

Flood risk mitigation and insurance at the household-level: Lessons from Germany



Daniel Osberghaus

27 October 2020

NaDiMa-Dialogue on
**Mitigation & Management of Floods:
Lessons from Iran & Germany**

Leibniz
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OUTLINE

- ❖ **Overview: Flooding and Flood risk management in Germany**

- ❖ **Specific aspects from the economic research on flood risk management at the household level:**
 - Effects of flood experience
 - Insurance and mitigation: Substitutes or complements?
 - The role of disaster relief
 - Situation of low-income households
 - Awareness campaigns

- ❖ **Summary / Lessons**

FLOODING AND FLOOD RISK MANAGEMENT

FLOODING IN GERMANY



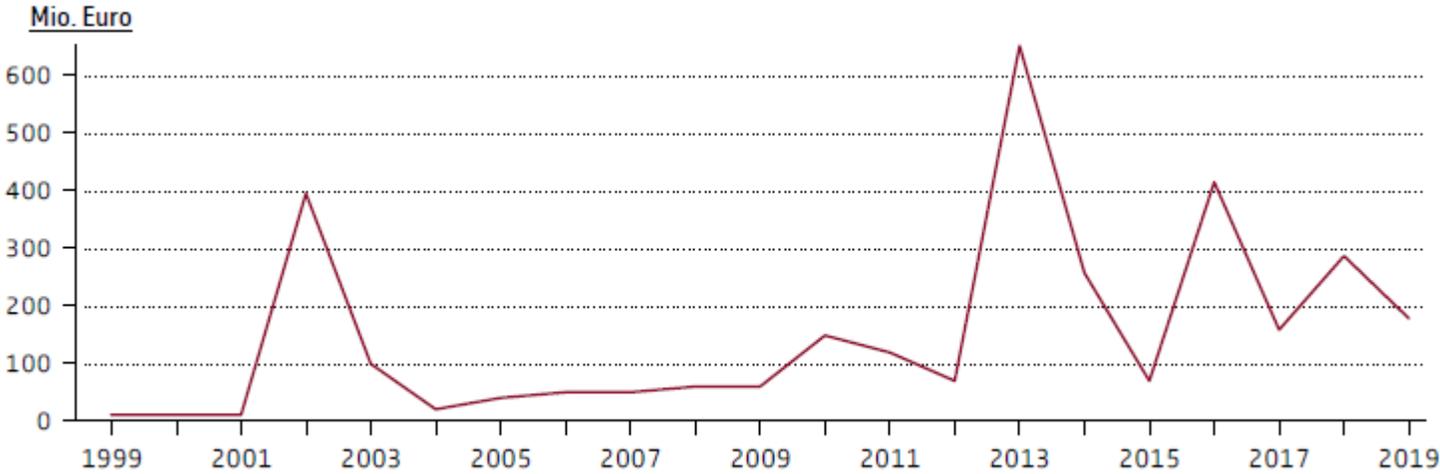
Deggendorf 2013



Many small inundations

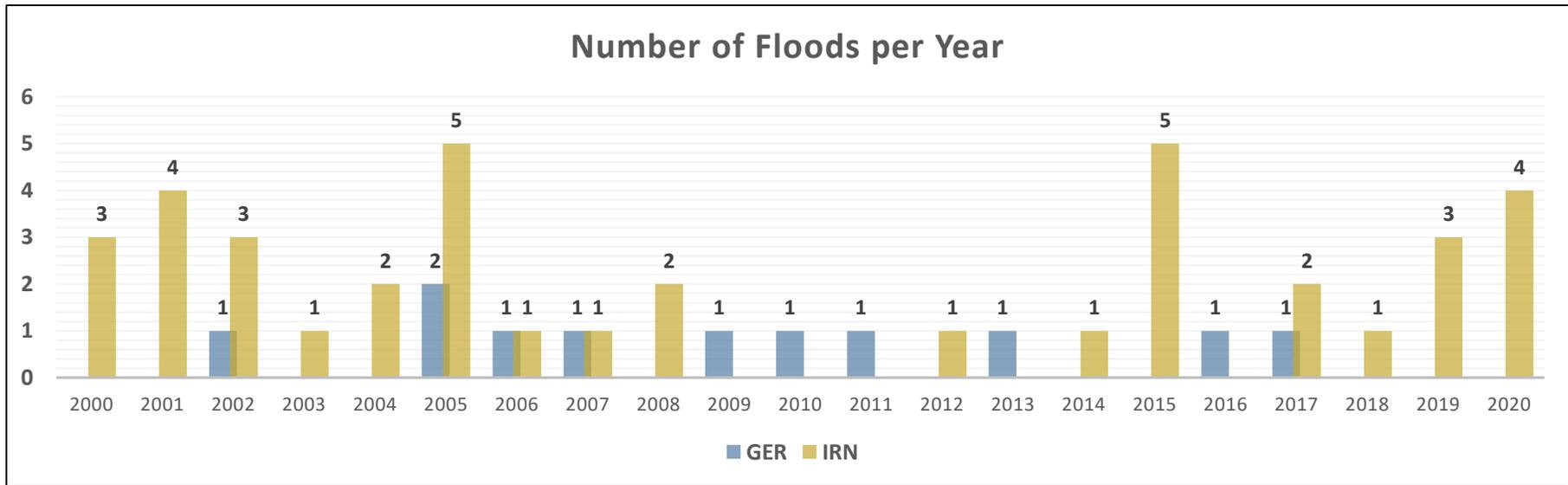
FLOODING IN GERMANY

Flood insurance residential buildings – insured damages



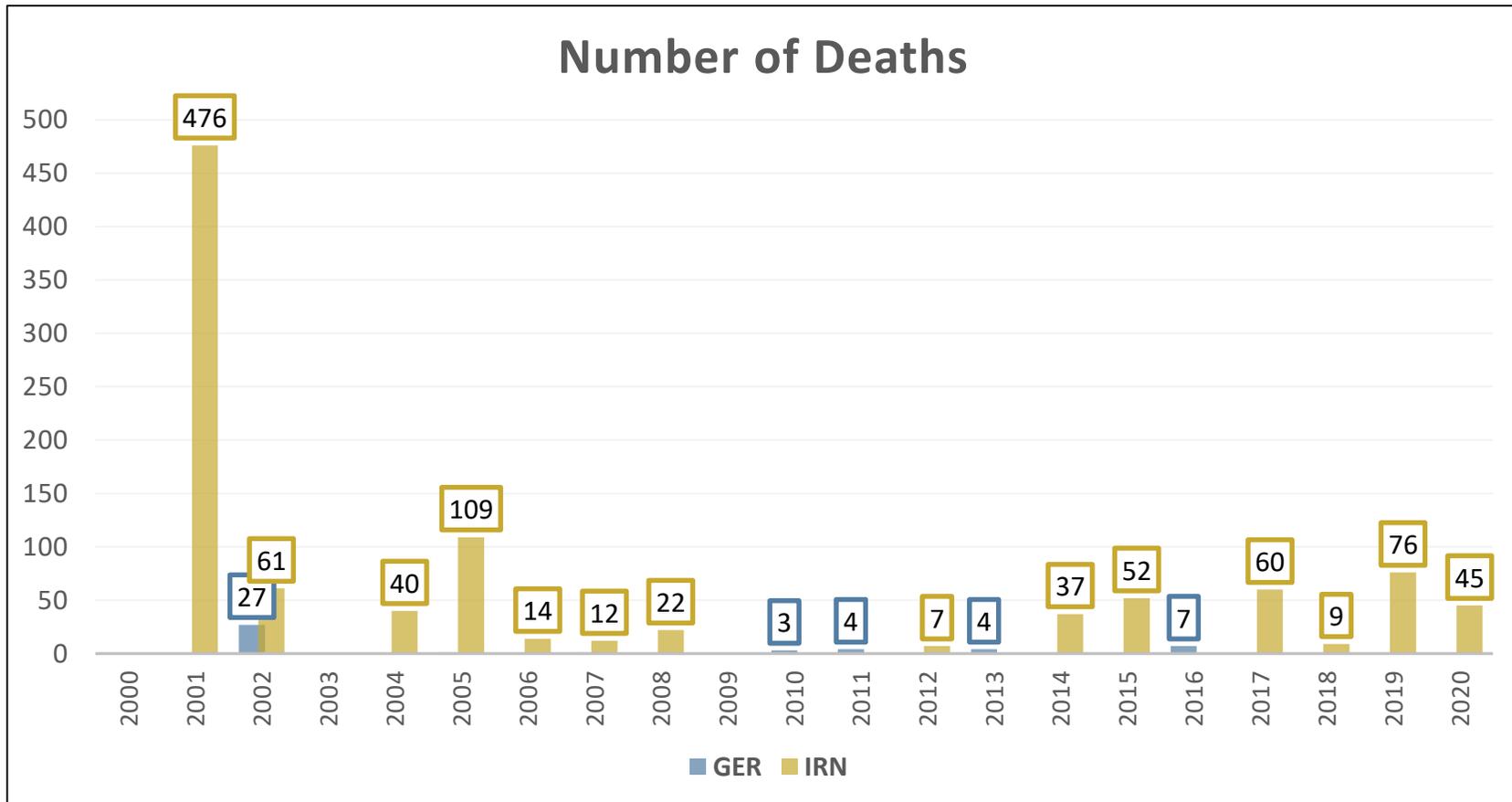
Quelle: GDV

FLOODING IN GERMANY AND IRAN



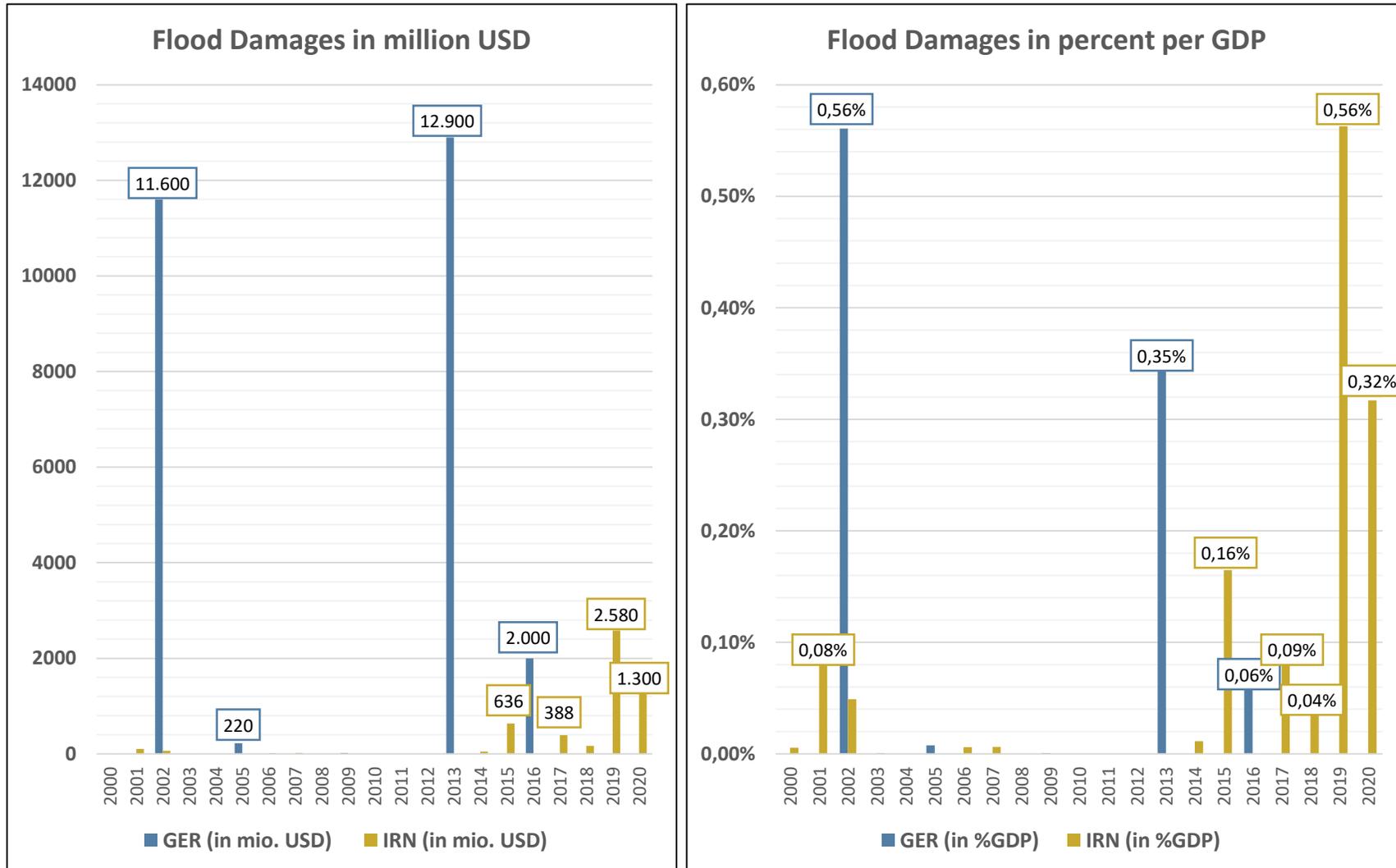
Source: EMDAT

FLOODING IN GERMANY AND IRAN



Source: EMDAT

FLOODING IN GERMANY AND IRAN



Source: EMDAT

FLOOD INSURANCE

FLOOD INSURANCE

- Various flood insurance market structures throughout Europe
- Often: governmental intervention due to low private demand
- Different forms:
 - Public insurance
 - Public reinsurance
 - Public disaster funds
 - Insurance obligations
 - Insurance bundling

