

Contents

<i>List of figures</i>	<i>page</i> x
<i>List of tables</i>	xiii
<i>Preface</i>	xvii
<i>Acknowledgements</i>	xix
Introduction	1
1 Climate change and natural disaster risk management	3
1.1 Background	3
1.2 Future natural disaster risks under climate and socio-economic change	6
1.3 Assessing natural catastrophe risk	13
1.4 Managing natural disaster risks	20
1.5 The role of insurance in adaptation to natural disasters	26
1.6 Outline of this book	31
2 Climate change impacts on the insurance sector	36
2.1 Introduction	36
2.2 The relevance of climate change for the (international) insurance sector	39
2.3 Observed climate change and projections for the Netherlands	46
2.4 Risk-sharing arrangements for weather risks in the Netherlands	50
2.5 International case studies of the impacts of climate change on the insurance sector	67
2.6 Possible and actual responses by the international insurance industry to climate change	82
2.7 Conclusions	87

3	Climate change and future costs of natural disasters	90
3.1	Introduction	90
3.2	International studies on the potential impacts of climate change on the risks of convective weather	93
3.3	Hailstorm damage insurance and data used in the analysis	96
3.4	Estimation results	105
3.5	Extrapolations of hailstorm damage using climate change scenarios	117
3.6	Economic implications: Adaptation by agricultural and insurance sectors to the projected increase in hailstorm damage	121
3.7	International studies on the potential impacts of climate and socio-economic change on natural disaster damage	124
3.8	Conclusions	128
	Appendix 3A Descriptive statistics	131
	Appendix 3B Statistical methods	131
	Appendix 3C Estimation results for high-damage months	132
	Appendix 3D Estimation results for various specifications	133
4	Climate change adaptation through insurance against flooding	137
4.1	Introduction	137
4.2	Current risk-sharing arrangements for flood damage in the Netherlands	140
4.3	Suggestions for managing risk with private flood insurance	142
4.4	Problems associated with private flood insurance arrangements and suggestions for possible solutions	146
4.5	International experience of flood insurance arrangements	153
4.6	Conclusions	162
5	Dealing with uncertainty in flood risk management	165
5.1	Introduction	165
5.2	Flood risk management in the Netherlands	167
5.3	The framework of modern portfolio theory	172

5.4	Application of modern portfolio theory to flood risk management	176
5.5	Conclusions	187
6	Damage mitigation measures at the household level and climate change adaptation	189
6.1	Introduction	189
6.2	International studies on the effectiveness of flood mitigation measures	191
6.3	Elevating buildings as a sustainable long-run water management strategy	196
6.4	Willingness of households to invest in elevating houses	198
6.5	Conclusions	206
7	Insurance incentives for homeowners to invest in adaptation	208
7.1	Introduction	208
7.2	International experience of the undertaking of voluntary mitigation measures and the role of insurance in encouraging mitigation	211
7.3	Damage mitigation measures and flood risk management in the Netherlands	219
7.4	Explanation of the survey	220
7.5	Descriptive statistics for willingness to undertake mitigation measures and an analysis of their effectiveness	224
7.6	Statistical model of the decision to mitigate by buying sandbags as a water barrier	236
7.7	Conclusions	242
	Appendix 7A Questions about mitigation and insurance	244
	Appendix 7B The statistical model and overview of the variables and descriptive statistics	246
8	Bounded rationality and demand for flood insurance	250
8.1	Introduction	250
8.2	Insurance purchases for low-probability natural hazard risk, and the theoretical implications	253
8.3	Climate change and the risk of flooding	255

8.4	Estimating demand for flood insurance	255
8.5	Conclusions	266
	Appendix 8A Mathematical derivations	268
9	Individual perceptions of flood risk	269
9.1	Introduction	269
9.2	Flood risk and perceptions in the Netherlands	272
9.3	The psychology of the formation of risk perceptions	274
9.4	Explaining the survey and variables used in modelling risk perception	276
9.5	An examination of perceptions of flood risk in the Netherlands	278
9.6	Results of statistical analyses of factors determining risk perception	286
9.7	Conclusions and policy implications	299
	Appendix 9A Questions used to elicit risk perception	302
10	Willingness-to-pay (WTP) for insurance against low-probability flood risks	305
10.1	Introduction	305
10.2	International studies on household demand for flood insurance	308
10.3	Household survey on the demand for flood insurance in the Netherlands	316
10.4	Results of the survey	322
10.5	Conclusions	334
	Appendix 10A Determination of risk using a risk ladder	336
	Appendix 10B Payment card	337
	Appendix 10C Explanatory variables and descriptive statistics	338
11	Market shares for insurance against flood risk under different climate change scenarios	341
11.1	Introduction	341
11.2	Explanation of the questionnaires	344
11.3	Experimental design and estimation methods	346
11.4	Estimation results of the choice models for flood insurance demand	350

11.5	Market penetration and WTP for flood insurance under various climate change and socio-economic scenarios	359
11.6	Policy implications and conclusions	364
Appendix 11A	Overview of attributes and levels of the choice experiment	368
Appendix 11B	Explanatory variables and descriptive statistics	369
12	Conclusions	372
12.1	Introduction	372
12.2	Managing risks in a changing climate	372
12.3	Climate change impacts on insurers and insurers' responses to climate change	374
12.4	Insurance arrangements for natural disaster risks and a comprehensive climate change adaptation strategy	377
12.5	Individual behaviour under risk and demand for natural disaster insurance in a changing climate	381
12.6	An agenda for future research	386
	<i>References</i>	389
	<i>Index</i>	428