' than it initially appears.

The interviews identified a number of issues which impacted the publics ability or willingness to purchase insurance, and which would require more collaboration and interaction with the insurers to achieve. These included the wish to be treated better by insurers, a push for Property Level Protection to be included upon making a claim or informing a quote, an improved knowledge on how levels of flood risk are being decided and wish to contest decisions if the decision is not accurate, and consumers want to know why having a flood makes the excess charged for claiming for a fire increase. Alongside a change of insurers behaviour, the public also wished to change their behaviour, and for insurers to accommodate this social transition. For example, consumers want to share

their knowledge and resources, and they want insurers to do the same with them. Working through these concerns, I now ask 'what business model is the best to achieve such a dialogue?'

A repeated case where consumers wished to contribute their own knowledge, but were unable to do so, involved challenging inaccurate flood maps, regardless of whether the inaccuracy was perceived or real. These maps were one of the greatest concerns people had, specifically regarding how these were used by insurers, and how to challenge insurers if they believed the maps were incorrect. To give some context, Flood Maps have been published on the web by the Environment Agency since 2004, though indicative floodplain maps were developed by the National Rivers Authority since 1994. These flood maps are used to inform the National Flood Risk Assessment (NaFRA), which is in turn available to insurers who purchase a license (Defra, 2013). Insurers use data from a number of sources to inform their flood assessments, though, Defra (2013) state that insurers which focus on household and small business markets are most likely to use NaFRA data. In addition to this, insurers may use commercial flood models or flood models developed in-house, which may require collection of their own data. However, the outputs of models and data, whether collected and processed in-house or elsewhere, do not necessarily correlate with insurance premiums, with decisions based on an insurers approach, sensitivity to risk, and cross-subsidies of other household risks.

Below are experiences of two respondents who were unhappy with flood maps. The first in Naunton and the second in Little Stour and Nailbourne:

> "Insurance was a big problem within the community and there is quite a number of houses that are not offered insurance, either that or they've gone from sort of £300 to £2,500. Which is a big, big problem and it is an

> area that again we need the government's support on to say to the insurers because I don't know if you did know, but the insurers were told by the government that they would be supported by them. I think they made quite a lot of money available to them but that's ending. . . .and if that ends, well that's going to be a really traumatic situation. Saying that, I phoned up John Lewis', Waitrose as such the other week and I said 'but why not, I'm 20 meters above the water level', they didn't know where I live, 'Oh, it's the postcode sir' and the Ex-Chairman of John Lewis lives in our village, he's getting on a bit now, but he couldn't even get his own insurance. Well the thing is, it's the Environment Agency maps, they cover an area and they haven't been looked at individually - the houses - but what you can do is you can challenge the Environment Agency maps, so if for example your house has never been flooded but you are within the blue line you can say to them 'listen, I've never actually been flooded so your maps aren't correct' because it's all just been modelled, they've all just put data in and some of it is historical evidence but not all of it. Well they have remodelled the water levels, but I mean this flood I don't think will occur again, certainly won't in my lifetime. It might in yours but you know it was something that we had not seen in the village and as you possibly saw from that report it was something that built up further up the river and then came down in one big deluge. "

In Naunton, the effort to change the maps was done individually. However, in Little Stour and Nailbourne a community representative with a background in Geology challenged the maps on behalf of the community:

"I think it's useful that I've got the general geology background and then we've got farmers and the city engineer. Having the city engineer, the district engineer on board has been absolutely invaluable because he will write, one of the things, as you're interested in the insurance issue because that's come to a head now because after the floods in 2000 the insurance industry promised that they would keep everything ticking along nicely and now that premium has come to an end so people are starting to have to pay large premiums for their insurance, in my case I'm interested in changing my insurer for a new insurance company, John Lewis said they wouldn't even touch it if there'd been flooding in the past. And the Environment Agency have flood maps. Are you familiar with their flood maps?

I: Yes.

R: Well, at least one of our communities [along the Little Stour and Nailbourne river] has challenged their flood maps because their flood maps, right at the moment we are, because the flood maps aren't drawn up on what actually happened in 2000, 2001 they're drawn up on a hundred year plan or something. So our city engineer has been absolutely fantastic in helping individual householders to get their properties which have never flooded off the flood map. I think that's a really good skill, that's a really good contact to have.

I: How does he do that?

R: He just writes a letter, because he was the man that was, and he's lived round here all his life. Local knowledge is so important."

In both of these cases the insurer has not added any additional information to the process

– it has been the Environment Agency changing their maps as a result of public input which has influenced the insurer. Thus, flood maps which were originally used to inform planning decisions are now influenced by a new set of users: the public (Porter and Demeritt, 2012). Porter and Demeritt (2012) argue that this change in the use of flood maps is a result of Local Planning Authorities (LPAs) developing Strategic Flood Risk Assessments to inform their planning decisions after "several LPAs got frustrated that the Environment Agency wouldn't modify their maps so [they] went out and commissioned [their] own Strategic Flood Risk Assessment (Planner 21)" (Porter and Demeritt, 2012, p.23). As a result there has been a shift in emphasis in the use of flood maps from catering to LPAs to informing the public in flood risk areas, who can then educate themselves and take appropriate risk mitigation action (EA 2009). The major problem with this rhetoric is that it assumes the role of the Environment Agency as a source of authority and the role of the public as without knowledge and needing to be educated (Bickerstaff *et al.,* 2008), which could lead to issues when locals challenge risk calculations. However, there is no evidence within this study that the Environment Agency was opposed to their analysis of risk being challenged by the public, with evidence to contrary contained in the previous quotes.

Thus, for these householders the approach of changing risk delegations through the EA after contacting insurers appears to have been successful – even if it is elongated – which, for this issue at least, holds the implication that increased collaboration between insurance policy holders and providers is not necessary, regardless that consumers may desire it. However, exchange of risk information between insurers and consumers may have mutual benefits, even if it is not necessary to challenge risk delegations. As in the case of the Hybrid Value Chain model, there may be benefits of insurance providers

sending Community Support Officers (CSOs) into areas of high flood risk to talk to residents about their experiences and include local knowledge within model calculations, as has been done in Lane *et al.* (2010). If the pool of CSOs are drawn from the community and not the insurance company, this essentially embodies a post-Marxist style of public participation – the public utilizing 'people power' to challenge the tyranny of an authority. Such an approach is not progressive under the definition which follows, and has shown to have less longevity and a reduced capacity to improve awareness or the adoption of risk reduction measures. By building a relationship of trust through a two-way dialogue with high risk policy holders, insurers may find consumers are more loyal with the more certain customer base and also may find the local knowledge increased their competitive edge. As described in the World Economic Forum's Global Risk report (2016):

> "Businesses have opportunities to win trust, build resilience and minimize the risk of disruption by committing to transparency, responsibility and higher standards along their supply chains in areas such as worker rights and environmental sustainability, and by collaborating with citizens in new ways." (p.43)

A belief supported by one respondent and purchaser of insurance in Cockermouth:

> "It is not cost that matter; what matters is how well the insurance company treats you. So I mean, telling you you're wrong, and inevitably you find that."

Whether the implementation of Flood Re will influence the issue of challenging inaccurate risk modeling is difficult to tell. A house dweller who has been incorrectly modelled as being at 'high risk' may be entered into the Flood Re scheme, and therefore get the

flood aspect part of their policy at a subsidized rate. Without knowledge of being in the scheme they may presume that their premium is risk reflective and would, therefore, not investigate their real levels of risk until their premium rises as the Flood Re cap is raised. At this point they could challenge that rise in premium through contacting the EA as earlier respondents have done. As such, there is a need for householders to be made aware of whether their insurers have entered them into the Flood Re, so that this can be challenged now, rather than at a later date.

Another implication regards how the data collected during Flood Re is disseminated: will the insurers chose to focus on treating the information with high levels of privacy, sharing it only with Defra, or will the wider public be able to benefit from the collection of such data? This issue is being debated by numerous parties (Krebs, 2015), and will shape the relationship between insurers and the public for the future. If insurers chose to keep their data sharing to a narrow, elite community of certified decision makers this embodies the continuation of the traditional Business Systems model of consumer-producer relationship. However, insurers may also seek new ways of gaining advantage over competition, and use information sharing and education as that advantage.

Collaborative models can be seen as weak because power is lost as information about risk becomes less valuable. However, this is narrow outlook ignores other sources of competitive advantage. I have already touched upon the issue of trust, which is widely perceived to improve customer loyalty (Halliburton and Poenaru, 2010). But there is also another advantage to be gained through broadening the dialogue between the public and insurers. The earlier section clearly highlighted the way in which the internalization of consumer purchasing decisions significantly impacts the output of insurance demand models. The argument that I present here is that insurers should use consumer behaviour

as a competitive advantage, and place less priority and secrecy upon risk information. Such a shift can be achieved through the manipulation of 'Big Data', which is well matched to insurers "high volume, highly automated, low transaction cost systems" (Ball *et al.*, p.16). Big data can be collected through websites and can focus upon the variables which drive consumer loss mitigation investment decisions, allowing insurers to tailor products while releasing risk information which then enables the public to modify their behaviour (examples of such practices can be found in McGuire *et al.*, 2012). The argument that insurers cannot release risk information to the public due to competitiveness highlights the persistence of an antiquated business model and a lack of respect for the public good.

