

# Germany and extreme weather events: Do investments in adaptation measures pay off?

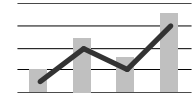
Thomas Drosdowski, Ulrike Lehr, Anne Nieters



Copenhagen, 13.05.2015



## Objective

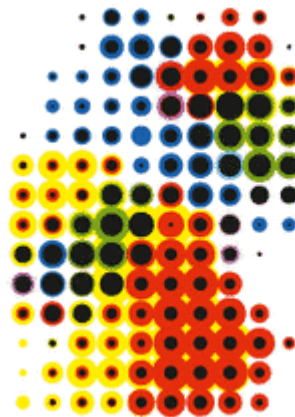


Model-based analysis of economic effects of adaptation measures in Germany on the aggregate and sector specific level

Main focus:

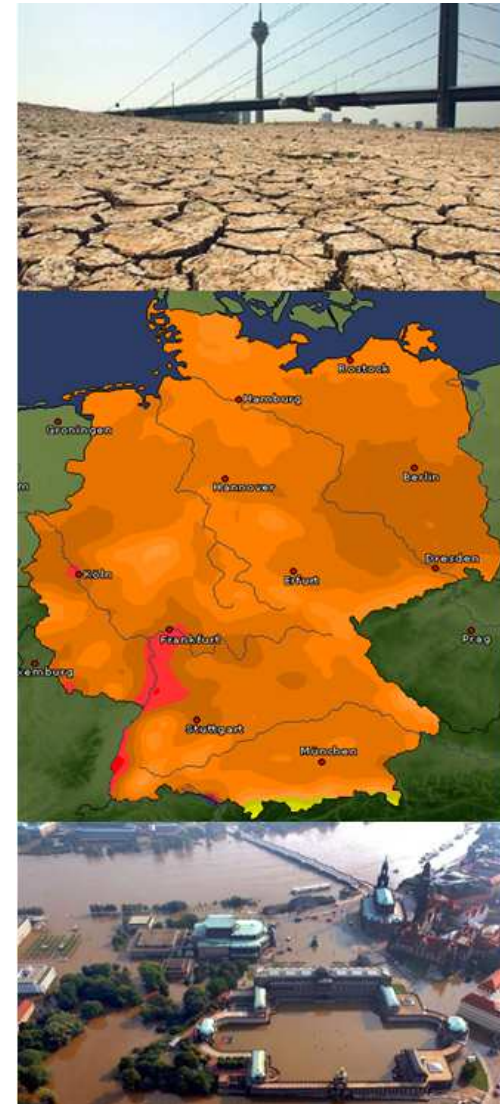
⇒ heat waves

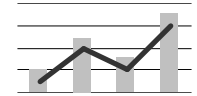
⇒ river floods



Research project:

Economics of Climate Change Adaptation (econCCadapt), funded by the German Federal Ministry of Education and Research's (BMBF) Program "Economics of Climate Change" (October 2011 - March 2015)





### Basic information

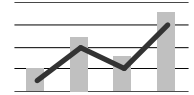
- ⇒ input-output-based macroeconomic model
- ⇒ combining economy and environment
- ⇒ focus on environmental and climate change policies in Germany
- ⇒ running until 2050
- ⇒ extended by modules for extreme weather events and adaptation measures

### Main method: scenario analysis

- ⇒ effects obtained by comparison of three scenarios
  - reference: economic development without (explicit) climate change
  - **extreme weather (climate) scenario**: heat waves and river floods take place
  - **adaptation scenario**: extreme weather events and adaptation occur

## Extreme weather events: damages from river floods

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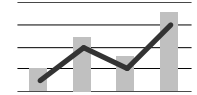


Possible representation of economic impacts of **flood events** in PANTA RHEI:

- ⇒ damages to residential buildings, plants, equipment and transport infrastructure (capital stock)
- ⇒ production decline due to damages to buildings and equipment as well as flooded fields
- ⇒ rising government spending for civil protection

## Extreme weather events: damages from heat waves

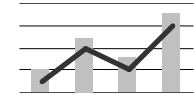
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Possible representation of economic impacts of **heat waves** in PANTA RHEI:

- ⇒ decline of agricultural production (rise of imported intermediate inputs)
- ⇒ restricted energy production on extremely hot days (shift in electricity import balance)
- ⇒ declining labour productivity on extremely hot days
- ⇒ shift among freight transportation modes from ship to rail and road due to extremely low water