M1. Solidarity public structure

M2. Semi-voluntary private market

M3. Voluntary private market

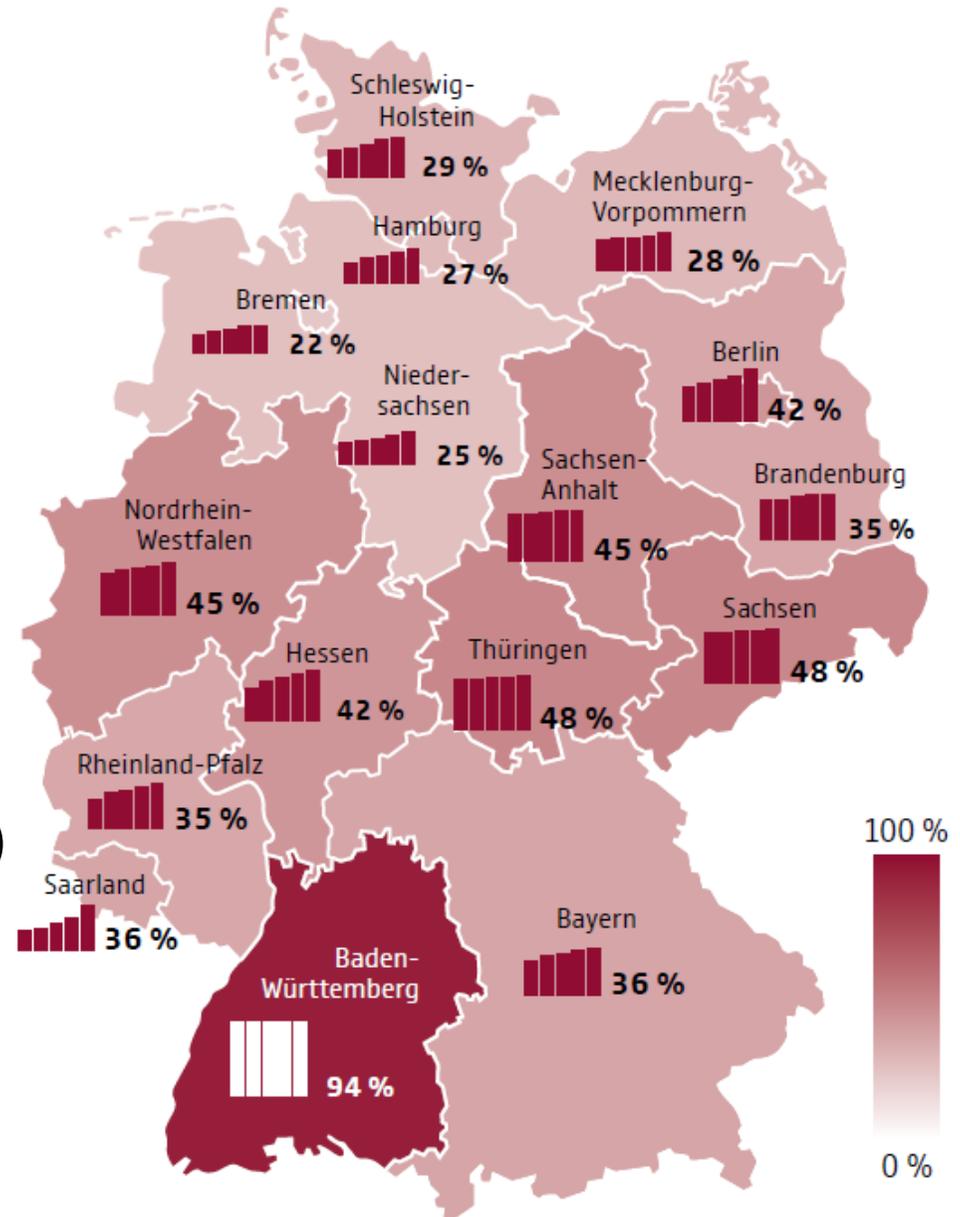
M4. Semi-voluntary PPP market

M6. Public-Private Partnership (PPP) market

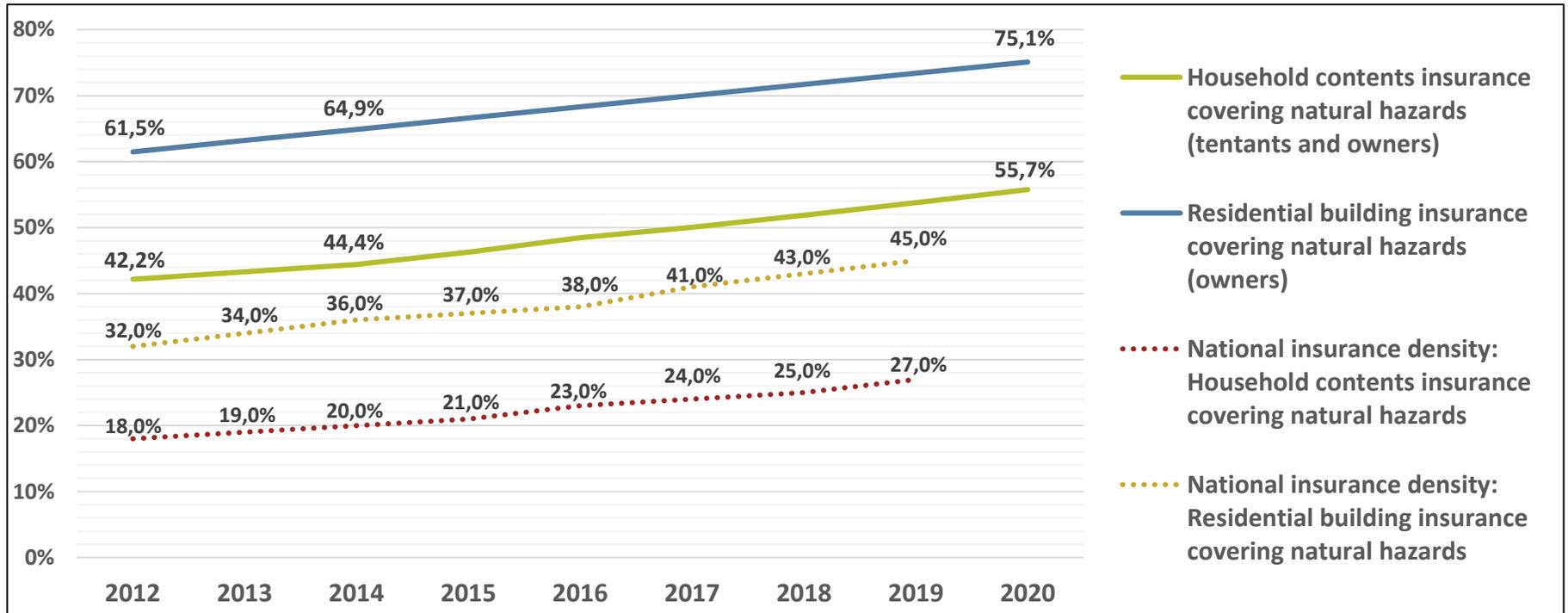


FLOOD INSURANCE

- Insurance coverage voluntary
- Penetration rates differ in the federal states
- German average: 45% (in 2020)
- Premiums risk-based (4 categories)
- Officially no governmental intervention in insurance market, but: *ad-hoc* disaster relief



FLOOD INSURANCE



Eval-MAP II. (n = 2,890 tenants + owners, n = 1,669 owners that have always been owners)

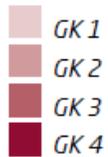
- Rising trend of owners and tenants who believe their insurance to cover natural events:
- National insurance density is much lower, indicating a systematic overestimation of the household's insurance coverage

➤ Insurance illusion

FLOOD INSURANCE

Flooding hazards

Distribution of the contracts on the hazard classes (GK) in ZÜRS Geo 2020



Statistically, a flood occurs:

GK 1: not affected by floods of bigger waters, according to current data

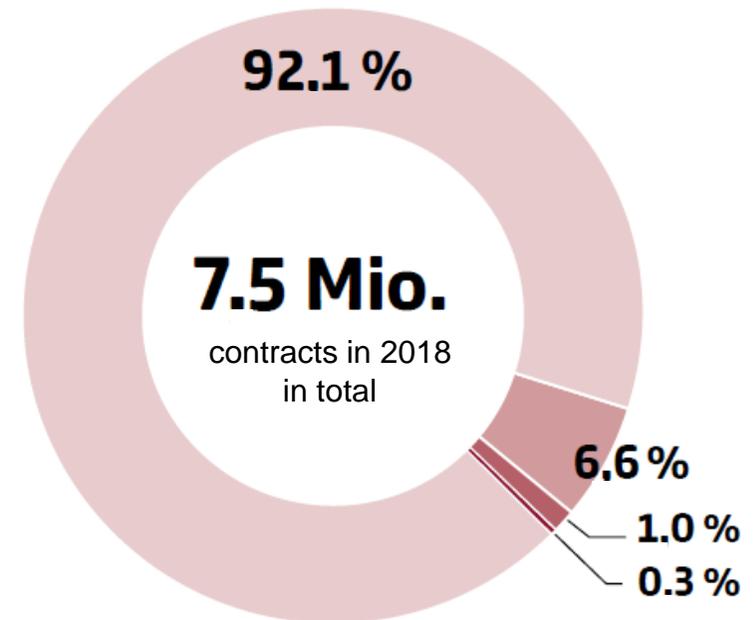
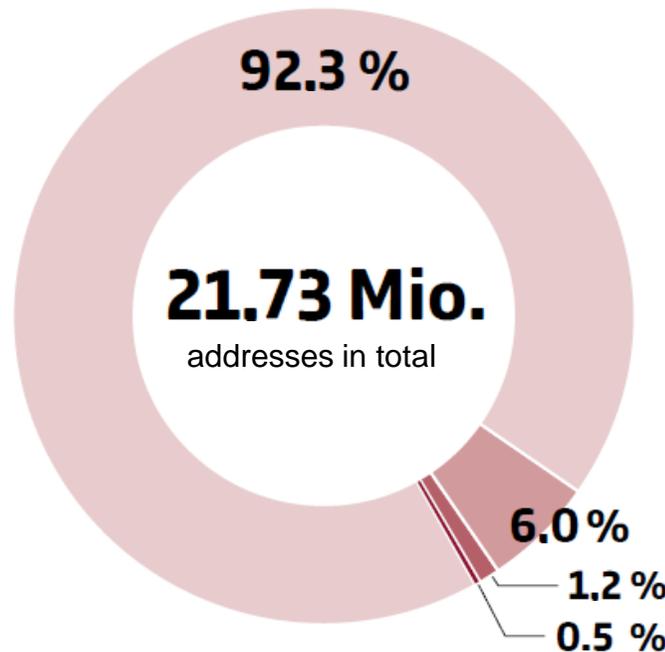
GK 2: floods rarer than 1x in 100 years, especially areas that may be inundated in case of an "extreme flooding"