The increased call for collaboration between insurers and policy holders also applies to the installation of property resilience and resistance measures, with consumers calling for property level protection to be taken into account with an associated reduction in insurance premiums or excesses. However, despite my earlier endorsement of, and argument for, increasingly collaborative relationships, I now highlight the critical role of insurance contracts in clarifying scenarios where a claim is possible, with the concern that increasing the caveats of this decision creates uncertainty. Ball *et al.* (2012) summarise the concerns insurers have regarding property level protection:

> "Insurers' [warn] that such measures may only limit increases in premiums and/or excesses rather than stop them, householders may find that they do not lower overall costs. Implementing such changes in premiums and/or excesses will also depend on the availability of surveyors and contractors (accredited by the insurers) who can provide robust estimates of residual risk once the property-level measures have been implemented. As already

> noted, many insurers still see such measures as short-term palliatives to be superseded by engineered defences in due course." (p.21)

These are systemic issues which emerge from a business model which requires simplicity of processes to keep high levels of automation and diminished transaction costs. In order to prevent perverse outcomes the insurer needs to know that the property level protection installed was appropriate, the reduction in risk achieved by the installation of property level protection, and a guarantee that the PLP can be properly accessed and utilised in the case of a flood (Ball *et al.*, 2012). This concern is confirmed by the insurers response to one of this studies interviewees who was enquiring about the impact of property level protection upon the cost of premiums and excesses:

> "People have had problems, they say, "Well we've got the flood gates," then the insurance company says, "But you might not use them." Well of course you could be away I suppose." [Respondent 3]

But as the interviewee continued, this concern by the insurers was well placed as, for many, the investment in property level protection appeared futile:

> "What I can tell you is that in 2009 when we visited every house that had flooded on one of the roads, Crosswet Road in Keswick, I went to three houses each of which had flood gates and the water level inside the house had been at best one brick lower inside the house than it had outside. So they didn't work very well because the ground is porous. What had happened is that the flood gate holds but it comes in through the floor." [Respondent 3]

Inappropriate implementation of property level protection has been a large problem for householders. Many of the communities interviewed had attended flood fairs and had

purchased a product without any survey (for example groups 4, 16, 21, 23). This had two major impacts. First, there was a negative impact upon the individual who invested in inappropriate property level protection, thereby losing that investment and remaining at risk from flooding (possibly at an increased risk if they expected the property level protection to work). The second impact influenced the entire community, if a neighbour had been flooded after property level protection had been installed, the rest of the community came to the conclusion that property level protection did not work, regardless that the purchase may have been made without any survey. This had a negative impact across the community, many of whom would not purchase property level protection in the future.

Despite some ineffective cases of property level protection other residents had been successful, and, as a result, the community got together to survey all of those with property level protection to find out which approaches worked, and which did not. As the respondent described:

> "We had more than half the houses surveyed, two reasons. First of all for some people it showed what was possible, other people had already done it, but the other thing it did do was it gave people something to show to their insurance company. This is what we need to have done, we've ticked this box and we've ticked that box. That was the aim for doing it. We did it as agents of the Cumbria Community Fund because they had means testing which caused all sorts of problems. As we were doing it that got ... the surveys, it got round the means testing side of it. Anybody who wanted it done could have it done and we in effect paid the bill and we were then reimbursed by the Community Fund which was about £11,000. It was quite

a lot of money".

Keswick is a case study where there is good social cohesion, and community flood volunteers / wardens to get involved. Other locations may not have succeeded in undertaking surveys across the area especially in the case where funds were raised to assist those in poorer circumstances to have a survey. What was found during the survey, and supported by the experiences of other groups within this study, is that resilience measures were more successful, in regards to working in times of flood and reducing the time out of a house, than resistance measures.

The issue which continues to prevail, however, is the question of who should install and pay for the property level protection. Some respondents within this study said that they had asked to have property level protection installed upon making a claim, and yet been told by insurers that this is not possible. This case was found by our interviewee in Keswick (Group 3):

> "One of the problems is that insurance companies will not allow you to do it as you reinstate. They will only do like for like which seems to me to be silly. They seem very reluctant if somebody says, "Okay, if we put it back like for like it would cost say, five thousand, if we are going to put the sockets higher it's going to cost six thousand, you pay five thousand and we'll pay the extra thousand," they seem very sort of rigid. Not in terms of thinking what will actually help in the long term. So given that this was the second flood a lot was done along that line."

That insurers are rigid with claims is understandable, as alternative behaviour could lead to perverse outcomes. However, there is ample room for collaboration here, especially for houses registered in Flood Re.

Yet again, Northumbria, in this case the County Council as opposed to a single community, is trialling a scheme whereby:

> "... The government has announced that households and businesses in Northumberland that were flooded in December 2015 can apply for a property level resilience grant of up to £5,000. The grants which are available are intended only to fund measures which improve the property's resilience or resistance to flooding, beyond repairs that would normally be covered by insurance." (Defra and DCLG, 2015)

Insurers, however, are still reluctant to commits themselves to either installing or recognising the benefits of property level protection, and it is unknown whether, despite improved property resistance / resilience, insurance premiums will be reduced. The insurance industry has the opportunity to win trust, build resilience and minimize the risk of disruption by committing to transparency, responsibility and higher standards and by collaborating with citizens in new ways. Under the industries current business model of high volume, low transaction costs, such a change is unlikely to occur. There is an opportunity for a niche market for flood risk properties which encourages collaboration, but such an example has yet to be put into practice in England.

6.3.2. Understanding the excluded consumer: more than a matter of price

The results of the agent-based model support that even with the existence of Flood Re there is one group of consumers who find themselves disproportionately excluded from the insurance market; the poor. The scale of the issue is not insignificant with

29% of low income households holding buildings insurance, in comparison to 91% cover across the rest of the UK population (Defra, 2013). These figures match the outputs of the agent-based model which showed that at current levels of risk, between 20% and 50% of those in low income households would purchase insurance over other options (purchasing nothing or purchasing property level protection) in comparison to 90% in high income households. Out of the low income households 20% would not be able to afford insurance even at the subsidized levels under Flood Re. Here I use interviews with representatives of deprived neighbourhoods to understand why the uptake of insurance and property level protection is low even among the poor that could afford insurance, and discuss if business models such as the HVC model could improve the uptake of insurance for the residents in this group.

As discussed in earlier chapters, the two communities in areas of high deprivation which I interviewed were Merseyside and Kingston-Upon-Hull. In Merseyside I spoke with the manager of St Leonard's Community Centre which was the establishment at the centre of the flood recovery effort. In Kingston-Upon-Hull almost 10 respondents were interviewed. These people were members of the Community Centre, they were also surveyors of the houses after the flood, and the telephone operators who took calls from locals wishing to claim money from the Local Authorities loss mitigation scheme. In addition to these two key case studies, I also discussed with other flood groups and officials related with flood group efforts as to how they worked with the vulnerable in the community in order to improve loss mitigation in the future.

The issues identified by these interviewees which impacted access to insurance included the distinction between contents and buildings insurance, needing / choosing to spend money on other priorities, not feeling capable of going through the insurance process

and not being aware of a flood risk. For this group, rises in insurance premiums or excesses were not identified as a primary concern because these respondents had never previously purchased insurance and so did not have the comparison of previous prices. The respondent from Kingston-Upon-Hull summarized the causes of non-insurance:

> "What a lot of people that complained was 'I wasn't insured': they weren't insured and they would always claim poverty and... not all of them but a couple of people would go round saying 'I can't afford my £5 a week for insurance'. Now this is another, this is another thing this one. There were quite a lot of people that thought because they had a council house that the Hull City Council insured them; which they do for their buildings but they don't for their contents. So there was a lot of people who weren't covered; [they] chose not to buy insurance. Now also a lot of people lived in an area called Kingswood... what we found out there was an awful lot of people lived in that area did not have insurance because they chose not to buy it."

Interestingly the interviewee in Merseyside described a very similar pattern of consumer behaviour:

> "R: And you must realise that this is a really deprived area it is [one of the most] deprived wards... So 60% of the people who were flooded had no contents insurance so they just lost everything, everything downstairs went. Because what caused the flood there was like a month's worth of rain fell in an hour and some of the drains were blocked I think...
>
> I: Did the people know that they were in a flood risk area?
>
> R: No. I think in about 1950 it had happened before and that is why they built the sluice gate, but it was just unbelievable. And then at half past

> eight it was like as if someone had pulled the plug out and the water just went down, it just went. So we carried on that and, what we did, we got a database with the council of names/addresses, how many lived in the house, how many children so we could attend to their needs. So some people had insurance and they got put in rented accommodation and some people who didn't have insurance [we got] the local and social landlord [involved] and they put them all in a motel which is about 20 minutes away in a car. So you can imagine trying to get on a bus and the cost. To get to work, to get your children to school. No cooking facilities in there.... As the weeks went on their needs changed because it was all the stuff about do I have to pay my council tax, do I have to pay my telephone and all that kind of stuff?"

Similar to Kingston-Upon-Hull, the Local Council partnered with the community group, with the Council offering Funds and the community group processing these funds:

> "There was an emergency fund set up which the community foundation administered. But I sat on the panel and a couple of other people and all people had to do was fill a form in about what they needed, what they had lost and then we would give the money out....People used to come in and we set up an emergency flood centre, so it was open every day and it was manned by volunteers and there was a microwave and a cooker and a fridge and somewhere to sit and have a chat and cook something if they wanted. But most of the time the reality was they had no money, they had no money to get their kids to school. If you are living on the edge of poverty all the time and just about keeping your head above water, something like this if

you are ready in debt, you don't know where to turn."

As can be seen from these interviews, the main reason for not purchasing insurance is down to misinformation rather than absolute cost – a trend which was confirmed in the first set of agent-based model runs. The interviews also tell us that these communities are very responsive to third party support. It therefore makes sense that as price adjustments alone do not appear to change the behaviour of the poorest, social adjustments should also be made, and it is here that I believe we can learn from cases such as Keswick, Par and St Blazey, and Emsworth among others.

