

Climate Change Adaptation and its Costs in a Carbon Constrained World

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This thesis aims at improving the current representation of adaptation in economic frameworks of climate change by a) accounting for the time-dependent evolution of the adaptive capacities of countries and b) quantifying unwelcome feedbacks of the adaptation process. In this context, it is proposed that economic assessments of climate change incorporate adaptation as a cyclic and phase-dependent process while devising their cost methodologies. A phase-dependent process acknowledges the existence of adaptation barriers while a cyclic process accounts for potential unwanted feedbacks of adaptation.

With this theoretical consideration in mind, a dynamic representation of adaptive capacity was elaborated at a country-level. The Human Development Index (HDI) was used as a proxy. The results indicate that between 2005 and 2020, half of the world's population will live in countries with low adaptive capacity. This percentage is then progressively reduced to 15% in the year 2050, with marked regional differences. The time required for a country to achieve an appropriate level of development sets a clear constraint on when, and to what extent, the country can engage on adaptation to climate change. Obtaining higher levels of adaptive capacity is likely to be associated with negative consequences for the climatic system. The statistical relation between HDI and per-capita emissions of countries was established and future projections made. Between 2000 and 2050 approx. 300 Gt of CO₂ are estimated to be associated with the increase of adaptive capacities of current developing countries. This value represents about 30% of the allowed CO₂-budgets to restrict global temperatures to an increase of 2 °C by 2100 compared to pre-industrial times -- while still accepting a 25% risk of failing to meet the target.

For the case of sea-level rise, the modeling framework DIVA (Dynamic Interactive Vulnerability Assessment) was used in order to illustrate the drawbacks of a simplistic representation of adaptation. The results show that adaptation via the construction of protective infrastructure might be economically feasible for particular countries. For others, modeled results fail to provide a clear choice between adaptation or inaction. Further, infrastructural protection as adaptive measure to prevent coastal damages can have the counter-productive effect of raising the amount and value of assets at risk. This is a direct result of DIVA disregarding the potential unwelcome feedbacks of adaptation itself.

In conclusion, the full potential of economic assessments of climate adaptation is likely to remain unlocked as long as adaptation continues to be misrepresented. The methodologies discussed in this work provide a way forward to alleviate this deficiency in forthcoming assessments.