## Extreme weather events: timing of events in the modelling

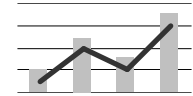


- ⇒ occurrence of flood events every 10 years (with the exception of the last decade from 2041 to 2050 with two such events)
- ⇒ occurrence of heat waves every four years
- ⇒ damage estimates based on data regarding severe river floods and heat waves in the past 15 years

| Year | Flood | Heat wave |
|------|-------|-----------|
| 2013 | x     |           |
| 2021 |       | x         |
| 2023 | x     |           |
| 2025 |       | x         |
| 2029 |       | x         |
| 2033 | x     | x         |
| 2037 |       | x         |
| 2041 |       | x         |
| 2043 | x     |           |
| 2045 |       | x         |
| 2048 | x     | x         |

## Adaptation measures

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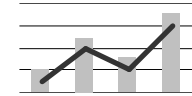
Possible adaptation measures in PANTA RHEI:

- ⇒ based on published estimates
- ⇒ prevent some damages
- ⇒ costly and gradually implemented, induce economic activity
- ⇒ **river floods**: dike reinforcement, extension of retention areas
- ⇒ **heat waves**: greening of roofs, installation of air-conditioners, installation of cooling towers at power plants

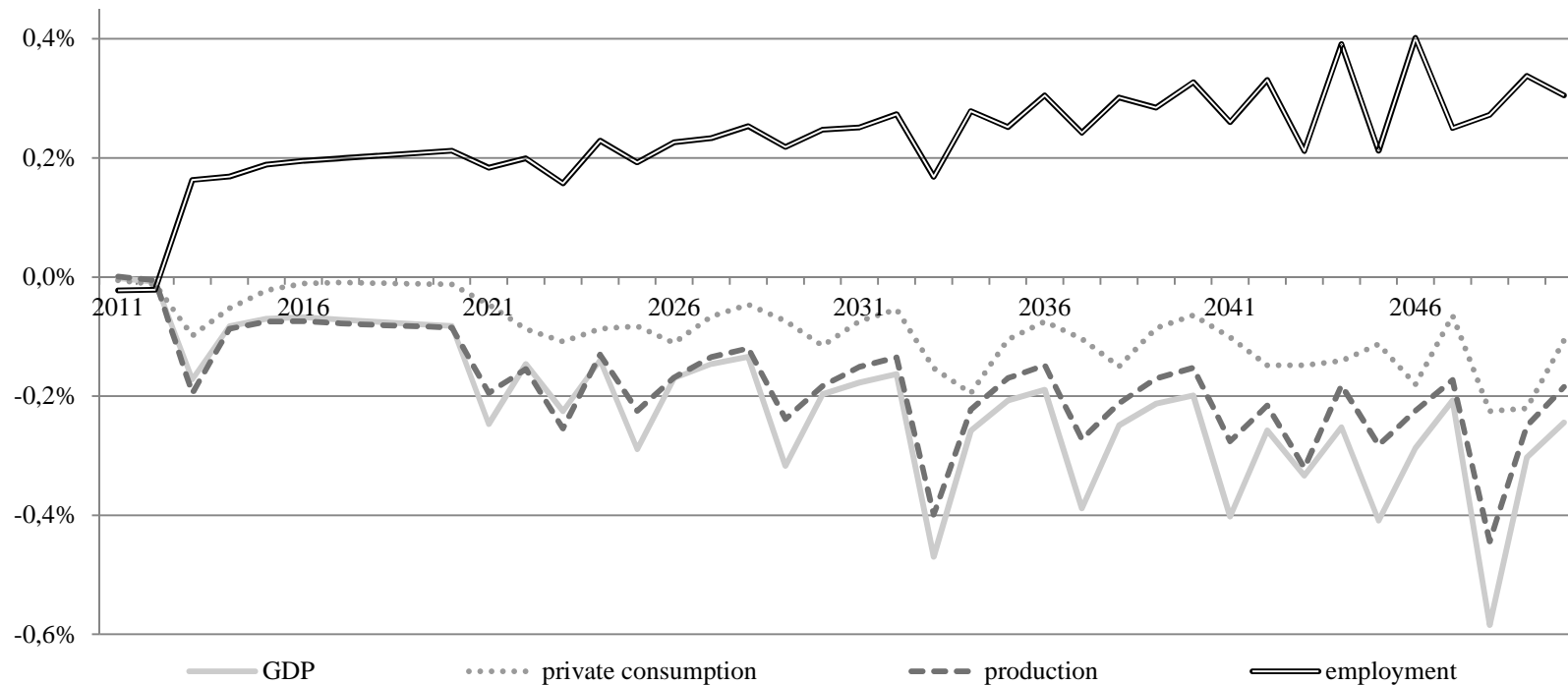
Modelling in PANTA RHEI:

- ⇒ increase of building investments
- ⇒ increase of government transfers
- ⇒ assumption: flood damages no longer occur, productivity decline is prevented, no increasing energy imports in the heat scenario. Other consequences of heat waves remain the same

## Results: extreme weather events



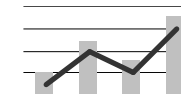
Development of price-adjusted key economic indicators, differences in %, **climate** vs. reference scenario