For the groups discussed, a relationship was forged between Local Authorities and local residents linked by a key networked member of the community who often also gained a privileged position in the Local Authority. Again in the cases such as Merseyside and Kingston-Upon-Hull where there was high levels of deprivation, it was not a community member, but a community organization which provided a link. These organizations worked closely with both the local community and the authorities to aid recovery following a flood and rectify insurance issues. The relationship between Council, Community Centre and insurer is summarized by our primary respondent from Hull:

"Basically we were liaising with [the local people] and we like found out what they had lost, if they had had any trouble with the loss adjusters and the insurance companies and, if they had any problems, we like the go between people, we would ring them up and have a word and go back and forth and we would note all this down but also giving stuff through to the council, helping out like that. We did that for quite a bit. After that, about a few months after that, I got seconded from my workplace to work along with some other people from Hull City Council which had a flood advice service

> what the council set up which was a direct line where people could ring up and maybe if they had any problems, yet again similar, if they had problems with the insurance companies, maybe with moving dumped rubbish, waste or it could be anything. . . .We were also the in between people because we could get directly though to other parts of the council."

From the quote above a number of themes can be drawn. First that the local people had issues claiming insurance, second that they were unable to rectify the issues themselves, and, finally, that effective support could be leveraged though working with community groups and the Council. With the data available it is difficult to know if any party was at fault which caused these issues. However, we do know that they were upset and that the community group was able to rectify these problems.

Chapter 5 highlighted evidence that when rolling out the Partnership Funding scheme the presence of collaborative relationships led to disproportionately more successful outcomes than contractual relationships in scenarios where flooding was a recurring issue, and from the evidence presented within this chapter it can be hypothesized that collaborative relationships would also improve the uptake of loss mitigation strategies. However, despite the existence of a community willing to collaborate to improve the uptake of insurance across the community there has been little indication from insurers that they would be willing to share risk information with consumers and collaborate with communities. Instead the relationship between the public remains far more reminiscent of a post-Marxist protesting relationship where people power, often supported by the Environment Agency, is used to hold insurers to account as opposed to a truly collaborative relationship where information is shared.

Whether asymmetry of information between insurer and consumer is preferential to a

collaborative relationship is open to debate. However, from the results of the agent based model there is an indication that a major issue is initiating a relationship between insurer and consumer in deprived areas. Asymmetry in the relationship between insurer and consumer may exacerbate the difficulty in getting people in deprived areas to become regular purchasers of insurance. Yet, we have seen that the public in Kingston-Upon-Hull and Merseyside will take advantage of agents who link them to authorities, such as the Goodwin Trust and St Leonard's Community Centre. The agent based model developed has shown that uptake of insurance can be improved in even the poorest of populations. What is needed now is a method of getting poorer flood risk communities insured, making it clear that contents insurance is different – and cheaper – to buildings and contents insurance, explaining the pricing, and demonstrating the potential losses.

The poor, especially the poor who are isolated from their local community, can be subject to disproportionate loss following a flood because they do not have the safety network of places to stay, a job that is flexible, savings to support them, mobility to find different work or schooling. That all people have some structured method of accessing funds to mitigate the loss following a flood is imperative to ensure that their daily lives can get on track as soon as possible. Ensuring such rehabilitation occurs as quickly as possible following a flood is achievable through more collaborative schemes which make use of the multiple actors involved in the provision of insurance, and using linkmen to clarify the comparatively low cost of risk reflective contents insurance and enabling access to the routes by which insurance can be purchased, particularly in cases where residents have limited access to the internet or price comparison sites. Thus, though Flood Re could be of benefit to these communities, more needs to be done to change public behaviour so that insurance becomes a regular investment.

6.3.3. Implications for improving access to affordable insurance

Whether or not the goods - be they public, private, common, club - provided by different flood risk management strategies align with structures of provision is integral to understanding the potential longevity various schemes. For example, insurance, in its natural state has the characteristics of a private good. However, because it is necessary to have some form of loss mitigation strategy at household level to ensure national economic stability there is market failure as householders without adequate funds or awareness are excluded, and, therefore, there is a strong argument for flood insurance to be treated as a merit good under the definition developed and applied by Musgrave (1959).

Under a non-adjusted insurance system it would not be commercially viable to provide insurance to those who insurers know are likely to flood, unless that insurance premium is in line with the expected damage or low risk houses cross subsidize those at high risk. As it stands, insurance is necessary in order to gain a mortgage, with non-risky mortgages ensuring a healthy property, banking and mortgage industry. This obligation to mortgage providers to ensure that a house is insured means that uptake of household insurance is high. Yet, if mortgage holders are required to insure, but have cannot afford insurance premiums, instability is introduced into multiple aspects of the economy. Therefore, there is a growing necessity to allow a period of respite for householders to adapt and make their houses resilient to allow a stable transition to risk reflective pricing of flood insurance premiums – and this requirement is reflected within the structure of Flood Re. Bearing this in mind, Flood Re should not be considered as a long-term transition of access to insurance from private to public, but instead as a bandage which allows those houses currently at risk to change the probability of flood water either entering or damaging their home. Of course, this solution will only work if insurers begin to take

into account property level protection, which according to those purchasing insurance with property level protection is rarely occurring, and if householders begin to either purchase property level protection or not purchase houses in flood risk areas.

After a period of 15 years it is expected that the amount of risk insurers will be able to transfer to Flood Re will be reduced and, thus, potential insurance premiums increased (if it remained the case that flood risk had not changed). After this point in time there will be a gradual decrease in the level of risk which can be transferred to Flood Re, with the expectation that after 25 years householders will have adapted their properties. However, the problem with this theory is that consumers may not be aware that they are being subsidized (Krebs, 2015). Currently insurance for contents is bundled to include fire, theft, and other risks, and, as such, householders will have no idea that they may be subsidized for the flood risk element of their insurance. Without such knowledge of a subsidy, and without such knowledge that this subsidy may be diminished in the future there is no reason why a householder would seek to implement property level protection. Therefore, a concern exists that Flood Re will not achieve its aim unless it makes its pricing more transparent, which it intends to do through providing an information pack on flood risk to those involved in Flood Re. However, if householders do not respond to this information pack, they will be left in the same position as they were when the Statement of Principles came to an end(ABI, 2008).

If we are to consider the long-term success of Flood Re as an insurance policy, we must look at how success can be achieved. A has been hypothesised by the Prospect Theory model runs one of the greatest failings of Flood Re, outside of its inequalities, is its ability to make household resilience and resistance measure a more attractive option in comparison to do nothing or only purchasing insurance. A solution to this would be to

provide property level protection, or household resilience, following a flood claim, though it is of note that in Northumbria a scheme is being piloted which awards grants of up to £5000 to install property level protection following a flood (Northumberland County Council, 2015). That insurance companies are dubious about investing in household adaptation measure is understandable; if a householder is provided with property level protection following a flood event this installation has cost the insurer money, and there is nothing stopping that householder moving to another insurance company the next year leading to the insurer never receiving the benefit of their investment. However, if the implementation of property level protection following a claim could be partnered with an insurance policy of duration which balances out the investment made by the insurance company, then the ambitions for property level protection stated within Flood Re could be achieved.

It has been theoreticized that the effects of climate change, including increased groundwater and surface water flooding, could put pressure on the Flood Re insurance pool, leading to rivalry. To an extent this concern has been mediated through a cross subsidy by low risk householders and a government loan in the case of a flood exceeding a one in 200 year event. There should also be the recognition that the effects of climate change are likely to lead to increased surface water flooding. However, the causes of surface water flooding are often more easily identifiable, as seen by flood groups [20] and [22] in Chapter 3, and with increase formation of such flood groups, it may be possible in the future to hold water companies into account if they have not improved their products in water and sewerage systems in line with predictions of climate change. Already, groups are increasingly partnering with water companies, as in the case of [25] and [23], and in the future it may be possible to extend collaborative relationships with authorities in

order to reduce surface water flooding, reduce the number of claims, and keep premiums low.

The next consideration which will influence the success of Flood Re is the political environment. For example in January 2016 Solvency II, an EU Directive that codifies and harmonizes the EU insurance regulation, will be implemented. Such EU regulation influences the amount of capital an insurer has to hold in order to avoid insolvency, and also sets out guidelines of transparency, for the governance and risk management of insurance, and the calculation of insurers liabilities. The UK's insurance industry's biggest in Europe (ABI, 2012), with such EU regulation having an impact upon wider international subsidiaries, such as in the USA. In addition to this, the UK is to hold an EU referendum in the near future with the implications of this being of large significance to the regulations which British insurers are held to. Such uncertainties have large implications for the longevity of Flood Re, both in the case that they go ahead, and in the case that England leaves Europe.

In comparison, Partnership Funding scheme has a great deal more stability. Businesses are encouraged to provide contributions with tax relief for businesses contributing to any flood risk management scheme, local authorities are increasingly being granted power to make decisions regarding local flood risk, and, especially in rural areas, the data in this thesis has shown that Flood Re will be able to help communities maintain their flood defenses. Both Partnership Funding and Flood Re are adjustments of the market to ensure that flood risk management goods are accessible. Yet, the tools approach the problems very differently, raising the question of what could Flood Re learn from Partnership Funding, if anything?