GK 3: floods 1x in 10 to 100 years

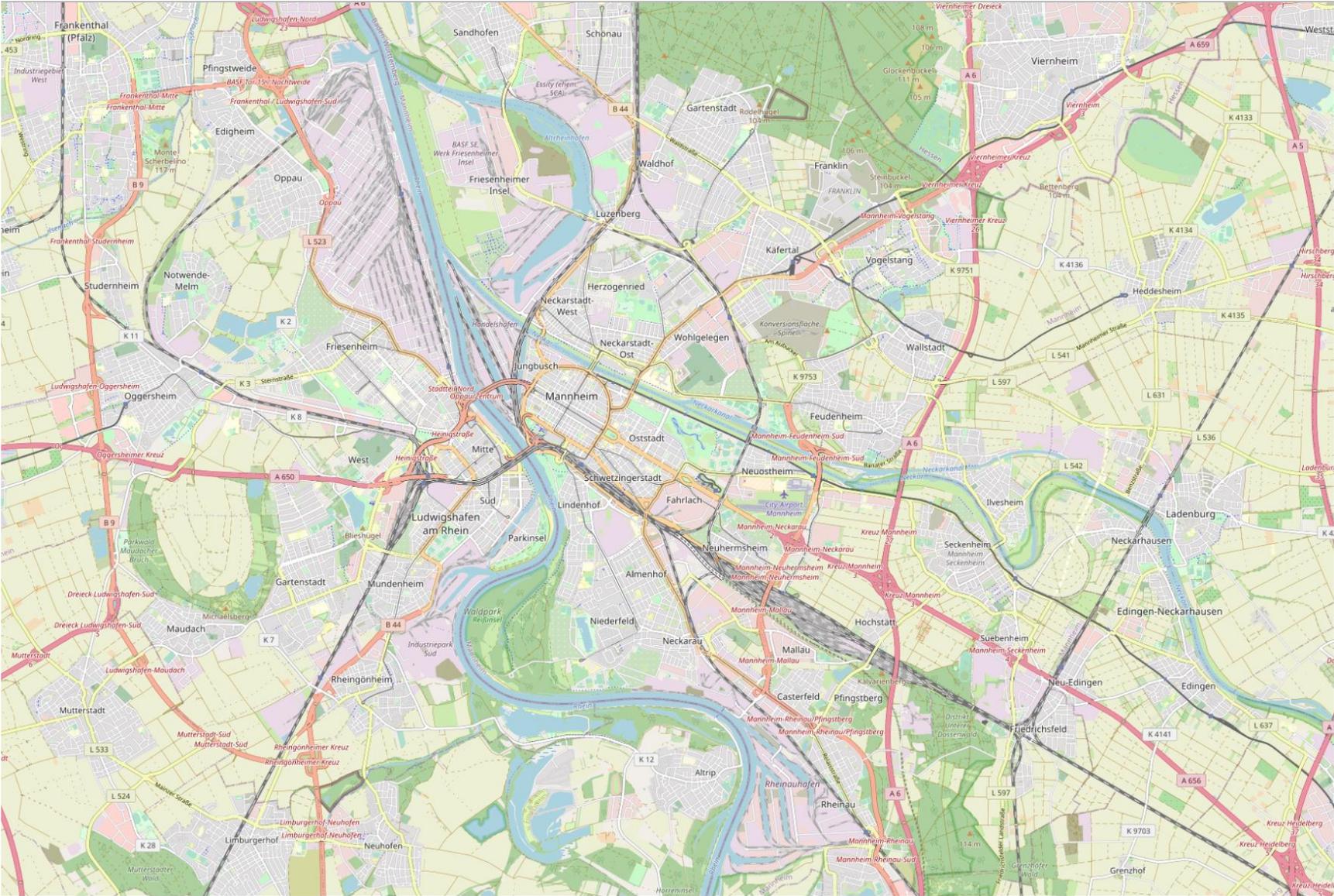
GK4: floods at least 1x in 10 years

Quelle: GDV

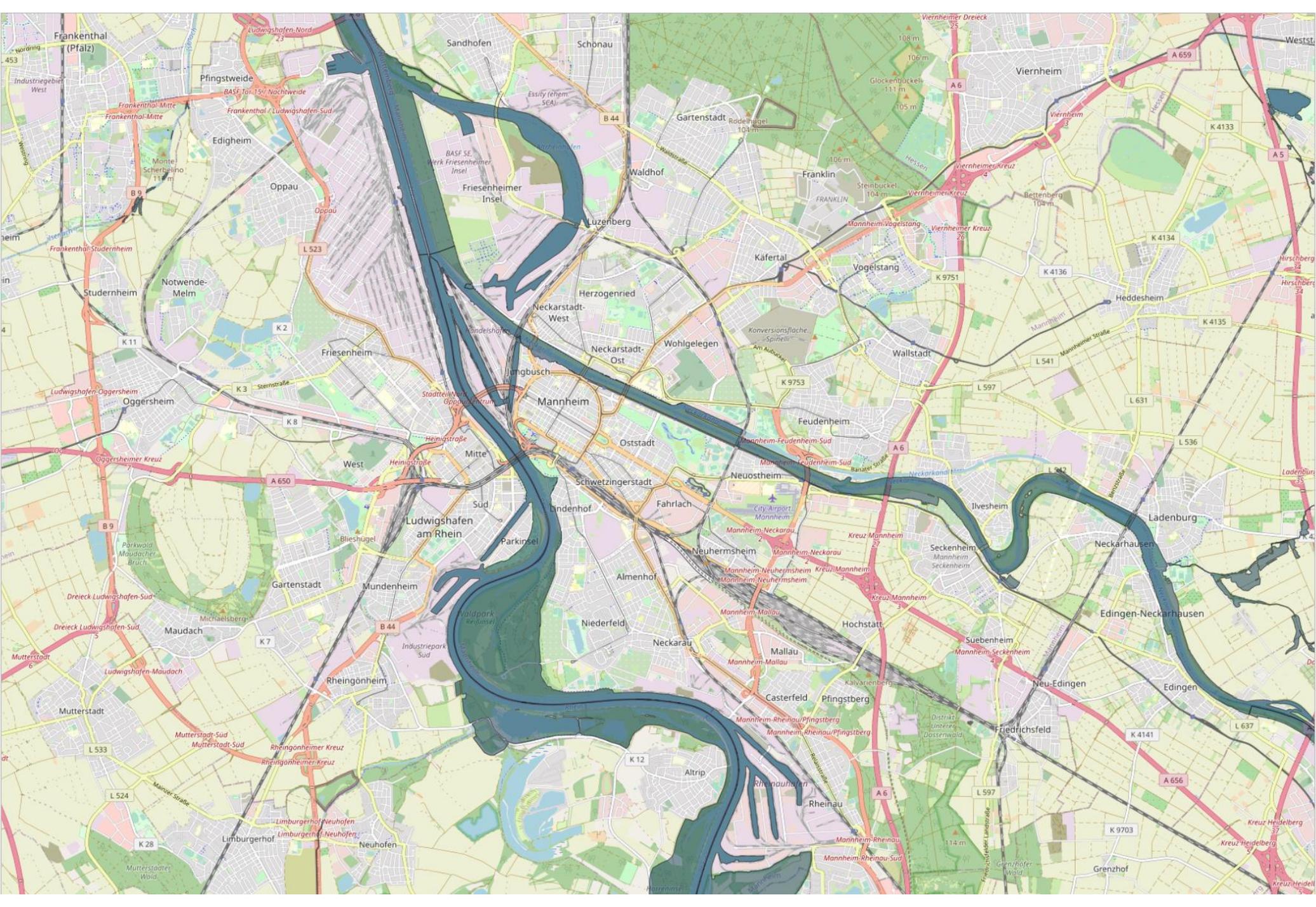
distribution of the contracts on the hazard classes (GKs)