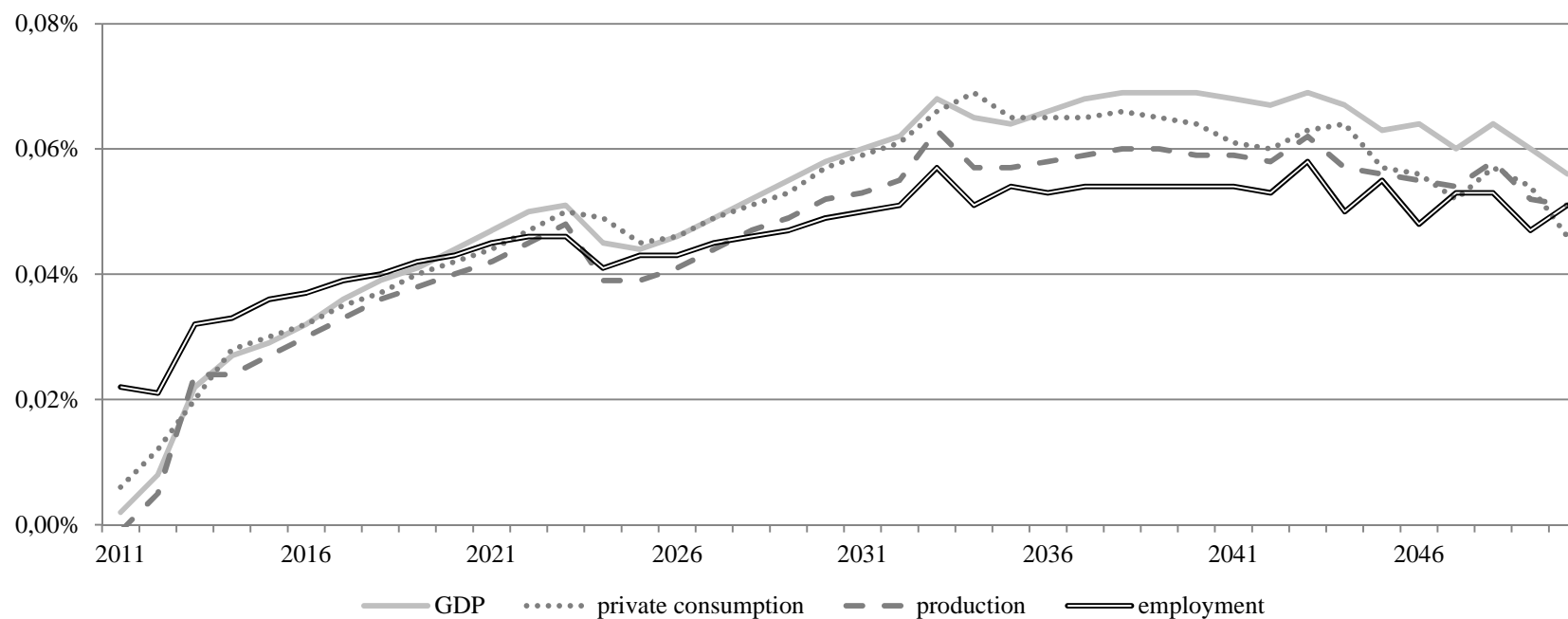
- ⇒ GDP, production and consumption slightly decrease given climate change
- ⇒ adjustments : capital stock reconstruction, imports supplement domestic production
- ⇒ difference in total employment increases over time



## Aggregate results: adaptation measures

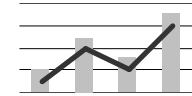


Economic development, differences in %, **adaptation** vs. **extreme weather scenario**, price adjusted