As I shall now discuss, the answer may lie in the modes of social order discussed in Chap-

ter 4, specifically moving the relationship between consumer and provider from being predominantly 'contractual' to a more 'collaborative' relationship. Jordan (2010) argues that the Third Way's collaborative approaches failed because within today's society 'contractual regulation' is prioritized over 'moral or cultural regulation':

> "The ultimate failure of the Third Way has been a moral one, and that this has stemmed from an inadequate and incoherent analysis of how ethical principles can be applied to the workings of a market economy exposed to global forces" (Jordan, 2010, p.1)

As discussed in Chapter 4 and Chapter 5, the existence of contractual relationship, similar to that described by Hobbes (1651), sets an asymmetry between insurance provider and insurer, with the public only engaging in civic life in order to defend their rights. Under a collaborative approach the public work together with authorities, contributing social resources (Bourdieu, 1983) beyond pressure. Each group shares knowledge in order to reduce asymmetry, and both parties appreciate the benefits of the relationship which they develop from their collaboration. However, Flood Re inspires no such collaboration, despite that respondents implied that they would like further collaboration with insurers. As previously mentioned, there is no two-way discussion directly between the public and service provider regarding insurance provision. Instead worried consumers emerge who may form pressure groups with the aim of keeping the cost of insurance below what is risk reflective. To date, that pressure may have led to the development of a policy which benefits those who can already afford insurance more than those who do not regularly purchase insurance at the expense of the general taxpayer. As Jordan (2010) discussed, policy fails when not enough attention is paid to everyday life and public behavioral traits.

Another option to aid the minority of high-risk, under-insured households is to take advantage of the club which is naturally emerging between those in lower Council Tax Bands who cannot afford insurance, and the local authority who may own the properties and who will have to support these households in order to prevent a moral hazard and social blight. A potential club could be developed if Local Authorities within drainage basins teamed together to make a 'drainage basin authority' and pooled funds from a democratically determined Council Tax Precept they could then deposit these funds in a larger pool with other 'drainage basins authorities'. It is highly unlikely that a flood event would impact every drainage basin in the country, and so a non-flooded 'drainage basin authority' would effectively pay for emergency flood insurance to a flooded 'drainage basin authority' in the case of a flood. The benefits might be paid to only those without the ability to claim on insurance and would be capped at a low rate in order to avoid perverse outcomes, such as deliberate non-insurance. Such details would be determined at the point where a local council democratically decides to opt-in to such a service, with the council precept vote including such details.

The concept of a State driven insurance scheme is not a big step from the current situation where currently many local authorities, such as Cornwall or Hull, have had to give flooded residents funds to rebuild their homes following a flood event. If the local authorities do not do this social blight may occur, with respondents from interviews in Hull describing houses with moulding carpets and inhabitants still dwelling in the building months after the flood event. A 'Drainage Basin Authority' Insurance Scheme would provide these local authorities with more security in the event of a flood to ensure social blight does not occur, that Council homes are not in an unhygienic or dangerous condition for extended periods of time, and that the moral hazard of non-insurance is

addressed.

That local authorities are giving emergency cash to flooded people is indicative of the necessity for access to insurance to be made non-rival and non-excludable. Flood Re does not target the main body of the population excluded from insurance – lower Council Tax Bands – and it will not begin to do so without becoming even more inefficient. Allowing Local Authorities to mop up this inefficiency through providing unexpected, ad hoc handouts to the uninsured is not a solution; those handouts should be internalized into the insurance industry by being planned and set aside in an official capacity, and in a way which means that the pool does not become rival in the event of a flood. I believe the 'Drainage Basin Authority' Insurance Scheme could achieve this, and would formalize the hidden inefficiencies of insurance so that they could be managed. Flood Re still has a place in insurance as a cap followed by price signals can stimulate the uptake of insurance, but it is unlikely that the uptake will be evenly distributed across society.

In summary, Flood Re could become more efficient by developing a more collaborative relationship with high risk households, especially those who require behavioural change to encourage uptake and internalisation of the annual cost of insurance. Insurance relies upon a club, or defined group of people, existing within a population. Currently two or more clubs exist within the population, those with mortgages who are required to purchase insurance, and those who do not have mortgages and do not regularly purchase insurance. Each of these clubs require a different approach to improve membership, with the modification of human behavior integral to increasing demand for membership of these clubs.

6.4. Conclusion

To determine whether access to flood insurance should be treated as a public good I have tested the equity and efficiency of Flood Re. In regards to efficiency, I investigated the extent to which Flood Re would achieve its aims of making flood insurance a more attractive gamble than non-insurance. To measure the equity of Flood Re, I examined how the affordability and adaptation measures were distributed across society using the indicators Flood Re itself had adopted, Council Tax Bands. Flood Re showed traits of positive but weak efficiency in improvement of affordability of flood insurance, and there was no evidence that Flood Re would increase the uptake of property level protection. The benefits of Flood Re were poorly distributed across Council Tax Bands, having little or no benefits for Council Tax Bands A, B, C, D, and E under current frequencies of average damage.

Penning-Rowsell (2015) describes how "in the United Kingdom, flood insurance is an important part of our portfolio of flood risk management measures". If this is to remain the case, then it would seem appropriate that insurance as a method of flood risk management is available to all, not just those that can afford the associated premiums. However, the method by which wider access to insurance and other loss mitigation measures can be achieved is open to debate, with suggestions made in the next chapter.

The results show a weighting of benefits under a 'Flood Re' scenario towards Council Tax Bands F, G, H, and I, support the projection that an insurance cap may lead to exacerbation in people occupying risky areas. There are two phenomena which exacerbate the concern that a cap may encourage the development of risky areas. The first is that insurance premiums are "approximately the same across population irrespective of risk" (Penning-Rowsell, 2015, p.7), and, associated, is the second that inhabitants of

the Council Tax Bands identified unlikely to also have higher value of assets as shown by the ABIs Rebuild Calculator (ABI, 2015). The result is that the public do not respond to risk signals (because the risk signal is in the excess, which by the increase in the reinsurance of excess indicates that that people are unable to strike the right balance between reducing premiums and increasing voluntary excesses), which, if noticed, may reduce the attractiveness of the area, and the associated cost of property, and due to the high value of the land in those areas the continued development. This trend was termed by Parker (1995) as the escalator effect, though Parker discussed that it driver was flood defenses rather than flood insurance.

The results of this study, which are supported independently by other academics (Krebs, 2015), have shown that 'Flood Re' is unfair, economically inefficient, and inadequate at stimulating the uptake of other household adaptation measures. Does this mean that the aim of achieving widespread access to flood insurance should remain intact? I would argue, that yes it should; flood insurance has the benefit of being a well establishment management measure in England, the prices could be flexible to flood risk if they were risk reflective, and the availability of insurance allows for protection from floods which may not be possible, predictable or viable to manage through other forms of flood reduction. However, support for widespread availability of flood insurance does not mean that the best route forward should be to keep tweaking 'Flood Re' until it's structure becomes remotely efficient, with the costs of 'tweaking' in both time and capital brought into question.

Overall, a collaborative approach is needed to improve insurance uptake. Flood Re exacerbates the contractual relationship which already exists between the public and insurance companies, and has shown to be ineffective leading to post-Marxist forms of

public participation. More information, contact between consumer and provider beyond that of a telesales representative and generic websites, and a greater understanding of the community benefits that uptake of insurance brings are all necessary to improving the uptake of insurance. A collaborative approach requires a redefinition of resources beyond those traditionally acknowledged, which will require insurers to take account of household activities which influence risk, such as property level protection. The two-way dialogue between insurers and the public needs to become less contractual, and more collaborative, especially in high risk flood areas where community engagement is already occurring as part of Partnership Funding.

7. Discussion: Equality and civic engagement in Flood Risk Management

The main research questions of this thesis was formulated as I listened to academics disputing whether flood risk management was the responsibility of the government or of the householder. I knew at the time this was also a concern for government who increasingly sought to redistribute responsibility for flood risk management to the scale of the flood hazard in order to increase the number of projects going ahead and more fairly distribute taxpayer money. Simultaneously, local communities were battling to get support for their flood risk management projects and gain clarity over who should be held responsible for maintaining existing defences. Finally, householders were feeling the threat of rising costs of insurance and wished for some stability and control over future insurance premiums. In summary, when I began this thesis no one was sure of what kind of good flood risk management should provide and who should be responsible for its provision, and that clarity had begun to lead to instability.

This thesis has shed light on these issues. I have demonstrated that Partnership Funding

allows for the appropriate re-delegation of flood defences from a public good to providing club, private, and public goods. Yet, simultaneously the case studies presented highlight the complexity of involving the public who show various levels of support for contributing to flood defences beyond taxation. In contrast to the provision of hazard reduction which moved away from being considered solely as a public good, a different movement was occurring in the management of flood losses. Flood Re, a cross subsidy on insurance premiums aimed at reducing excludability of access to premiums and rivalry of the insurance pool, once implemented will transform access to insurance away from being considered as solely a private good. Overall, I project that Flood Re will be a beneficial tool to support those who require insurance, but that in it's current form will not do enough to encourage those who do not frequently purchase insurance to change their behaviour. Due to the devastating impacts an uninsured loss can have not just upon the householder, but also upon the community as a whole, I argue that Flood Re is inadequate in it's present form, and may become more so as Partnership Funding, alongside development pressure and climate change, increases the reliance upon householders to manage residual flood risk.

In light of these findings, I now discuss how schemes such as Flood Re and Partnership Funding, which require public involvement, influence equality of access to flood protection. Bearing in mind the heterogeneity of the British social landscape, such discussion is of importance because not all people requiring flood defences will have a personal attachment to their community, and in those cases promoting authorities will have to explore alternative incentives to encourage the local public to raise funds for flood defences. In addition to this, an increased move towards household protection may have implications for the costs of reducing residual risk, with little knowledge of how those

accumulated costs across a population will influence a society in the longer term.

The past decade has been witness to a change in perceptions of how Flood Risk Management should be delivered in order to ensure equality in access to flood risk reductions measures. As shown in the earlier chapters, new policies have been developed and implemented, the public have revised the role which they play within Flood Risk Management, local authorities have been granted additional powers, and, resultantly, collaboration between stakeholders has increased. Many new policies seek to ensure equity and efficiency in an environment of fiscal constraint. Yet, the legacies of past developments, such as building on the flood plain, subsidized and opaque insurance policies (which remain in place today), and the negative externalities which lead to disproportionate protection of those who may be able to afford to protect themselves, mean that Flood Risk Management is obliged to cater for the unsustainability of past approaches.