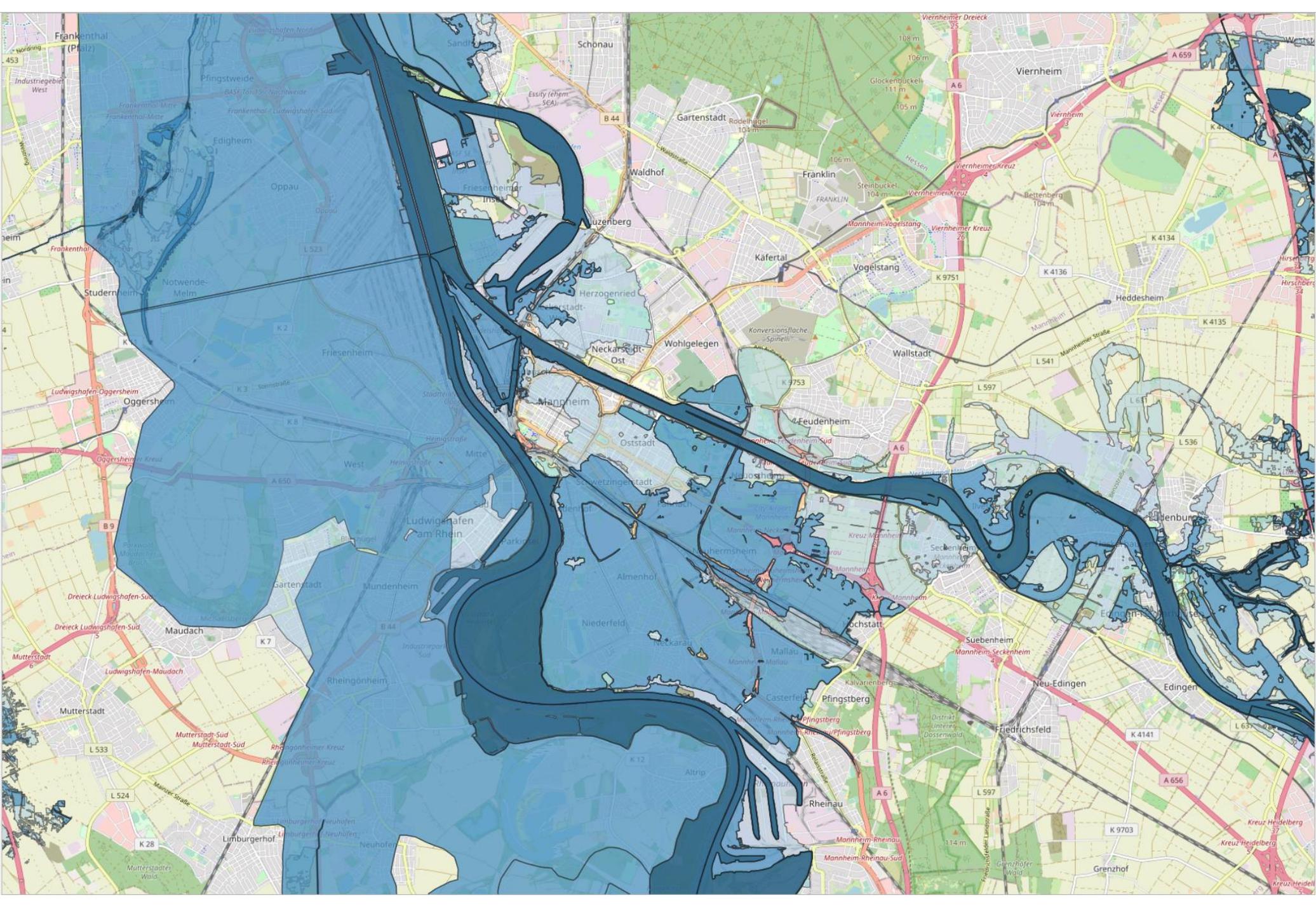


FLOOD RISK MAPS





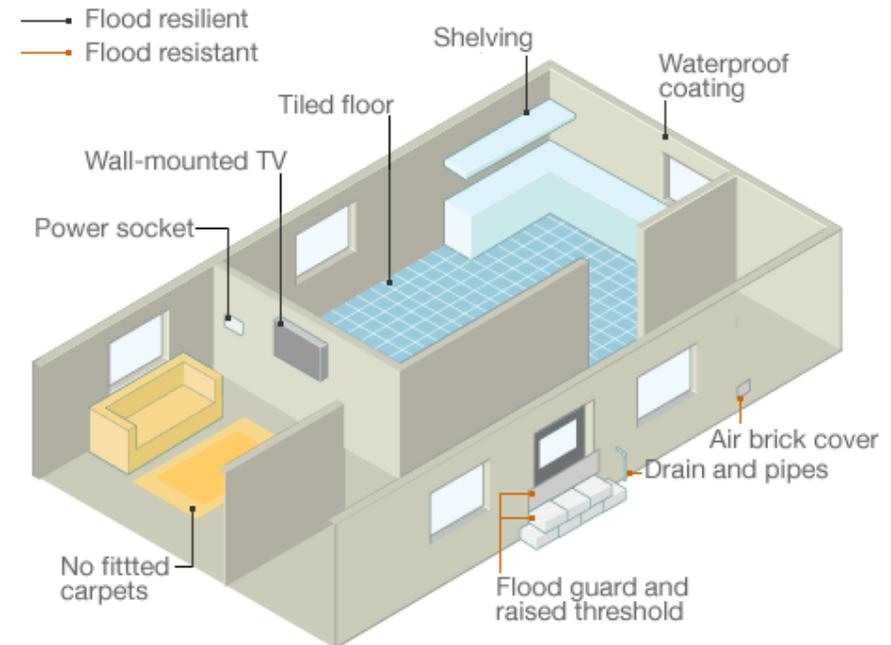




FLOOD MITIGATION AT THE HOUSEHOLD LEVEL

- Insurance against natural hazards
- Mitigation measures:
 - Relocation of valuable furnishings in a higher floor
 - Protective cap for basement windows and doors
 - Backflow flap
 - Water-repellent exterior plaster, interior painting and floors

