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The economy wide consequences of natural hazards: an application of a European interregional input-output model

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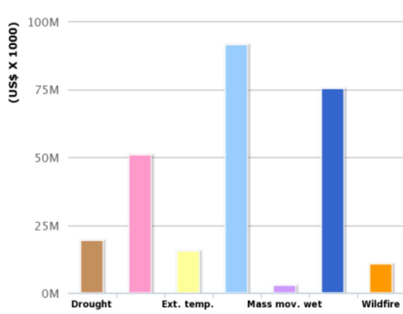
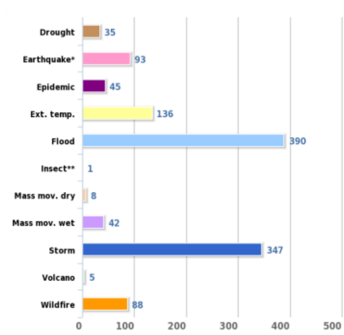
Numerous disasters have occurred within Europe

- Between 1980 – 2008:

Total damages for each natural disaster



Occurrences:



Source: www.preventionweb.org, EM-DAT

Why is it scientifically relevant?

- Disaster modelling literature states that the consequences for the affected region will most likely be negative in the short-term, but it can be positive for a larger (surrounding) area. Empirical research shows mixed results
- Risk analysis is often only done for the affected region itself. Only recently more interregional models are being developed.
- Multiregional studies for flooding specifically, have so far only been done for the direct losses

Research question

What are the total economic consequences of a natural hazard in the European Union?

- What are the consequences for the affected region(s)?
- To what extent can the rest of Europe take of production?
- Will the rest of Europe ´win´ or ´lose´?

What happens due to a disaster?

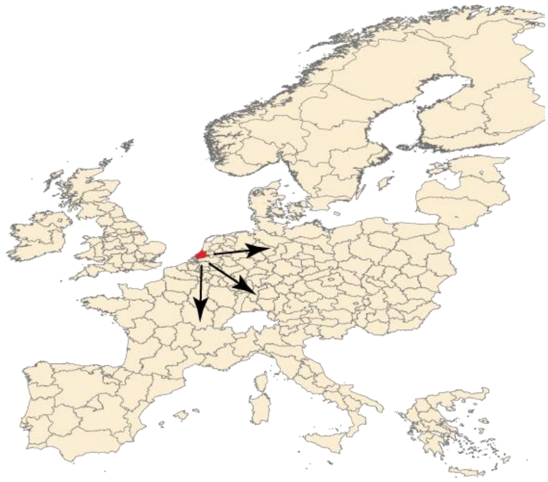
- Less production in the affected regions due to damaged buildings and infrastructure and evacuation of employees;
- Less supply and demand to other (non-affected)regions due to reduced production in the industries in the affected regions;
- Additional import demand from the affected regions to other regions to satisfy the demand for products that cannot be satisfied by the affected regions;
- Additional demand from the affected regions for reconstruction needs.

Methodology: the idea (i)

- InterRegional Impact Assessment (IRIA) Model

  Characteristics
  - Coupling to biophysical model
  - Supply and use framework
  - Interregional
  - Dynamic recovery modeling path
  - Combining linear programming with Input-Output (I-O) modeling

Methodology: the idea (ii)

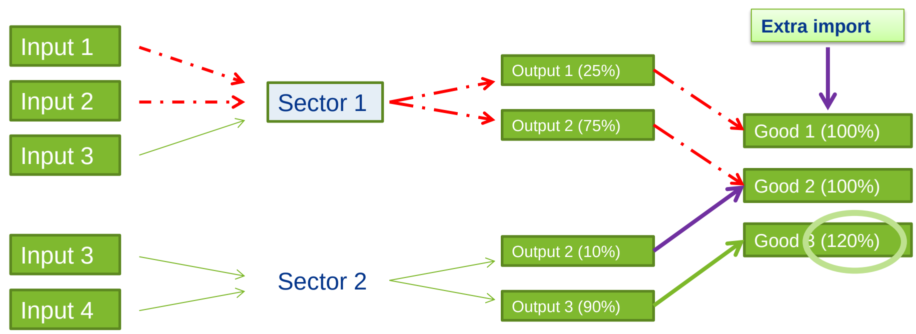


Methodology: model specifications (i)

- Products are produced at the lowest costs…
- …and together with the demand for products in every region this determines which technologies are being used and to what extent….
- …It implies that inefficient technologies are being used to produce products when production is limited due to supply constraints…
- ..In our model, these inefficiencies are unnecessary byproducts supplied to the market that are not demanded → and considered to be waste.

Methodology: model specifications (ii)

- 20% too much of good 3, due to inefficiencies in the technologies available to produce



- The demand remains equal, so this increase in production is a cost, not a benefit.