In earlier decades of flood defence, equality of access to flood protection measures was achieved by protecting entire urban populations so that all residents and infrastructure users in these areas could reap benefits of reduced flood probabilities. However, for a number of reasons, now described, the perception of how fair these schemes are has diminished. First, being capital intensive has meant that only a small number of schemes could go ahead at any one time, leading to a long waiting-list of future projects. Second, only projects which filled the cost benefit requirements were granted funds meaning many communities were left undefended, and exacerbating this was the impetus of local pressure groups who pushed their own projects forward, while areas with low social capital felt they had no supporting voice. Finally, residual flood risk caused by climate, changing maintenance practices, and increasing volume and value of assets on the floodplain began infringe upon the effectiveness of existing schemes. Residual risks

are often left to manage at household level, and resultantly unfairness crept in, isolating those who could not afford insurance or property level protection.

Partnership Funding, the first scheme discussed in this thesis, has immediately stabilized the encroaching unfairness associated with the previous funding structure. The result of the scheme has been that projects which had not met the cost:benefit requirements under the previous funding structure could now go ahead if they could raise the funds. For areas where there has been localised flooding, such support has been of immediate benefit, with cases of deployable defences being invested in for collections of properties, e.g. Montague Road Flood Action Group. In towns which had larger flood issues, respondents claimed that with an ability to raise funds, the speed of implementation of flood defence projects significantly improved. Thus, many new schemes have gone ahead which would not have been considered previously. In addition to this there have been immediate positive externalities. These externalities have included increased awareness of flood risk which has fed the desire for local control of community Flood Risk Management assets. Warden schemes have sprung up, implementing local rain gauges to distribute warnings, maps which identify vulnerable people who need assistance during a flood event, and support for the community both in the aftermath of flood and in the provision of assistance to prevent possible losses in the event of a future flood. Therefore, currently Partnership Funding has provided fairer distribution of taxpayer money, and fairer access to protection by flood defences.

Despite the initial success of projects, concerns around Partnerships Funding's reliance upon the public do exist. One of these concerns is that Partnership Funding may be unfairly utilised by those with enhanced social capital, which would inevitably be those with the financial resources to support their activities. Under this scenario communities

in wealthy areas who were able to form flood action groups would put pressure on local authorities to ensure that their schemes would go ahead. As shown in the interviews (Chapter 5), this predicted behaviour did occur; those areas where there were wealthy neighbourhoods were far more likely to develop a flood action good to pressurize the Authorities into providing flood defences, whereas in the most deprived areas of the UK flood groups did not form. However, when this interview data was contrasted with the RFCMPs (see Chapter 4) this polarization of local activity correlated with wealth had not led to deprived areas being left undefended.

One reason that equality in access to new flood defence schemes has prevailed under Partnership Funding is, in part, due to the weighting awarded to deprived areas. Under Partnership Funding a project is more likely to reach the percentage required to be granted full funding if a project has households in the highest 40% of deprivation. Therefore, even if an initial scheme proposed by a flood group does not include areas of deprivation, it is in the benefit of the promoting authority to adapt any Flood Risk Management scheme to ensure the inclusion of deprived communities. Thus, even if low income areas do not have the social capital required to promote their own cause, the weighting within Partnership Funding ensures that others are more likely to seek for their inclusion. The result of this transition has been that more projects have been planned to go ahead within the next five years than in the previous five years (see Chapter 5).

A further issue to be considered is the potential problem in the case that the number of projects which exceed the required percentage to receive a full grant increase beyond the means of the pot of funding available. The amount of funding available for flood defences is ultimately rival, which will mean that even though a project has passed the requirement to enable it to receive full funding, full funding may not be granted.

Instead, those projects that fall above the required percentage will be ranked from high to low, with those schemes with the highest percentage receiving full funding, while others will not. How this will influence the form of flood projects submitted is yet to be seen. However, it would be expected that promoting authorities, especially in towns with heterogeneous land uses, and, therefore, projects which may overlap with other needs of the general population, will push ensure interdisciplinary public service provision which tackles social problems such as provision of green spaces, increased housing development, and Flood Risk Management. All of this which would be a positive step forward from the exclusionary, narrow focused, Flood Risk Management projects of the past (Adams, 2004).

Following on from this is an increasing concern regarding equality in access to management of residual flood risk, with evidence that Partnership Funding encourages lower cost schemes which may shift the increasing cost of residual risk on to those who cannot afford to protect themselves. Flood Re may present a solution to the problem of residual risk by providing loss mitigation to protect against floods which are not easily managed through engineered, larger scale defences, such as surface water or ground water flooding. However, privatization of residual risk through encouraging insurance and property level protection could foster an environment in which it is possible for authorities to shirk responsibility, which is particularly concerning when considering the increasing threat from these sources of flooding. For example, in 2007 over 35,000 houses were flooded by surface water flooding (Gov.uk, 2015), with 1.6 million homes at risk from groundwater flooding (MacDonald, 2010). Neither Flood Re nor Partnership Funding in their current form fully support the mitigation of these forms of flooding for those that cannot afford insurance.

Partnership Funding does, however, advocate the implementation of property level protection as part of the remit of forms of defences which the scheme may cover. Yet, proving a national benefit in order to reduce the contributions of those who cannot currently afford flood insurance may be difficult, and, if a contribution was required, to be of comparative benefit, the contribution by property owners would have to cost less than the cap upon flood insurance provided by Flood Re. That household flood resilience measures are of a longer term benefit is of little consequence if the householder cannot access the capital to purchase these resilience measures. As demonstrated by Mendoza (2011) in his article "Why do the poor pay more? Exploring the poverty penalty concept", the inaccessibility of loans or bulk capital means that often poorer citizens end up paying far more than their wealthier counterparts for the same service. State funded loans or grants for property level protection may be a way around this problem, and is a solution being explored by Northumbria following the 2015 floods (Northumbria County Council, 2015).

Another potential solution to fill the gap in protection if the hypotheses developed in this study prove correct is to have some form of Local Authority insurance scheme. At present emergency funds provided by local authorities and NGOs, for example the Red Cross, have covered the losses incurred by deprived households following a flood event. In effect, these organisations have been providing unofficial loss mitigation, which, though undoubtedly welcome by their beneficiaries, is an unreliable source of emergency funds. It is acknowledged that there are wishes to protect the UK's strong insurance industry, however a Local Authority insurance scheme does not have to work publicly. Instead, it would be possible for a Local Authority to act as an agent for insurance, pooling with other local authorities so that the scheme does not become rivalrous. Local Authorities

would democratically opt in to an insurance scheme though a council tax precept if the constituency voted that flooding was of social and economic significance for the entire area. In the case of a flood, all constituents would be able to apply for funds up to a low threshold, such as £500, which would limit perverse outcomes, such as deliberate non-insurance. Of note is that Northumbria County Council has also put in place a £500 formal hardship grant and Council Tax relief for those who have been flooded in 2015 (NCC, 2016). All of this could be achieved with the State acting as the facilitator rather than the insurer, allowing the UK to keep providing flood insurance privately.

The existence of a State facilitated insurance scheme also does not mean that Flood Re should be cast aside as redundant. Government interventions have been shown to be of vital importance for those householders who are obliged to purchase insurance as part of their mortgage agreements (Chivers and Flores, 2002). Without a subsidy householders may find themselves in a position where they can meet neither the terms of their mortgage nor afford insurance, which is highly undesirable in regards to ensuring economic stability and continued investment in housing in a fragile economic environment (Wringley, 2011). In addition to this, Flood Re also ensures that access to insurance remains non-rival, which when considering the £3 billion paid out by insurance companies for 185,000 claims as a result of the 2007 floods (Pitt, 2008) is necessary to guarantee the long term compliance of insurance companies to provide cover for high risk households.

Despite the potentially complimentary approaches of Flood Re and Partnership Funding, a gap in the provision of residual Flood Risk Management services may exist. What is of concern is that residual forms of flooding, i.e. those that cannot be protected by flood defences, might be spatially dispersed which creates an issue for the potential use of people power to pressurize authorities into acting. In addition to this, we showed

that often deprived communities are unsure of how to connect to the local authorities, meaning that even if property level protection could be accessed at an individual level as part of the Partnership Funding scheme, it is unlikely that people in these areas would have any idea of how to go about initiating this process. Thus, not only would it be likely that little demand for household mitigation would arise in these areas (or that the cost of supply would exclude demand), but also that these areas would have more difficulty negotiating with other stakeholders.

Due to the inequalities in access to household Flood Risk Management measures, I argue that insurance and property level protection should, therefore, be considered as merit goods. Supporting this prognosis is the repeat evidence that the public do not consistently value the outcomes and externalities of flood risk mitigation products accurately. According to Forte (2010) there are three justifications for services or goods being provided as merit goods. These are:

1. "Goods the private individual is unable to choose to an optimal extent and in an optimal manner on the market, on account of imperfect rationality;
2. Empowering (or functioning-related) goods to assure some quality of starting points and to provide a safeguard against the major risks of the social lottery that the average citizen may face;
3. Empowering goods, in order to provide for the needs of the less well favoured individuals" (p.174)

Thus, the provision of Flood Risk Management services, be they household or community level, might be considered as merit goods because we have shown that the public often have imperfect rationality, less well favoured individuals can receive disproportionate utility from Flood Risk Management goods, and the social lottery whereby people

are born into certain political, social and economic circumstance (Rawls, 1971). At household level, the restricted market for flood defences has the potential to stimulate a household level market for property level protection and household resilience. However, due to uncertainty at this time surrounding the effectiveness of property level protection, the reliance upon individual to appropriately implement appliances, and the lack of loyalty to specific insurance companies, the market for property level protection market is not currently reaching its full potential.