How to protect your home from flooding



Source: Environment Agency

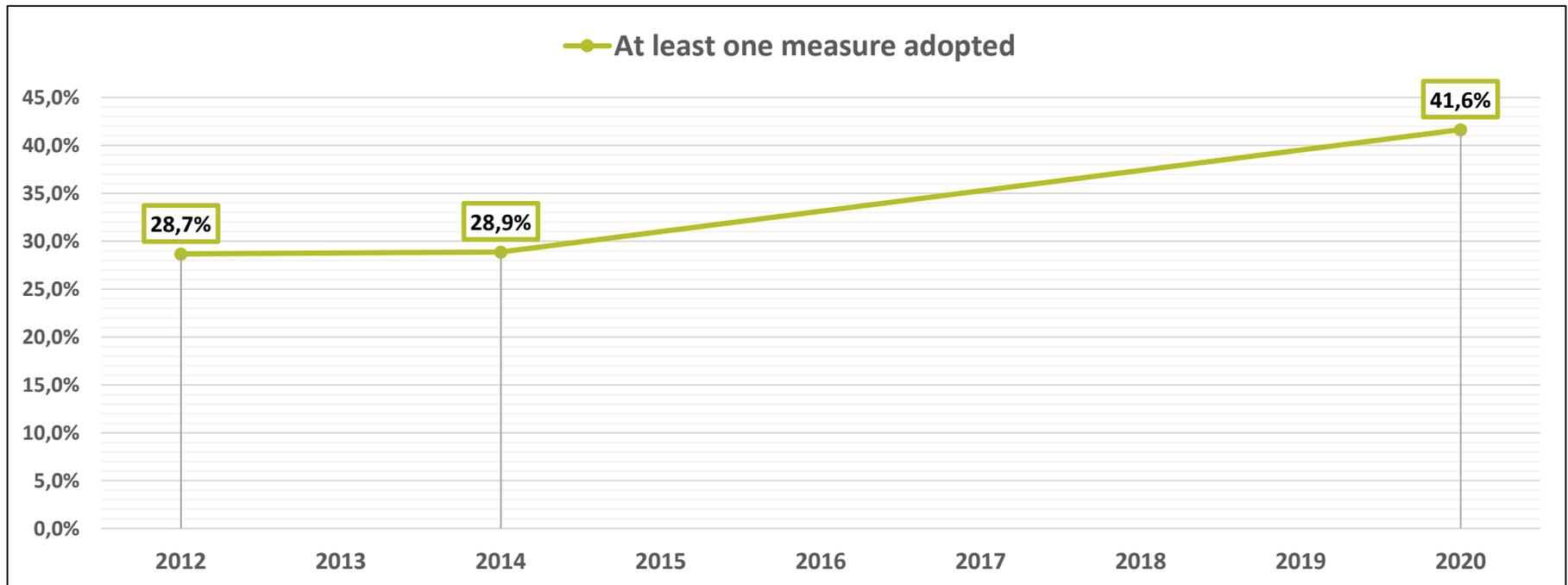
FLOOD MITIGATION AT THE HOUSEHOLD LEVEL

Flood protection measure	Neither implemented nor planned	Planned	Already implemented
Moving valuable furnishings to higher floors	82.3 %	4.0 %	13.7 %
Protection flaps for basement windows and doors	90.1 %	3.2 %	6.7 %
Backflow-flaps	58.6 %	5.0 %	36.4 %
Water-repellent exterior plaster	79.7 %	1.6 %	18.7 %
Water-repellent interior plaster	92.8 %	1.8 %	5.4 %
Water-resistant floors due to risk of flooding	73.1 %	1.6 %	25.4 %
Flood-proof heating system	80.5 %	1.6 %	18.0 %
Pumps	98.5 %	-	1.5 %
Drainages	97.6 %	-	2.4 %
Other measures	94.7 %	-	1.7 %
At least one measure adopted	-	-	48.8%
Average amount of implemented protection measures	-	-	1.3

Source: Eval-MAP household survey 2020

FLOOD MITIGATION AT THE HOUSEHOLD LEVEL

Time trend of households which have implemented at least one flood adaption measure. (n = 2,890)



FLOOD MITIGATION AT THE HOUSEHOLD LEVEL

- Publication in Ecological Economics, 2015

Ecological Economics 110 (2015) 36–50



Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon



Analysis

The determinants of private flood mitigation measures in Germany – Evidence from a nationwide survey

 CrossMark

Daniel Osberghaus

Centre for European Economic Research (ZEW), L7, 1, 68161 Mannheim, Germany

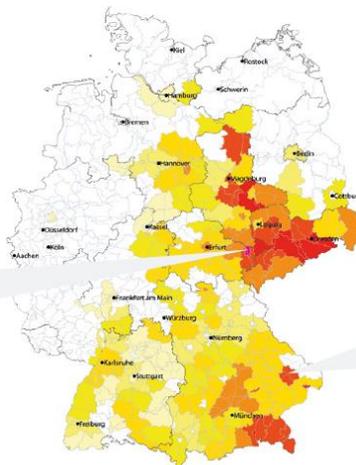
<p>A R T I C L E I N F O</p> <hr/> <p><i>Article history:</i> Received 25 April 2014 Received in revised form 12 November 2014 Accepted 27 December 2014 Available online xxxx</p> <hr/> <p><i>JEL Classifications:</i> Q54 D81 R22</p> <hr/> <p><i>Keywords:</i> Climate change Adaptation Flood mitigation Moral hazard Charity hazard Germany</p>	<p>A B S T R A C T</p> <hr/> <p>Public flood protection cannot eliminate totally the risk of flooding. Hence, private mitigation measures which proactively protect homes from being flooded or reduce flood damage are an essential part of modern flood risk management. This study analyses private flood mitigation measures among German households. The final data set covers more than 4200 households from all parts of the country, including flood plains as well as areas which are typically not at a high risk of riverine flooding. The results suggest that the propensity to mitigate flood damage increases i.a. with past damage experience and damage expectations for the future. The latter effect can be interpreted as a 'climate adaptation signal' in the flood mitigation behaviour. All other factors remaining equal, a strong belief in a climate-change-induced increase of personal flood damage in the next decades correlates with an increase of the probability of flood mitigation by more than 10 percentage points. Moreover, empirical evidence for moral hazard in the flood mitigation behaviour cannot be observed. Households expecting insurance coverage do not reduce their mitigation efforts. Likewise, the expectation of government relief payments hinders mitigation only for some groups of households.</p> <p style="text-align: right;">© 2015 Elsevier B.V. All rights reserved.</p>
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FLOOD EXPERIENCE EFFECTS

Juni-Hochwasser 25.05. – 15.06.2013

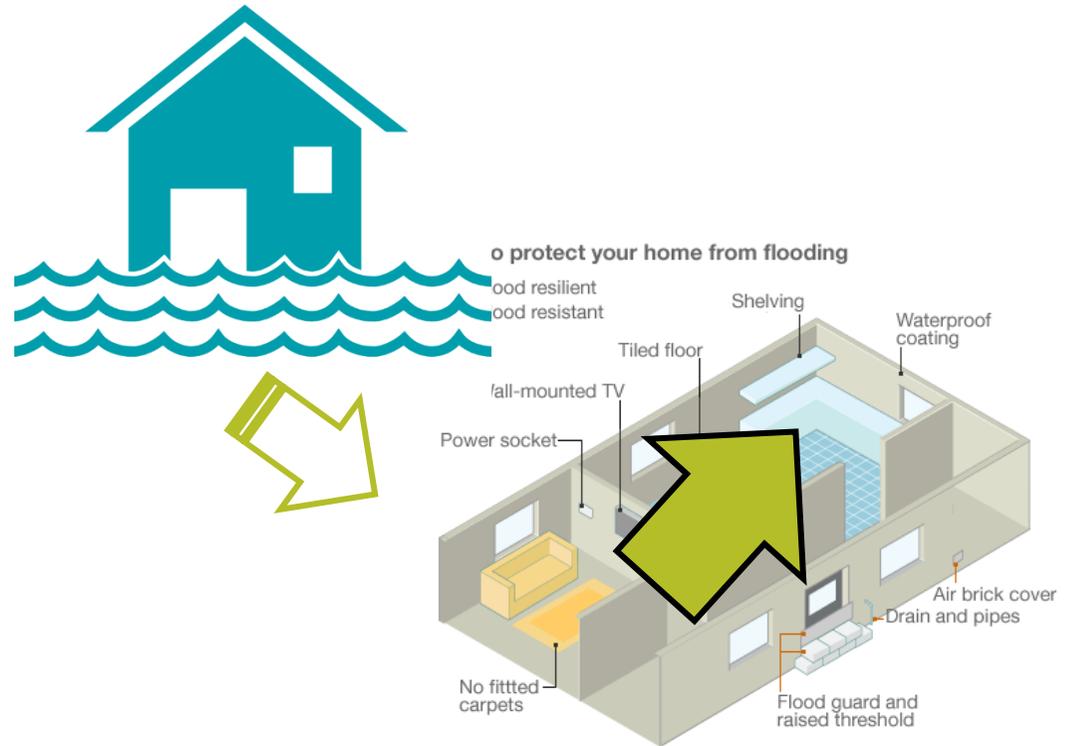
Sachversicherung: weitere Naturgefahren (Elementar)
Schadenaufwand: 1,65 Mrd. Euro; Schäden: 120.000

Stadtkreis
Gera
am stärksten
betroffen:
Schadenhäufig-
keit: **13,8%**
Schadendurch-
schnitt:
24.411 Euro



im Landkreis
Degendorf:
Schaden-
durchschnitt:
182.462 Euro

Quelle: GDV



Source: Environment Agency

- After the flood of 2013, in the flood affected areas, the increase of flood mitigation implementation was significantly higher than in unaffected areas
- Causal effect of flood experience on individual flood mitigation

FLOOD EXPERIENCE EFFECTS

- Publication in Global Environmental Change, 2017

Global Environmental Change 43 (2017) 126–136



Contents lists available at [ScienceDirect](#)

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha



The effect of flood experience on household mitigation—Evidence from longitudinal and insurance data  CrossMark

Daniel Osberghaus
Centre for European Economic Research, L7, 1, 68161 Mannheim, Germany

