Extreme weather events are a pressing global concern due to the devastation that they can cause. This thesis focuses on flooding, which is the natural disaster with the greatest effect on humanity. Europe as a whole has suffered an annual average loss of $14 billion between 1980 and 2010 due to the effects of extreme weather events. The increasing trend over time in flood risk has resulted in a growing interest in flood risk management, and financial mechanisms such as insurance to deal with increasing flood risk. The main research question of this thesis is: How can insurance and household-level risk reduction be combined to create a flood-resilient society? This can help to meet the Sendai framework’s call for increasing investments in disaster risk reduction. To answer this question this thesis consists of five content chapters that answer different aspects of this core question.

Chapter 2 finds that there are large both tangible and intangible welfare impacts from flooding and that the intangible impacts may be twice as large as the tangible impacts, highlighting the need for increased effort in reducing flood risk. Moreover, Chapter 2 showed that there are substantial welfare benefits from individual risk reduction measures (~€39,000), which provides a rationale for exploring how the implementation of such measures can be improved using insurance. Chapter 3 offers empirical evidence that household-level disaster risk reduction measures can have a substantial impact on the damage suffered during a flood if a household is suitably prepared. For example, ~25% of the average monetary flood loss can be prevented by implementing certain wet flood-proofing measures. The thesis provides a clear rationale to examine the ability of insurance to promote the use of such household-level risk reduction measures, and Chapter 4 finds that the German and U.S. natural disaster insurance markets are likely free of moral hazard, showing that voluntary insurance purchase may not have acted as a disincentive to prepare for risk. Moreover, Chapter 4 shows that in the case of the U.S. only the presence of very large deductibles incentivised household risk reduction, indicating that other incentive mechanisms are required.

Chapter 5 shows that premium discounts could strongly incentivise and promote the use of some of the risk reduction measures studied in Chapter 3 in the case of Germany and France. However, even though risk based premiums could promote risk reduction, they often remain potentially unaffordable for low-income households in high-risk areas. Chapter 6
reconfirms this finding when using an EU wide insurance model, which estimates that on average 18% of those at high flood risk would find premiums unaffordable by 2055. This unaffordability can be corrected via means-tested insurance vouchers in order to facilitate an adjustment to risk-based premiums.

Chapter 6 also presents six stylized insurance market structures for the EU and shows that, as society moves forward in time and risk increases, the general structure of insurance markets will have to adapt. While there is not a uniform optimal market structure, the common traits of desirable flood insurance systems are: a sufficiently strong connection of premiums with risk reduction measures; a limited premium cross-subsidization between higher and lower risk households, and the presence of a public-private partnership through a government reinsurer to cover losses from extreme events. Moreover, strengthening requirements to buy insurance may be required in order to maintain high insurance penetration rates. The research presented in this thesis indicates that as flood risk develops into the future, a stronger partnership across stakeholders focusing on risk reduction is required.

There are four main policy recommendations drawn from this research. The first is that floods can have large intangible impacts, which should not be ignored when assessing risk. The second is that while moral hazard may not be present in natural disaster insurance markets adverse selection is potentially present, and the suggested policy mix to overcome this issue is based on risk zoning and compulsory insurance purchases, which increases solidarity. The third is that risk-based pricing and premium discounts are likely to be more effective at promoting risk reduction than relying on the common current practise of deductibles alone. The fourth is that while risk-premiums may be unaffordable for low-income households in high risk areas, this can be eased by introducing income support mechanisms from outside the insurance market, such as temporary vouchers.