Methodology: model specifications (iii)

- Industries in each region minimize their costs given the demand for products, the available technologies to make products and their maximum capacity

$$Min\, Z_t = \sum_{s=1..15}^{r=1..256} X_{rst}$$

- Total demand must always be satisfied by supply:

$$S_{rpt} \geq \left(U_{rpt} + F_{rpt} + R_{rpt}\right)\left(1 - \rho_{rpt}\right) - Id_{rpt} + E^{eu}_{rpt} + E^{world}_{rpt}$$

Methodology: model specifications (iv)

- Regions can import products if own production cannot satisfy demand:

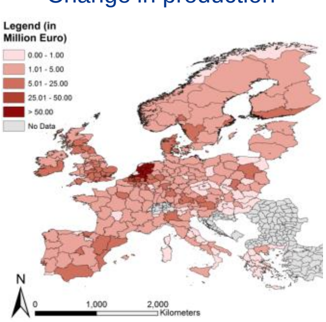
$$Id_{rpt} = Max\left(0, \left(U_{rpt} + F_{rpt} + R_{rpt}\right)\left(1 - \rho_{rpt}\right) + E_{rpt}^{eu} + E_{rpt}^{world} - \delta \sum_{s=1..15} A_{rsp}^{make} \alpha X_{rst}\right)$$

- To make sure this happens efficient, we have introduced *δ:*
  - maximum regional production capacity

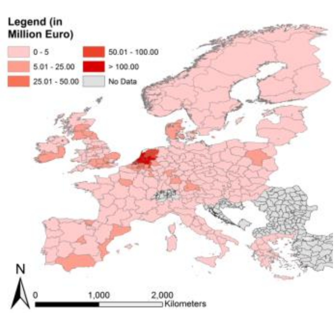
- This should prevent industries in the affected region from producing goods at very inefficient technologies only to satisfy demand

Preliminary results (i)

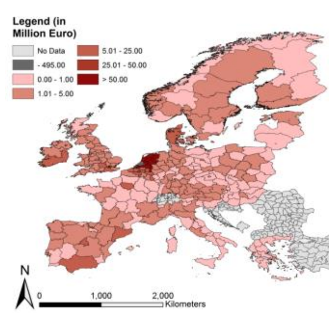
Change in production



Change in production costs

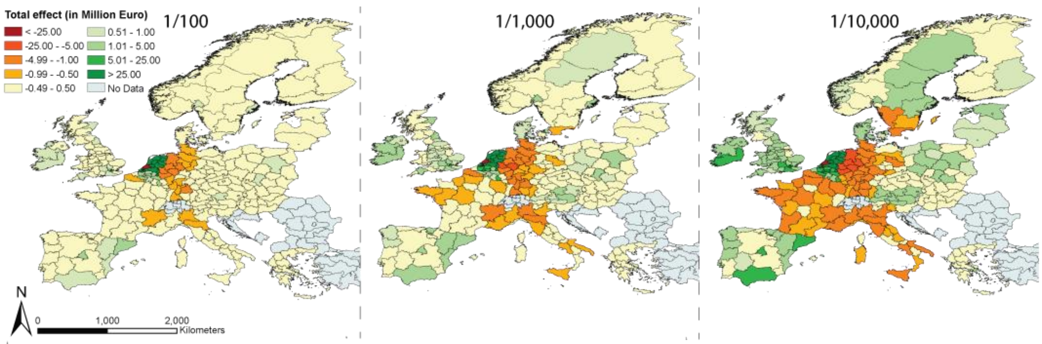


Change in value added



Preliminary results (ii)

Total indirect losses



Preliminary results (iii)

- 75% of additional imports of the affected region are satisfied in Europe
- The additional import of public services can be fully satisfied within the Netherlands
- However: only 25% of the increase in production in the EU is due to these additional imports.
  - So: 75% are higher order effects (cascading effects).
  - As explained before: this is mainly due to the increased inefficiencies in the production process -> final demand does not change

What is the added value of such a model?

- Detailed risk analysis possible for every region within the EU
  - More than just the direct consequences (asset losses)
  - What does a flood in region A means for region B
- Applicability for climate adaptation strategies and risk financing
  - A natural disaster in region A can have consequences for region B.
  - Does region B needs to think about adaptation in region A?
    > **It is a start for discussion!**

Conclusions

- The model clearly shows that the effects are transboundary
  - Both positive and negative
  - Regions further away from the affected region, still suffer (substantial) losses
- However, caution should be taken with the interpretation of results
  - Uncertainty in parameters and bandwith of results
- Model is now being used for floods, it can however be used for any type of hazard.
- Finally, the model results can help shape adaptation strategies

Questions?

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