How to manage risk?

- Flood risk is non-uniformly changing more methods for managing are needed.
- All stakeholders should play an active role in managing risk
- What role can households play in managing future risk?
  - Can household damage mitigation work?
    - How effective are they in mitigating damage?
How effective are household measures?

- There is a traditional method of evaluation
  - Represented by studies such as Kreibich et al. (2005)

- Mean Comparisons
  - Simple and intuitive
  - Estimates the ATT; the effect of the measure on the population that use it

- However, it can be problematic
Non-random usage means we can:
• Overestimate if SB>0
• Underestimate if SB<0

A later studies tries to address this issue
• Same method, but…
  • …look at households with the same traits

Solves SB, but reduces sample size

Objectives

There are two problems to solve:

• SB because usage is non-random
  > We need a technique to mimic random assignment

• Dimensionality
  > Having to find identical people in a sample can be hard or impossible
  > We need a way of compressing all the information
A New(ish) Method

- We use Propensity Score Matching to make selection into using a measure “as good as random”
- Propensity scores compress all the relevant information into a single value

Matching Method

- All in all, we use 5 matching methods
- Why?
  - They should provide roughly the same estimate of effectiveness
  - If they are not consistent something is wrong
    - Propensity score is not correctly constructed
    - Rule of thumb
What propensity variables to include?

- The variables that affect both using a measure and outcomes

\[ \text{Incentive} = F(\text{probability})F(\text{exposure, vulnerability, Hazard})^* \]
\[ F(\text{social pressures, risk perceptions}) \]

\[ \text{Outcome} = F(\text{exposure, vulnerability, Hazard}) \]

The Sample

Data (taken from Kreibich et al., 2011)

| Date       | Two Telephone Survey waves  
|            | 2003 for 2002 floods  
|            | 2006 for 2005/6 Floods  |
| Locations  | The German Elbe and  
|            | Danube River Catchment  
|            | Areas                  |
| Observations | 2000 Observations in total  
|            | (1600 from the 1st wave, 400 in the 2nd) |
| Questions asked | Socio-economic status at the time of flood (i.e. income)  
|            | Flood traits (i.e. water height)  
|            | Vulnerability traits (i.e. type of house) |
DMM description

<table>
<thead>
<tr>
<th>DMM</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood-adapted use</td>
<td>Use in a low-value way the flood endangered floors, to keep possible flood damage low, e.g. storing only low-value items in flood-prone areas.</td>
</tr>
<tr>
<td>Flood-adapted interior fitting</td>
<td>Avoid valuable fixed units as interior fitting in the flood-endangered floors but use water-resistant or easily replaceable materials for interior fitting.</td>
</tr>
<tr>
<td>Adapted building structure</td>
<td>Adapting the building structure, e.g. an especially stable building foundation or waterproof sealed cellar walls.</td>
</tr>
<tr>
<td>Water barriers</td>
<td>Mobile Barriers to prevent water entering the building, e.g. sandbags or local small flood protection walls.</td>
</tr>
</tbody>
</table>

Propensity Variables

- Exposure: Replacement value of household contents, household value
- Hazard: Flood water height, flood duration,…
- Vulnerability: Type of house, house age, quality of construction…
- There are about 40 variables

- Matching methods – Nearest Neighbour, Radius, Stratification, Gaussian Kernel and Epan. Kernel
## Results (Damage Prevented)

<table>
<thead>
<tr>
<th></th>
<th>Adapted Use (Contents Damage)</th>
<th>Adapted Use (Building Damage)</th>
<th>Adapted Interior Fittings (Contents Damage)</th>
<th>Adapted Interior Fittings (Building Damage)</th>
<th>Water Barriers (Contents Damage)</th>
<th>Water Barriers (Building Damage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our Estimate</td>
<td>€6 732</td>
<td>€14 385</td>
<td>€5 202</td>
<td>€11 302</td>
<td>Not effective</td>
<td>€8 551</td>
</tr>
<tr>
<td>Previous Estimate</td>
<td>€8 415</td>
<td>€21 968</td>
<td>€9 063</td>
<td>€25 817</td>
<td>Not effective</td>
<td>€15 486</td>
</tr>
<tr>
<td>Selection Bias</td>
<td>€1 683</td>
<td>€7 583</td>
<td>€3 861</td>
<td>€14 515</td>
<td>-</td>
<td>€6 935</td>
</tr>
<tr>
<td>Matches Made</td>
<td>85</td>
<td>93</td>
<td>80</td>
<td>88</td>
<td>68</td>
<td>88</td>
</tr>
</tbody>
</table>

## Conclusion (1)

- Household measures are still effective….

- … the measures investigated follow the same pattern as Kreibich et al. (2005) in the magnitude of effectiveness…

- ….just less so than previously thought
Conclusion (2)

- We have shown the applicability of a “new” evaluation methodology to natural hazard risk subjects

- We also have 4 main recommendations on how to apply propensity score matching:
  - 1) Use multiple matching methods
  - 2) Have direct indicators for exposure, hazard, vulnerability
  - 3) Include variables other than direct confounders (connected to outcomes)
  - 4) Try to have a wide geographical reach

Thank you for your attention
References


- Holub, M., Fuchs, S., 2008, Benefits of local structural protection to mitigate torrent-related hazards, Risk analysis VI, WIT, transactions on information and communication technologies, edited by Brebbia, C., Beriatos, E., 39, WIT, Southampton, 401-411