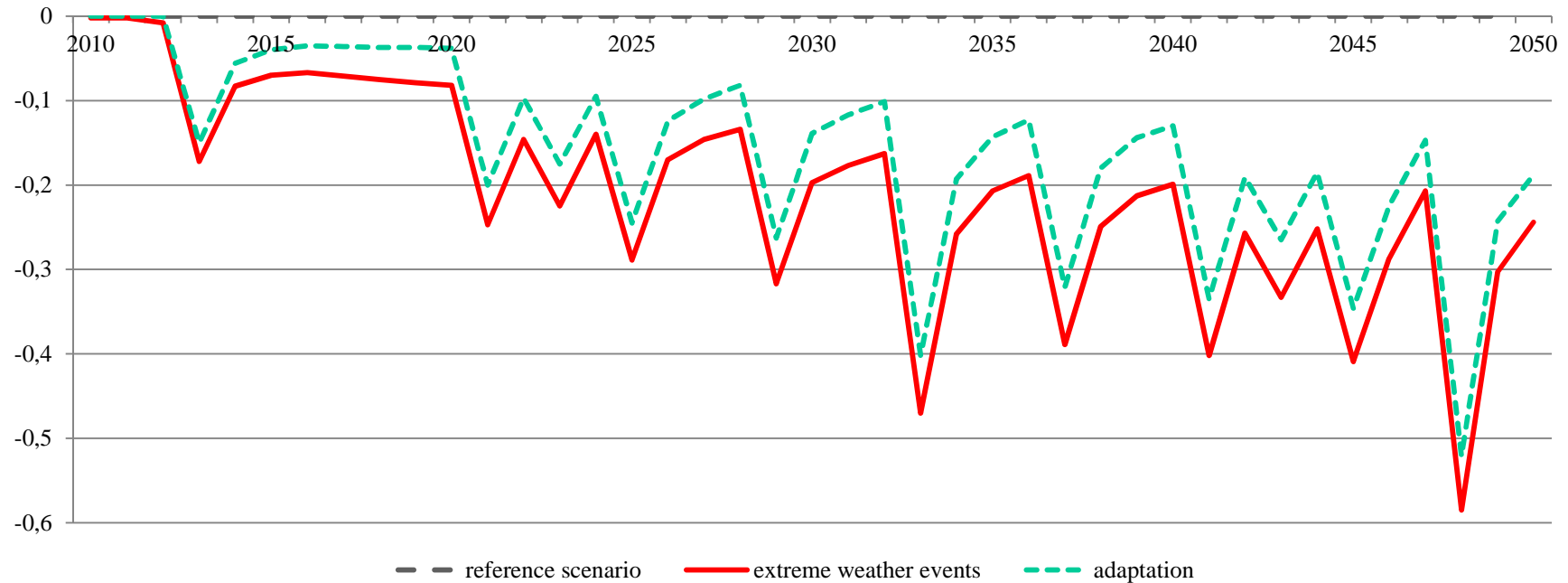


- ⇒ although adaptation measures are costly, the investments are profitable for the German economy
- ⇒ the positive effect is slightly decreasing in the last decade, because more expensive adaptation measures are taken later

## Aggregate results: adaptation measures



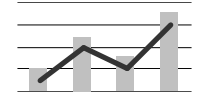
Price-adjusted GDP differences in %,  
reference vs. **extreme weather** and **adaptation** scenario



- ⇒ GDP deviations from the reference are smaller in the adaptation scenario compared to the deviations in the climate scenario
- ⇒ Germany's economic situation only slightly less negative in comparison to the reference

## Sector-specific results: extreme weather events

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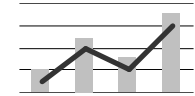
Differences in gross value added: **climate** vs. reference scenario

⇒ Absolute deviations (bill. Euros)

- other services and manufacturing
- transport, trade and construction

⇒ Relative deviations (%)

- mining and quarrying and manufacturing
- transport and construction



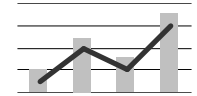
Differences in gross value added: **adaptation scenario** vs. **climate scenario**

⇒ Absolute and relative deviations (bill. Euros/%)

- transport: infrastructure more intact, no additional investments required, no need for evacuation of materials etc.
- +
- all other sectors: smaller losses and bigger gains
  - manufacturing: lower damages to buildings and production sites (retention areas, dikes), diminished necessity for disposal of rubble or destroyed machinery
  - mining and quarrying: more demand for intermediate inputs from manufacturing
  - energy sector: less utility companies reduce energy production (cooling towers)
  - agriculture: less damages, payments for retention areas
  - construction: investments in dikes, roofs, air-conditioning

## Conclusions: modelling results

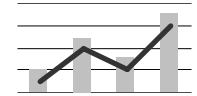
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- ⇒ total economic effects of heat waves and river floods are expected to become slightly (but increasingly) negative in Germany
- ⇒ conservative assessment, since other extreme weather events not modelled
- ⇒ the most negatively affected sector (gross value added) is manufacturing
- ⇒ some sectors (e.g. transport) profit from climate change
- ⇒ adaptation measures diminish the negative aggregate effects
- ⇒ residual damages remain, mitigation strategies may be preferred
- ⇒ due to adaptation negative effects on the sectors decrease, whereas the positive effects increase

## Conclusions: general insights

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- ⇒ the data situation is still unsatisfactory
- ⇒ input-output-based macro models need to be improved for better analysis of extreme weather events
- ⇒ an aggregate view is incomplete, because of heterogeneous impacts across German regions
- ⇒ global consequences of climate change such as shifts in foreign trade need to be taken into account

# Thank you for your attention!

**For more:**

[drosdowski@gws-os.com](mailto:drosdowski@gws-os.com)

[www.gws-os.com](http://www.gws-os.com)

Nieters, A., Drosdowski, T. & Lehr, U.  
(2015): Do extreme weather events  
damage the German economy? GWS  
Discussion Paper 15/2, Osnabrück.

