MACROECONOMIC IMPACTS OF REGIONAL CLIMATE CHANGE ADAPTATION STRATEGIES

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Overview

Among great efforts of mitigating anthropogenic climate change in past and present, adaptation to global climate change has received growing attention lately. Adaptation comprises measures, like seawalls and storm surge, erosion control, transport infrastructure enhancement, underground cabling and many more. They are necessary to deal with expected climate change impacts, such as floods, storms and heat and their associated economic, environmental and social costs. Whereas climate change mitigation is a global issue, most adaptation measures are implemented at the regional or local level due to varying climate impacts and vulnerabilities between regions. Mitigation and adaptation measures are both designed to reduce damage costs of climate change, but they also involve costs. The challenge for regional policy makers is to find a cost-effective mix of adaptation and mitigation efforts (Bosello et al. 2010; Klein et al. 2005). In the latest IPCC Fifth Assessment Report, the Working Group II calls, among others, for a better assessment of global adaptation costs, funding, and investment (IPCC 2014).

In this paper, we analyze economic impacts of regional climate change adaptation strategies. From a macroeconomic point of view, adaptation measures can be classified as additional final demand, mainly investments. Even though, such investments involve costs, they also drive the demand for other goods. For instance, infrastructure investments increase the demand for construction services, such that overall employment may increase and trigger additional income and consumption as second-round effects. Thus, adaptation involves economic losers and beneficiaries within and across countries and regions. Quantifying the resulting net effect of these actions is the first of our research objectives.

The second objective refers to the regional and financing dimension. The relative costs of adaptation vary strongly among and within economic sectors, regions and countries. In this paper, we focus on adaptation measures in the German federal state of Baden-Württemberg as an example of a small-open economy at sub-national level. The impact of regional adaptation measures to a regional economy strongly depends on the way investments are financed. As climate change is a global problem and not all countries and regions exhibit required adaptation funds, the UN have launched a global adaptation fund in order to help sharing the financial burden (UNFCCC 2011). We are interested in analyzing and quantifying the difference, which that makes.

To sum up, our analysis follows two research questions:

1) How do regional adaptation measures affect the sectoral structure of a small-open economy at sub-national level and which trade and competitiveness effects arise?
2) What difference does a global adaptation fund make compared to region-specific financing at sub-national level?

Method

In order to cope with regional effects in a global context we develop a global, multi-sector, multi-region Computable General Equilibrium (CGE) model. The CGE model is based on the GTAPinGAMS and GTAP-EG framework (Rutherford 2010 and Rutherford & Paltsev 2000). As an example of a sub-national small-open economy, Germany is disaggregated into the federal state of Baden-Württemberg and the rest of Germany. The disaggregation requires the creation and implementation of a regional input-output-table following the structure of the underlying GTAP data base (Narayanan et al. 2012). Besides the standard framework, the model includes a detailed representation of the energy sector, especially electricity generation. CO_2 emissions are an additional input if fossil fuels are used. There are global bilateral trade flows between regions. In order to cope with employment impacts widely, the assumption of perfect competition in the labor markets is waived by allowing for unemployment.

We conduct scenario analysis in order to estimate macroeconomic impacts of regional climate change adaptation strategies under different policy regimes. This includes the comparison of adaptation vs. no adaptation in combination with region-specific vs. global funding.

A similar methodical approach has been followed within the PESETA-II project of the EU Joint Research Centre (JRC 2014 and Ciscar et al. 2012). There, the global CGE model GEM-E3 has been applied to study economic

effects of climate change and adaptation. The major focus is on benefits of avoided damages mainly in agriculture, less on sectoral impacts and regional financing sources.

Results

Our results show region specific changes of economic supply and demand decisions, relative prices and income induced by exogenous shocks (adaptation measures). This makes it possible to quantify macroeconomic indicators such as GDP, employment, exports, imports, competitiveness and overall welfare. Especially the buildings and transport sector as well as agriculture are supposed to be quite sensitive to adaptation measures.

Conclusion

Our analysis shows direct and indirect economic effects of regional climate change adaptation measures. In line with varying types of funding options, this helps to better understand financial burdens of different economic regions, production sectors or households. Our results contribute to the discussion on finding a cost-effective mix of adaptation and mitigation efforts for regional policy makers. Even though our analysis focuses on Germany's federal state of Baden-Württemberg, analogue conclusions could be drawn for other regions, too.

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