ARTICLE INFO	ABSTRACT
<p><i>Article history:</i> Received 19 September 2016 Accepted 6 February 2017 Available online xxx</p> <p><i>JEL Codes:</i> Q54 D80 C23</p> <p><i>Keywords:</i> Difference-in-differences Floods Flood experience Flood mitigation Longitudinal data Insurance</p>	<p>Proactive flood damage mitigation on the household level is seen as a crucial element of comprehensive flood risk management. The ongoing socio-economic development and climate change will further increase the relevance of flood risks in the future. This paper analyses the causal effect of flood experience on mitigation decisions of households. It contributes to the emerging literature on the determinants of private flood mitigation and adopts data which has rarely been used in the field: Instead of cross-sectional data, longitudinal data of household surveys before and after a major flood event in Germany is used (N > 7,400). Flood experience is elicited by three different data sources: reports of heads of households, issuance of flood alerts, and damage reports of the insurance industry. The results show a causal effect of insured flood damage on private flood mitigation and a correlation of mitigation with self-reported flood experience. The estimated effects differ for mitigation types (higher for behavioural options, such as “adapted use”) and household types (higher for better educated heads of households).</p> <p style="text-align: right; font-size: small;">© 2017 Elsevier Ltd. All rights reserved.</p>

FLOOD INSURANCE AND MITIGATION

FLOOD INSURANCE AND MITIGATION

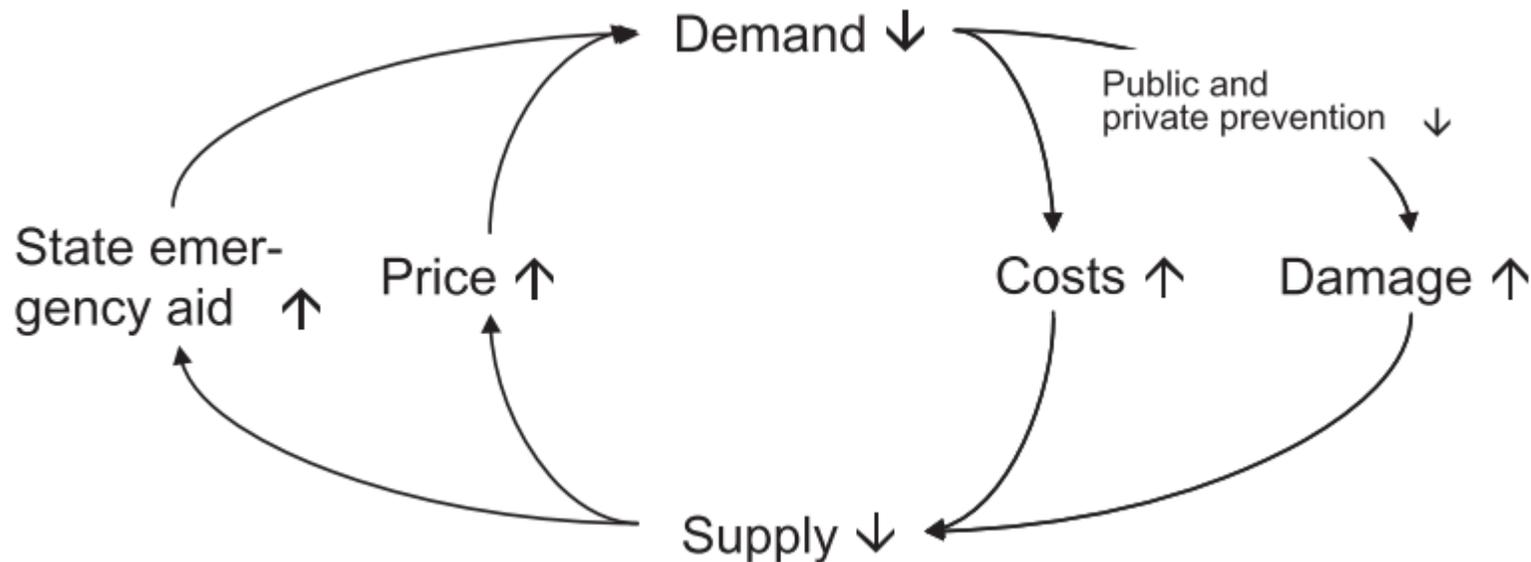
- Are flood insurance and flood mitigation measures substitutes or complements?
 - **Substitutes:**
 - Both are costly strategies to cope with flooding
 - Mitigation reduces the expected pay-off of an insurance contract
 - **Complements:**
 - Deductibles: Mitigation pays off even for insured households
 - Different effects: Insurance only financial, mitigation can also reduce non-monetary damage
 - Premium reductions (?)
 - Obligations to install certain mitigation measures (backflow flaps)

- Empirical question.
- So far, there is more evidence for both strategies being **complements**.

DISASTER RELIEF

DISASTER RELIEF

- In both large flood events 2002 and 2013, the government provided disaster relief to uninsured households (billions of USD)
- Political economy of natural disaster insurance:



DISASTER RELIEF

■ Publication in Ecological Economics, 2020

Ecological Economics 169 (2020) 106534



Contents lists available at [ScienceDirect](#)

Ecological Economics

journal homepage: www.elsevier.com/locate/ecocon



Analysis

Natural Disasters and Governmental Aid: Is there a Charity Hazard?

Mark A. Andor^{a,*}, Daniel Osberghaus^b, Michael Simora^c

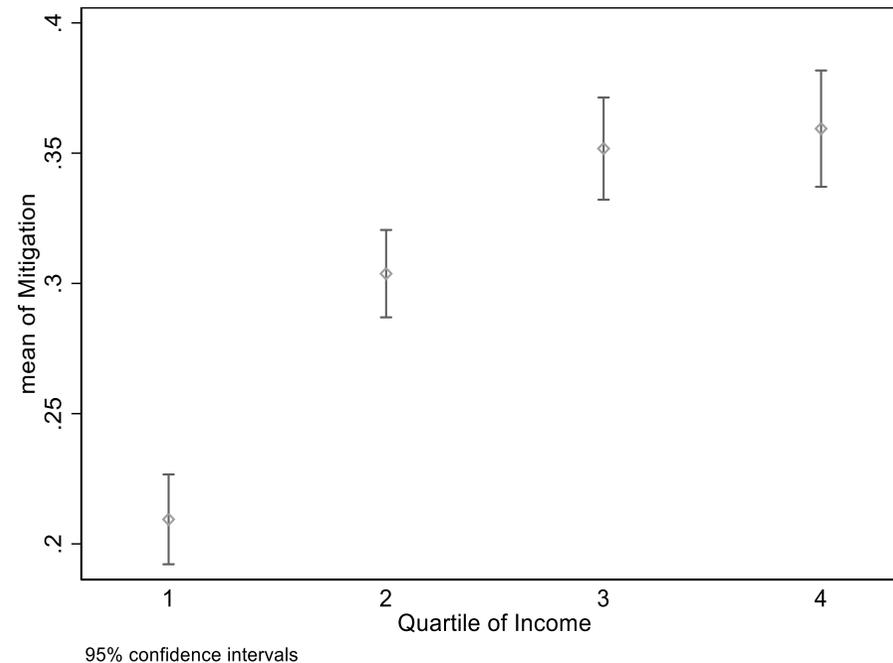


^a RWI - Leibniz Institute for Economic Research, Germany
^b ZEW - Leibniz Centre for European Economic Research, Germany
^c Ruhr Graduate School in Economics and RWI - Leibniz Institute for Economic Research, Germany

ARTICLE INFO	ABSTRACT
<p>Keywords: Adaptation Flood protection Flood insurance Objective flood exposure Charity hazard</p> <p>JEL Classification: Q54 C35 R22</p>	<p>In the aftermath of natural disasters, governments frequently provide financial aid for affected households. This policy can have adverse effects if individuals anticipate it and forgo private precaution measures. While theoretical literature unequivocally suggests this so called “charity hazard”, empirical studies yield ambiguous results. Drawing on rich survey data from German homeowners, we analyze charity hazard for different private flood precaution strategies and flood exposed vs. non-exposed areas. Our results indicate a substantial charity hazard in the insurance market for individuals residing in flood-prone areas. In contrast, we find a positive correlation between governmental aid and non-financial protection measures. Moreover, our results suggest that insurance and non-financial protection measures are rather complements than substitutes. Finally, we provide suggestive evidence that status-quo bias might play an important role for insurance uptake.</p>

