Climate change - a challenge for the grid? – Results from an economic model for Germany

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Abstract

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1. Background

Limiting global warming to well below 2°C is one of the major outcomes of COP 21 in Paris. However, climate change has already begun and will continue to be felt in the future. Amongst others, consequences can be an increasing frequency of weather extremes (e.g. storms, heavy rain and heatwaves), drought in certain regions, changes in the marine biophysical composition and in sea levels among others.

Germany, like several other nations, has a developed framework of climate change adaptation strategies (German Federal Government 2008, UBA 2013), which is comprised in the German Adaptation Strategy, the GAS, or DAS in German. This strategy has produced a body of literature und assessment of the future vulnerability and the feasibility of a set of adaptation measures. Monitoring reports (UBA 2013) and the involvement of the respective authorities such as the Federal Office of Civil Protection and Disaster Assistance, the Federal Railway Authority, or the German Environment Agency, try to mainstream climate change adaptation into the German policy mix. The assessment of the vulnerability of Germany gathers the latest research results of risk and damage assessment for different vulnerable sectors and suggests a wide catalogue of measures and instruments for adaptation. However, macroeconomic assessments of these catalogues have not been part of the exercises as of yet.

2. Methodology

This knowledge gap is exploratively filled by a research project under the title “Analysis of macro-economic effects of adaptation measures and instruments” commissioned by the German Environment Agency. The analysis follows four steps: Firstly, climate change damages are quantified and (2) translated into economic variables and quantities. Then adaptation measures are selected, which a) are relevant and effective and b) matter in the overall economic context. The selection procedure involves the classification of policy measures and instruments according to their respective macroeconomic relevance and representability in an economic modeling context. The final, and most important, step involves the simulation as such and the scenario comparison.

Next to official statistics, data for the identification of damages are collected through a wide variety of channels, such as insurance data, forest models, climate change models, and newspaper clippings and further desk research. The analysis is based upon simulation results obtained with the macro-econometric model PANTA RHEI. PANTA RHEI. PANTA RHEI has a macro-econometric simulation and forecasting model at its core, which consistently describes the annual inter-industry flows between the 63 sectors, their contributions to personal consumption, government, equipment investment,

construction, inventory investment, exports as well as prices, wages, output, imports, employment, labor compensation, profits, taxes, etc. for each sector as well as for the total economy. In the behavioral equations, decision routines are modeled that are not explicitly based on optimization behavior of agents, but are founded on bounded rationality. The parameters in all equations in PANTA RHEI are estimated econometrically from time series data. Producer prices are the result of mark-up calculations of firms. Output decisions do not stem from an optimization process but follow observable historic developments, including observed inefficiencies. Employment is determined from the production volume and the real wage rate in each sector, which in return depends on labor productivities and prices.

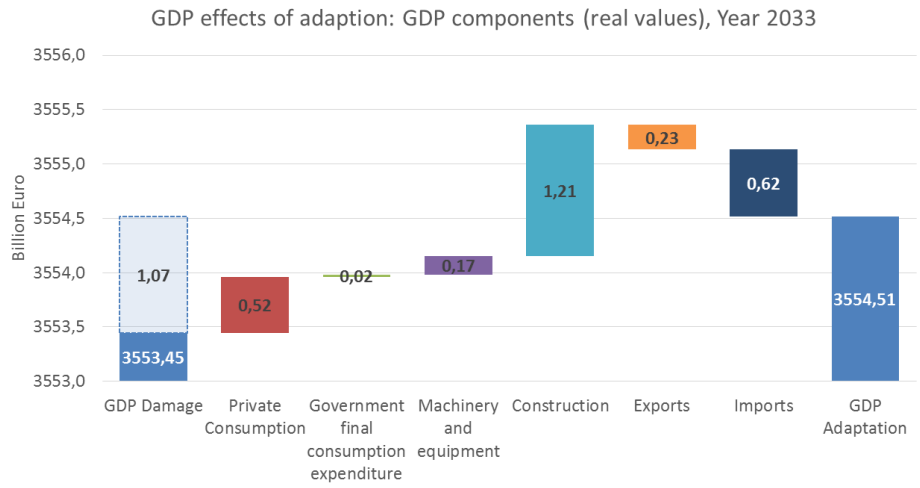
To examine the economic effects of adaptation policies in Germany, we need to simulate the effects from climate change as a first step. The analysis focuses on extreme events and explores the modelability of gradual temperature changes and the effects on forests and trees. Storms, extreme rainfall and heat waves in urban areas are included in the model via the respective damage equations. The values of damages are taken from the literature, insurance statistics as well as media reports. Next, adaptation policies are selected based upon expert information and modelling assessment and considerations. The measures and instruments are simulated and the results of the simulation runs with and without adaptation are compared to assess the feasibility of adaptation.

The respective differences in economic indicators, such as employment, GDP etc. can then be attributed to the additional efforts in the sectors described above, since all other factors are held equal. Changes in volumes and prices are fully accounted for. The simulation model runs until 2050.

3. Results and Conclusion

The results can be summarized as follows: Modeling damages from extreme weather events and gradual temperature change is a challenging but solvable task. Economic effects of adaption are small and most often positive. The economic perspective can help to develop the adaption strategy and select the synergistic measures.

Adaptation measures are particularly relevant for all sectors relying on intact infrastructure. This comprises rails, electricity grids, roads as well as airports. Figure 1 shows a decomposition of the GDP effect from adaptation measures regarding the electricity grid.



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