To answer the question of whether flood risk management of today is more equitable and how this is shaped by the public, on the whole I would say that new schemes are fairer to the nation as they distribute funds according the proportion of local to national benefits. However I believe the privatization of residual risk management has the potential to lead to some disturbing inequalities. First, Flood Re, though necessary for mortgage holders, allows residual risk to be privatized further and in turn encourages non-tangible costs to be removed from sight and mind. The reality is following a flood families are out of their homes, away from their jobs and schools for around six months following a flood event, and for some people this could have life altering implications. Bearing this in mind, loss mitigation should be treated as a safety net, and should not be considered as a first line of defence against flooding. As such, my immediate concern with the future management of flood risk is the emergent risk of treating loss mitigation as a substitute for reducing the probability or magnitude of a flood event.

Next, the awareness which is being raised as part of Partnership Funding is being seen as a panacea to managing flooding, and there runs the risk of an over-reliance upon volunteers who believed their financial efforts would be a one-off. I am dubious to dismiss the potential for flood groups to remain positive if flood magnitudes and frequencies

remain high, and money has to be repeatedly raised for defences. However, I believe it is important to acknowledge the severity of future flood risks, and personally believe the UK may have to consider managed realignment more frequently in areas with repeat serious flooding. Flood defences, public awareness and insurance will only go so far, and as our respondent in Cockermouth summarizes:

> "There's no denying that the weather pattern has changed for this country and being near to the coast we're always wondering when the next [flood] is going to be.... It's taken a long while to recover [from the flood]....But we've done fantastically. We've got it all back, but we need to protect it because it will never come back that way again, if it happens again."

In Ecology a theory exists called the Intermediate Disturbance Hypothesis (Townsend *et al.*, 1997), which states that resilience and diversity is at its optimum within a community when ecological disturbance is neither too rare nor too frequent. Within this theory, a disturbance can be considered as an abnormal event within a daily routine which leads a population to reorganize, becoming increasingly resilience or breaking down. At present there is a drive towards building resilience into flood risk communities, and this has been shown to reduce vulnerability through improving awareness and encouraging action at a household and community level which mitigates the flood hazard. However, as demonstrated in the Intermediate Disturbance Hypothesis, and supported by research in flood communities (Kotzee and Reyers, 2016), there may be a point in time where the frequency and magnitude of floods become significant enough to stagnate the recovery of a community, and prevent community members from effectively contributing to the social, economic and political wellbeing of their neighbourhoods. As such, Local Authorities who suffer severe flooding should frequently check the health of their community

through measuring indices of deprivation (or developing indices of resilience), and ensuring that vulnerable members of the community are identified and provided with the appropriate support.

This thesis has provided a greater insight into whether the goods provided by flood risk management should be provided as public, private or club goods regardless of their natural characteristics, and the extent to which the public should be included in the provision of Flood Risk Management goods. Investigating two policy instruments in detail, Partnership Funding and Flood Re, Flood Risk reduction measures were perceived as providing club goods with costs proportionately shared among beneficiaries. In comparison, Flood Re, which focused on loss mitigation through reducing the excludability of insurance premiums, transforms access to insurance from a private good to a public good. However, I hypothesis that Flood Re will be less successful at achieving it's aims due to the way in which those who do not currently purchase insurance make decisions. I propose that the cause of the differential success is due to the models of social order which contextualizes each. Flood Re is based on contractual regulation between consumer and service provider, whereas Partnership Funding fosters collaboration and moral regulation. Contractual regulation fortifies information asymmetry and encourages post-Marxist forms of civic engagement, which often result in conflict. In contrast, collaborative approaches promote the sharing of knowledge, financial and social resources, and comprehensively target vulnerability and hazard aspects of flood risk. As flood risks and their externalities become more complex, collaborative approaches and carefully tailored club goods will be necessary to avoid market failures caused by income gaps, knowledge asymmetry, and necessary property rights. Learning from this new ways of thinking about community level loss mitigation should be developed. However,

a strengthened loss mitigation sector of Flood Risk Management should not be considered as a substitute for flood hazard reduction measures. With increasing residual risks, local authorities should utilize existing nodes of social capital within their communities to monitor and safeguard the resilience of their citizens.

8. Conclusion

8.1. Summary of Findings

In this thesis we have shown that the benefits provided by Flood Risk Management are generally to be categorised as public goods, as defined in classical economic analysis. This is because these goods are often freely available to the populations affected (no one is excluded) and/or because they are not "used up" or consumed by those who benefit from them. We have also shown, through a sample of responses from "flood action groups" that the public sees many of the outputs from Flood Risk Management measures as public priority goods, to be provided by the state rather than through private enterprise.

However, exceptions exist, which we have highlighted, with a general trend in Flood Risk Management, in England at least, towards providing some of Flood Risk Management goods as private or "club" goods (e.g. locally funded small-scale Flood Risk Management schemes) through the intervention of individuals and local communities. This is partly because government wants less active involvement in this area, and partly because many communities and professionals see the value of local involvement in Flood Risk Management measures, in order to attract "buy in" through a process of engagement

by those who benefit in the provision of the relevant infrastructure and the favourable environments that this can provide.

Importantly, the classification of different forms of Flood Risk Management interventions as public, club or private goods does influence the level and form of public participation and stakeholder engagement in Flood Risk Management. Our survey of action groups showed that 'pure' goods did not encourage long term, sustainable participation in that they did not facilitate increased awareness, or associated uptake of individual risk reduction measures. In the case of 'pure' public goods which were national in scale, participation emerged from our research as a method to ensure levels of protection or high cross-subsidies remained. Those goods which were quasi-private in nature often encouraged participation forms which indicated increased awareness of those at risk. This result suggests that rescaling of the traditional national borders of a public good delivery by the central government's funding of most Flood Risk Management to a local level to encompass community scale private goods may be of benefit to sustainable and responsive Flood Risk Management outcomes.

What we conclude, however, is that stakeholder engagement and public participation in Flood Risk Management is both helped and hindered by changes in the perceived distribution of benefits of Flood Risk Management interventions. Where these goods are provided opaquely, as in the insurance industry, public engagement is not enhanced, because the critical social aspect of engagement is missing. But where communities are actively and transparently involved – thus socializing this process - in designing and implementing Flood Risk Management measures, as public goods to those affected, then the stakeholder engagement there has been considerably strengthened. We would wish to see, and hence recommend, a progressive reduction in the 'hidden' or poorly

understood provision of Flood Risk Management services, and a progressive opening up of the access to insight and knowledge about their effects, so that the adverse effects of private goods (the individual or local small communities protecting themselves and perhaps exacerbating risk elsewhere) are minimized and the core character of Flood Risk Management as a public good is maintained as much as possible.

How this is achieved will clearly depend on the nature of the flood risk reduction measures, and the scale at which they are implemented. So, for example, flood insurance arrangements are determined largely at a national level, and the insurance industry needs to agree with government ways to make their provision more transparent. Many small scale flood risk reduction measures, on the other hand, are local in character, and any attempts to protect just those communities which are actively involved in the process, and pay for the measures involved (perhaps turning them into "club goods" if not entirely private), should be subject to a wider scrutiny, probably by the Environment Agency, so as to ensure that they are not unduly restrictive. We recognise that in certain circumstances such restrictions may enhance stakeholder engagement, but we believe the losses involved are greater than these gains. Indeed, we judge this process of opening up of the access to insight and knowledge to be in the interests of the greater positive involvement of the public in influencing the policies and practices that can reduce the flood risk that they face both now and into the future.

8.2. A critique of the Methodology

The greatest challenge of this thesis lay in its interdisciplinary nature which combined geography with elements from social science, computer science and economics. Under-

standing such an array of topics was only possible by working with different departments from multiple universities, listening to experts, and experimenting with the structure of models. Despite the interdisciplinary nature of the work, this thesis has been successful in showing the relationship between social feasibility and the excludability and rivalry of flood risk management interventions, while simultaneously demonstrating the advantages of integrating human adaptation into models. However, there are aspects of the research which could be strengthened and those will be mentioned here.

The development of an agent-based model was challenging not least because of the novel application of elements of Prospect Theory (See Section 3.5.1.2 for a full exploration of the limitations of the approach used), but also in determining which values for parameters were appropriate, the boundaries of probabilities and behaviours, and balancing the simplicity of the model with the accuracy of output. Adding to this challenge was the task of structuring the process which determined insurance premium pricing within the model when in reality flood insurance is bundled within household insurance. Thus, the model environment, processes and agents were highly idealized to the extent that the outputs could not be considered absolute, and could only be analysed as a prototype to demonstrate that behaviour can be included in models and as comparison to the EMV agent-based model to highlight that adding behaviour into assessments makes a significant difference to model outputs. These observations are significant as a model with adaptable agent reference points had not been developed previously, and, despite the focus on community resilience within the flood risk management arena, adaptation and behavioural responses are not currently integrated within models which inform practitioners and policymakers.

If I were to undertake this research again, I would seek greater realism by developing a

questionnaire structured around the Prospect Theory elements used within the agent-based model to allow at-risk householders to fill in those variables themselves. Questions might include asking the householder the reference point by which they judge gains and losses, how keenly those gains and losses are felt, their perception of the probability of flooding and the probability of an intervention functioning properly, in addition to more basic questions such as the amount of money they put aside for insurance and their Council Tax Band. Thus each agent within the agent-based model would correlate to an actual householder[1]. The reason that I did not develop such a questionnaire was due to the order of my investigations where I first interviewed people to find out their concerns regarding insurance, and, knowing that I would have to develop computer simulations of public reactions to Flood Re as the policy had yet to be implemented, then looked for a structure / model which aligned with the behaviour I had observed. It is my hope that in the future similar models will be developed to tailor insurance products to consumers, and, importantly, encourage those who currently do not purchase annual premiums, but who could benefit from doing so, to begin to invest.