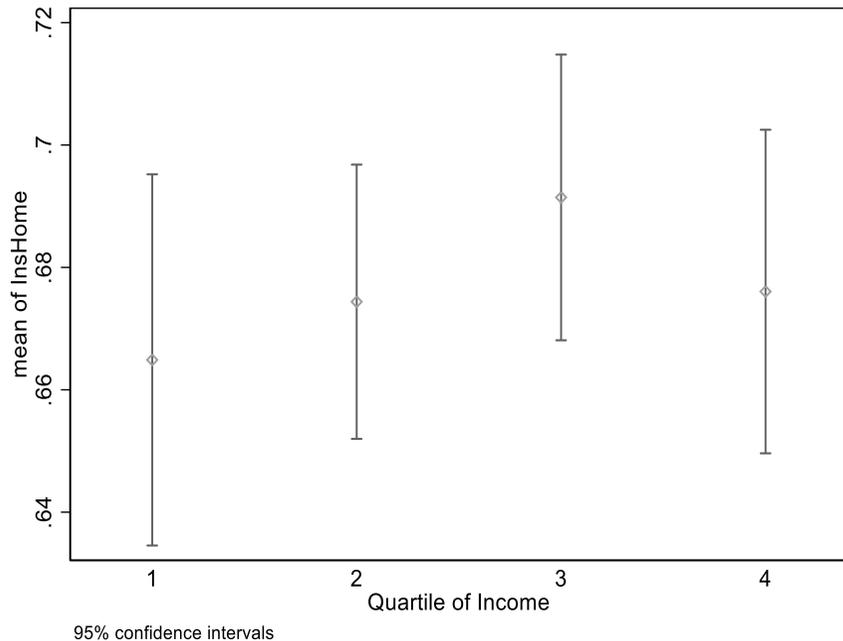
LOW INCOME HOUSEHOLDS

LOW INCOME HOUSEHOLDS: MITIGATION

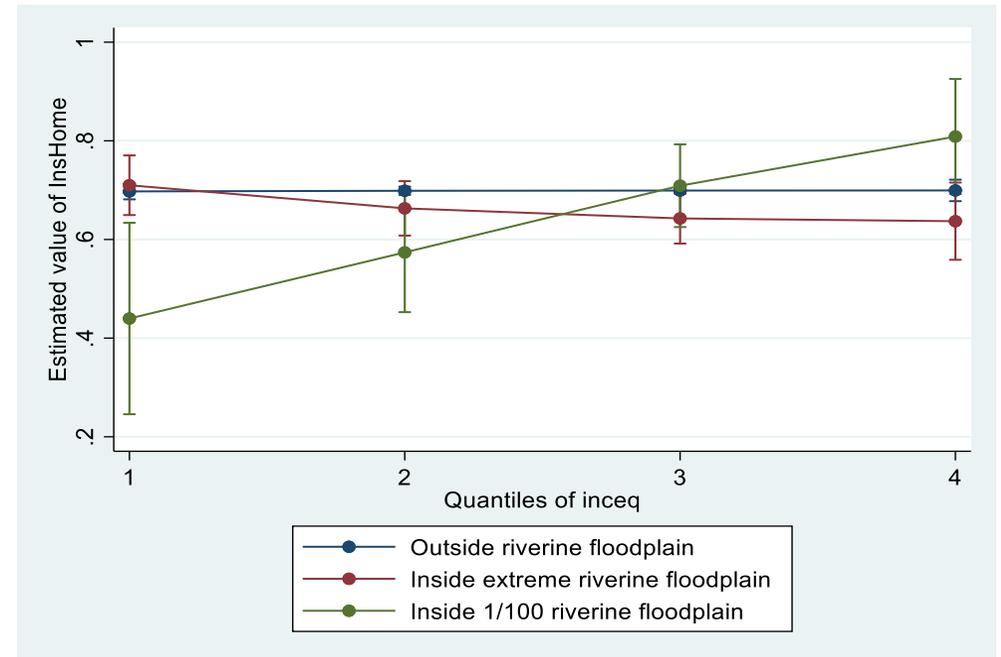


Predicted probability of mitigation is significantly lower for low-income households (effect net of control variables, output of a multivariate regression model)

LOW INCOME HOUSEHOLDS: INSURANCE



Predicted probability of flood insurance does not vary significantly with income (effect net of control variables, output of a multivariate regression model) ...



... but in high risk areas, income affects insurance demand

EFFECTIVENESS OF AWARENESS CAMPAIGNS

EFFECTIVENESS OF AWARENESS CAMPAIGNS

- GDV together with ministries and consumer advice centers
- Leaflets, press conferences, websites, consumer helplines, newspaper ads, cooperation with communities, ...



- Were these campaigns effective in terms of insurance and mitigation behavior?

EFFECTIVENESS OF AWARENESS CAMPAIGNS



EFFECTIVENESS OF AWARENESS CAMPAIGNS

Table II. Analysis 1: Results of the General DD Estimation with Fixed Effects, Estimated Coefficients with Standard Errors

	<i>inshome</i>	<i>inscont</i>	<i>mitigation</i>
<i>campaign*post</i>	0.003 (0.037)	-0.006 (0.033)	-0.007 (0.026)
<i>post</i>	0.004 (0.012)	0.018* (0.010)	0.021** (0.009)
<i>income</i>	0.041 (0.041)	-0.002 (0.033)	0.014 (0.030)
<i>education</i>	-0.030 (0.048)	0.038 (0.043)	0.104** (0.041)
<i>hhsiz</i>	0.024 (0.019)	-0.008 (0.019)	0.008 (0.017)
<i>homeowner</i>		0.033 (0.055)	0.321*** (0.057)
constant	0.298 (0.329)	0.510** (0.255)	-0.079 (0.236)
household-fixed effects	included	included	included
adjusted R^2	0.541	0.537	0.529
N (observations)	5,261	8,492	8,948
N (households)	3,590	5,955	6,182

Table V. Analysis 2: Results of the General DD Estimation with Fixed Effects, Estimated Coefficients with Standard Errors

	Penetration	Ratio	Frequency	Average
<i>campaign*post</i>	0.011 (0.007)	-0.066 (0.053)	-0.195 (0.122)	-62.2 (362.4)
<i>income</i>	-3.6e ⁻⁵ * (1.8e ⁻⁵)	4.8e ⁻⁵ (5.4e ⁻⁵)	-0.2e ⁻⁵ (1.1e ⁻⁵)	0.335 (0.327)
constant	0.985** (0.359)	-0.121 (0.586)	2.435 (1.436)	1347.4 (4923.7)
federal state-fixed effects	included	included	included	included
time fixed effects	see below	included	included	included
year: 2013	0.025*** (0.004)			
year: 2014	0.044*** (0.011)			
year: 2015	0.071*** (0.018)			
year: 2016	0.109*** (0.025)			
year: 2017	0.151*** (0.038)			
adjusted R^2	0.993	0.103	0.297	0.234
N	96	256	256	256

- No significant effect of campaigns.

EFFECTIVENESS OF AWARENESS CAMPAIGNS

- Open Access publication in Risk Analysis, October 2020

Check for updates

Risk Analysis, Vol. 0, No. 0, 2020 DOI: 10.1111/risa.13601

The Effectiveness of a Large-Scale Flood Risk Awareness Campaign: Evidence from Two Panel Data Sets

Daniel Osberghaus * and Hendrik Hinrichs 

In the context of integrated flood risk management, governments and public agencies aim to strengthen flood risk reduction and insurance at the household level. They often employ awareness campaigns in order to educate the public about flood risk and possible coping strategies. However, the effectiveness of these awareness campaigns has hardly been an

SUMMARY / LESSONS

- Free insurance market comes with challenges (underinsurance, insurance illusion...)
- Large events provide a window-of-opportunity for risk management
- Insurance and private flood mitigation are probably not substitutes, but complements
- Disaster relief can impede private insurance and mitigation
- Low-income households are constrained in their risk management
- Effectiveness of large-scale awareness campaigns is questionable