The next critique of the methodology resides in the small number of communities interviewed who had participated in Partnership Funding. The step of interviewing communities was the first aspect of my methodology, and, even though a number of subsequent interviews took place, the majority of interviews were carried out in 2012. The result of this was that Partnership Funding had only recently begun to roll out across England and there were not many groups which I could interview to gain a better understanding of their experiences. All groups, regardless of their involvement in Partnership Funding, were asked about whether they would contribute to flood defences beyond taxation.

[1]One householder would most likely inform many simulated agents to account for path dependencies of decision making over the simulation time of a model run.

However, it is impossible to know whether their answers to these hypothetical questions would remain unchanged in the scenario where the Environment Agency asked them to make a contribution. From news articles, conferences and follow-up conversations, my interpretation of events appears to be accurate, though large question marks still loom over the ability of the Partnership Funding scheme to raise funds outside of privileged networks and in large cities. Ultimately, if funds are found without being sourced from individual community members, the lack of public involvement may be of little consequence to flood risk of the area, and, that some areas find it difficult to raise funds through the community outside of a Council Tax precept supports my call for a policy which reflects the spatial heterogeneity of England.

Overall the methodology was experimental because I explored a broad set of research objectives which could not be answered without applying multiple methods. This experimentation required the unconventional application of traditional theories across multiple disciplines. However, when experimentation means that policy can be improved in order to make flood risk management fairer, more efficient and adaptable to the pressures faced by today's society – and I believe the results of this thesis make a positive contribution to that cause – then such experimentation is justified.

8.3. Recommendations for future academic research

A key objective of this research was to apply an innovative and interdisciplinary approach which could act as a springboard for future academic development. The use of interviews to understand social phenomena is well practiced within academia, as is the use of agent-based models to test implications of policy developments. What is not commonly

applied is a methodology which uses both these approaches simultaneously, and, to my knowledge, what has never been attempted is the development of an agent-based model which takes the behavioural traits identified in prospect theory and uses those traits to enable agents to adapt and revise the milestones by which they base their decisions informed by either incremental changes, i.e. gradual increases of insurance premiums, or catalytic changes, such as a flood events. Weaving its way throughout this thesis has been the concept of change; examining how rivalry and excludability alter over time, how contractual interactions between the Public and the State can be transformed into cooperative relationships, and how the process behind decision-making responds to external and internal influences. As such in this section I want to focus upon future research which would allow models to implement thresholds at which the way agents make decisions adapts.

There are three aspects of the agent-based model which merit further academic research. These include widening the application of the model, improving the realism of the model, and exploring the theory which underpins the model. Examples of the wider application which this model could be applied with a minimal adjustments include examining the impact of catalytic policy change compared to incremental change upon long-term behaviour responses, applying indicators of affordability of insurance wider than that of Council Tax Bands, and testing how variance in the average duration which a householder dwells in a property influences the long-term ability to manage flood risk in an area. All of these applications relate to current discourse within academic and policy circles, and could readily influence decision-making in this field.

The next desirable area of academic research to follow on from this thesis would focus on improving model realism. As already discussed, areas of complexity which could be

developed include transferring the model to cellular space, programming more realistic memory processes of agents, replacing idealised agents with data from real respondents (using a mobile App for instance), and adding more than one choice of probability-weighting than what is applied within the agent-based model developed. Enhanced realism is not only of interest in regards to developing the technological capabilities of mimicking human decision-making processes within software, but also for experimenting with the commercial application of such software and how agent-based modeling could be used to support decision making in other academic areas.

However, it is the theoretical underpinnings of this thesis which could be carried forward furthest by academic research. Kahneman (2002) has discussed how he would like his theories to be used to inform better decision-making, yet the way in which Prospect Theory can be structured and used within an agent-based model in order to aid decision-making is fundamentally different to the structure of the Theory. Whether the deviance to the traditional use of Prospect Theory is acceptable to economists is an important question, and, if it is not, academics need to discuss how such theories could be applied to inform decision-making as opposed to explaining decision-making. Finally, how the unconventional use of Prospect Theory could inform the expansion of Prospect Theory is also of interest and should be subject to further investigations.

8.4. Implications for Public Policy

Notions of excludability and rivalry are dynamic, and, fundamentally, they are informed and limited by social feasibility. Social feasibility of flood risk management interventions varies between localities due to variables which impact resources, such as time, capital,

knowledge, access to privileged networks etc. These variables can include, but are not limited to, deprivation, experience of flooding, the ratio of flooded to non-flooded residents, age and occupation. Resultantly, notions of rivalry and excludability do not just vary over time, but also are a product of the spatially influenced indicators of social feasibility, which is important when decision makers seek to design effective and equitable flood risk management policy which is resilient to the passing of time and heterogeneity of space.

Too often in flood risk management, social feasibility and hazard management are assessed separately, i.e. hydraulic models may focus on how defences change water flows and then a separate initiative will assess and modify the vulnerability of the population. Such an academic separation can no longer be justified with the ever increasing accessibility to technology such as agent-based models. What's more is that as academics we must more fully embrace and experiment with cross-boundary disciplines. Geography is interdisciplinary in itself, and as geographers, we can learn a great deal from economics, psychology, sociology and computer science. By combining these disciplines this thesis has been able to incorporate aspects of society which influence the success of policy. These include integrating time-dependent adaptation of the population into models, modeling an entire society in order to analyse outcomes caused by a variance within the population, and, by integrating those elements just stated, accepting the non-adherence of many people to expected utility.

We know that the public does not always follow expected utility, we can see how different flood risk management interventions stimulate different behaviour changes and that these behavioural responses vary between localities. That policymakers and practitioners continue to base their decisions primarily upon the outputs of models which do not

integrate these known behavioural characteristics and responses, and therefore do not systematically incorporate social feasibility – and I have gone to great lengths within this thesis to demonstrate the significant impact of including social feasibility has upon any model – into models is unjustifiable. Crude indicators of the social feasibility of flood risk management schemes, such as how many houses of deprived people the defence protects, serve their purpose but rarely take account of, or encourage, public adaptation.

We – the human race – now live in an era where predicting the impacts of climate change, the nature of which is incomparable to anything which has gone previously, is highly challenging. Ensuring that the magnitude of these climatic developments does not result in crippling economic costs, or even flood events becoming a matter of life or death in the UK, adaptation and resilience will be required. Therefore, we must build adaptation and resilience into the models that we develop to assess the future resilience of flood risk management interventions. This thesis has shown that the technology is there, now what is required are innovative minds which can take these ideas forward and apply them to larger models which can learn and adapt, and while doing so make use of the most connected and networked populations and their associated data which have ever existed.

The integration of behaviour into models also allows policymakers extreme flexibility in the scale of delivery of flood risk management interventions – allowing policy makers to deliver policy straight into the hands of individuals. What then does this imply for the scales that flood risk management interventions are best controlled? Despite my emphasis throughout this thesis on managing flooding at a local level, from having talked to flood risk communities across England I do not believe that a return to the Internal Drainage Boards of the 1980s run by rural elites is the best way forward. Instead,

I propose a new model which allows local people – regardless of the amount of land they own or social influence they hold – to choose to define themselves as flood risk communities (or otherwise) through voting to contribute additional capital to manage community-wide flood issues. The most obvious mechanism through which these additional contributions would be made would be through a Council tax precept. Such a model has already been applied by the Somerset County Council which this year will charge a 1.25% 'shadow precept' [2] to residents to support the Somerset Rivers Authority, while an increasing number of flood risk communities, including Northumbria, are pushing to make such a tax part of local life. As stated previously, notions of excludability and rivalry are fundamentally determined by social feasibility. If this is the case, then a mechanism should be put in place to allow the public to express their preferences as to whether floods which impact their community should be treated as a private or public good.

The final issues within flood risk management which need to be addressed are those of property level protection and insurance. Regardless of the original purpose of insurance (to distribute the cost of a loss over time) the role of insurance in flood risk management today is of the utmost significance. It is for this reason that the government has been so proactive in adjusting the flood insurance market. However, Government is much slower at responding to social change than the insurance industry because there are fewer opportunities for the public to make choices over their government than there are opportunities for the public to choose their insurance policy and there is a greater range of

[2] I do not fully support the enforced 'shadow precept' and would encourage communities to define themselves as flood risk communities. With the emergence of Partnership Funding, this would mean that in an area which does not consider itself to be a flood risk communities, flood risk householders may have to contribute larger sums than the £15 proposed increase in Council Tax bills. Also, it is important to remember that Partnership Funding has weightings which support households in areas of deprivation, which would mean that these areas should not lose out if a community voted against being considered as a 'flood risk community'.

insurance options than government parties. This means that the flood insurance industry today is hindered by Government adjustments and is not as innovative or segmented as it would like to be (ABI, 2013), and could be, without the stabilisers of long-term, slower moving government policy. Thus, despite the increasing realisation, embodied in Flood Re, that access to insurance is a public good, the private provision of this good could encourage more innovation in this field.

During the interim period where insurance premiums will gradually return to risk-reflective prices, there is an opportunity for property level protection to be addressed. At current property level protection is a controversial issue due to the difficulty of installing appropriate property level protection resistance / resilience measures, and the delegation of the responsibility for the cost of such measures. Adding to this is the unwillingness of householders to invest in property level protection if their investment is not recognised in their insurance premiums and insurers frequently only replacing 'like-for-like' upon the householder taking out a claim. Some local authorities have attempted to intervene by providing grants for property level protection following a flood, e.g. Northumbria. The presence of demand for property level protection implies that a market does exist, and the inability to cater for that market indicates that regulation may be required. Such regulation could ensure that if a house is at high flood risk, after submitting a claim that house must meet specific flood resilience criteria, or at least utilise water resistant materials upon its rebuild.

The introduction of such regulation requires further research and discussion. However the presence of regulatory measures would force householders to accept that they are at flood risk[3], and that recognition may be more likely than Flood Re's pricing signals to

[3]Harries' (2008) example of householders not willing to install property level protection because they did not want to accept being at risk.

encourage behavioural change while organically reducing expected damages following a flood. Such regulation would not necessarily have to increase the transaction costs of the insurer, if applied innovatively, such as making use of longer term policies.

The major concern, however, is for those residents who do not purchase insurance as they would not receive the benefits of such a scheme because they would never make a claim and, therefore, be subject to regulation. These householders are often those in more deprived areas who cannot afford insurance. England needs more local councils offering grants for property level protection and we need those Authorities to work with charities, such as those we have seen in Merseyside and Kingston Upon Hull, so that the poor do not continue to pay more – in regards to both the absolute cost of flooding and the costs incurred by a forced change in lifestyle – following a flood.

Adaptation, policies that accept variation across populations (and how that variation impacts behavioural change), and increased interactions between service provider and consumers will be key to reducing and stabilising the long-term impacts of flood risk in England.

8.5. Closing remarks

Public goods and public priorities are inextricably linked. As society adapts to the provision of a good, learning ways to exploit its benefits, externalities are internalised, and the availability and accessibility of that resource is transformed. This is a natural progression and illustrates the enduring ability of people to make the most of resources, sometimes inadvertently to the detriment of others. It is the role of Government and policymakers to ensure that public goods do not become excludable, either by redefining

those goods as private or club goods or by putting regulation in place to ensure society cannot develop mechanisms to make a good excludable. This task is continuous, and there should be no expectation that a policy which benefits the majority of society today will benefit such a wide variety of the population in the future. Instead, collaboration should be sought on complex issues of service provision occurring at both community level by making use of third parties, and using technology and social networks to deliver policy into the hands of individuals. Collaboration encourages a greater understanding of public behaviour in response to flooding, and this, in turn, can inform better policy. Most importantly, we must remember that the good we seek to retain through effective flood risk management is the stable economic and social platform from which we carry out our daily lives.

A. Flood risk areas interviewed and contacted

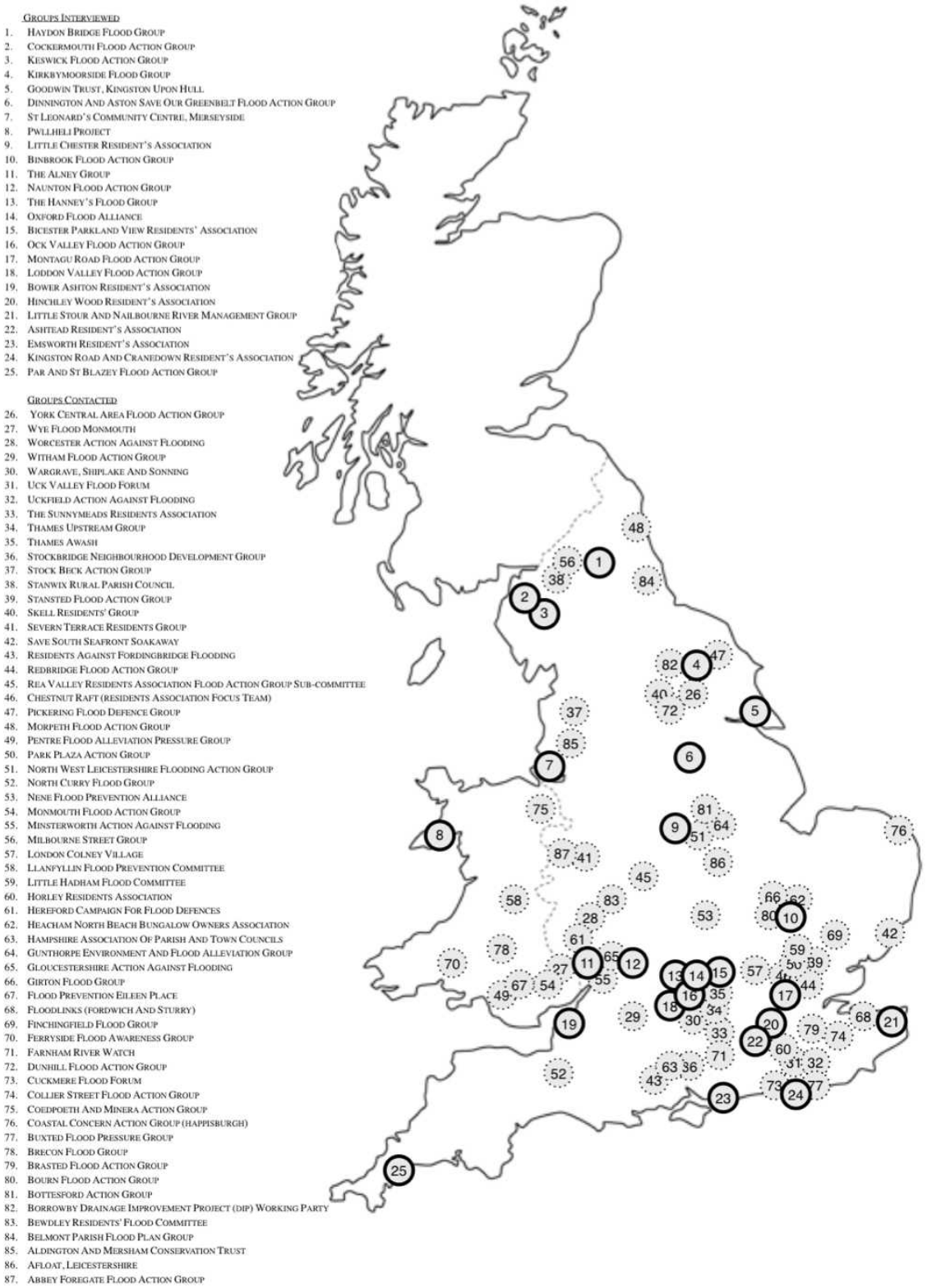

Figure A.1.: Map of flood groups contacted and interviewed

Group name	Primary respondent	Interview form / location	Date / time
Alney Group	Sensitive - available on request	Email	11 July 2012 8:57 AM
Ashtead Residents' Association	Sensitive - available on request	Email + forwarded on documentation	02 April 2012 3:35 PM
Bicester Parkland View Residents' Association	Sensitive - available on request	Telephone	07 May 2014 8:05 PM
Bin Brook Action Group	Sensitive - available on request	Telephone	27 March 2012 7:49 AM
Bower Ashton Residents Association	Sensitive - available on request	Email	29 March 2012 5:50 PM
Cockermouth Flood Action Group	Sensitive - available on request	Telephone	29 March 2012 5:37 PM
Dinnington and Anston Save Our Greenbelt Action Group	Sensitive - available on request	Telephone	01 April 2012 9:03 PM
Emsworth Residents Association	Sensitive - available on request	Telephone	27 March 2012 9:55 AM 05 January 2013 (Unknown time)
Goodwin Trust, Hull	Sensitive - available on request	In person (Kingston Upon Hull)	01 May 2012 4:00 PM
Hanneys Flood Group	Sensitive - available on request	Telephone	26 March 2012 7:30 PM
Haydon Bridge Flood Group	Sensitive - available on request	Telephone	20 March 2012 4:38 PM
Hinchley Wood Residents Association	Sensitive - available on request	Telephone	03 April 2012 8:57 AM
Keswick Flood Action Group	Sensitive - available on request	Telephone	26 March 2012 5:14 PM 15 January 2013 (Unknown time)
Kingston Road and Cranedown Residents' Association	Sensitive - available on request	Telephone	12 April 2012 8:44 PM
Kirbymoorside Flood Prevention Group	Sensitive - available on request	Telephone	26 March 2012 3:20 PM
Little Chester Residents' Association	Sensitive - available on request	In person (Little Chester)	14 April 2012 8:47 AM

Table A.1.: Flood group interview name, date and time

Group name	Primary respondent	Interview form / location	Date / time
Little Stour and Nailbourne River Management Group	Sensitive - available on request.	Telephone	26 June 2012 7:54 AM
Loddon Valley Residents Association	Sensitive - available on request.	Telephone	25 March 2012 10:56 AM
Montagu Road Action Group	Sensitive - available on request.	Email	27 March 2012 1:32 PM
Naunton Flood Group	Sensitive - available on request.	Telephone	09 April 2012 12:40 PM
Ock Valley Flood Group	Sensitive - available on request.	In person (Abingdon)	24 April 2012 18:00 AM
Oxford Flood Alliance	Sensitive - available on request.	In person (Oxford)	30 May 2013 14:30 PM 11 December 2012 18:00 PM
Par and St Blazey	Sensitive - available on request.	Telephone (in addition to casual conversation at conferences)	26 September 2013 18:00 PM 14 May 2013 4:43 PM
Project FOSTER	Sensitive - available on request.	In person (Oxford)	17 May 2013 12:30 PM
Pwliheli Project	Sensitive - available on request.	Email + forwarded on documentation	17 April 2012 3:18 PM
St Leonard's Community Centre, Liverpool	Sensitive - available on request.	Telephone	30 April 2012 2:39 PM

Table A.2.: Flood group interview name, date and time (Continued)

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