



Modelling Historical Adaptation Rates to Inform Future Adaptation Pathways

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Motivation

- Long tradition of attempting (flawed) Cost-Benefit Estimations on Climate Change
- Increasing Literature on **Climate Damage Projections** in recent years

The elephant in the room?

How well will we be able to adapt to climate change?



Picture credit: Adobe Stock

Key Questions:

- 1) How much Adaptation has happened in the past?
- 2) How much Adaptation can we expect in the future?

ESTIMATING HISTORICAL ADAPTATION

1.) How much Adaptation has happened in the past?

- Building on the growing literature of macro-econometric cost estimations (see e.g. Dell et al. 2012, Burke et al. 2015, Pretis et al. 2018, Schwarz and Pretis (in prep.))
- Exploiting year-to-year weather variation to assess temperature impact on economic growth

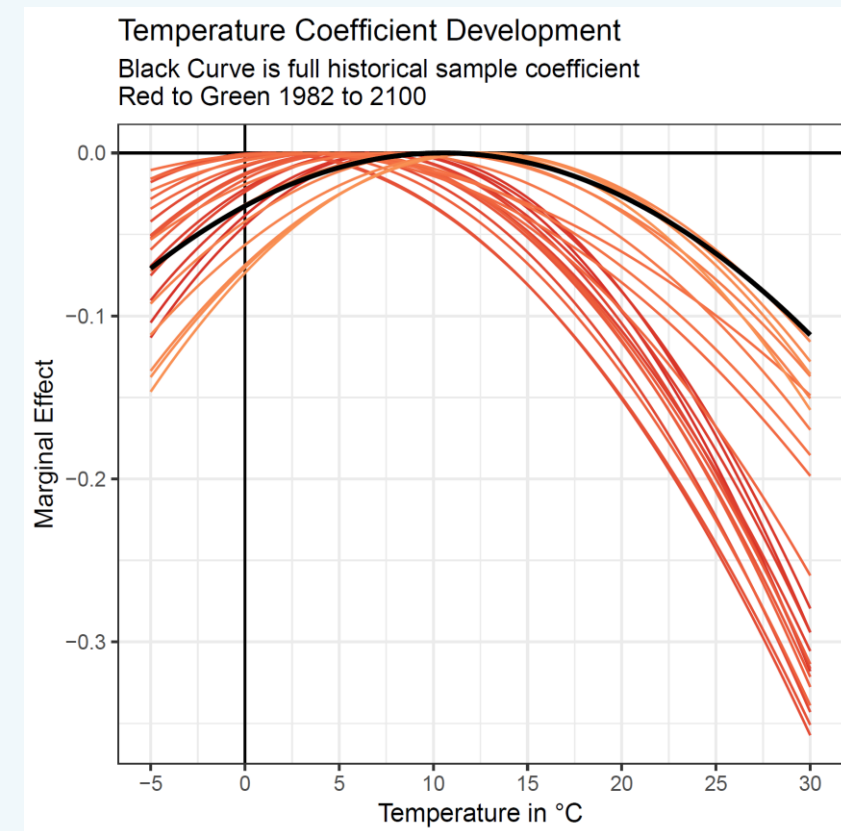
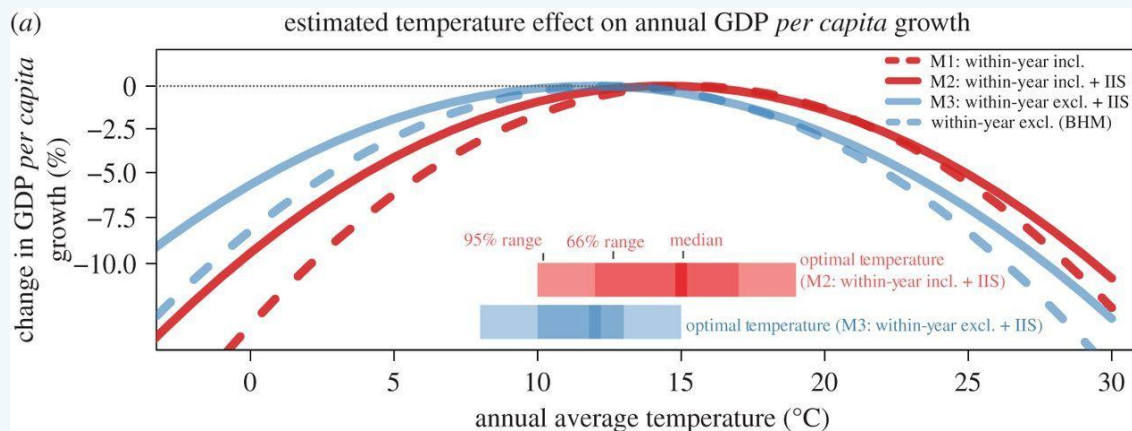
Given these foundations, we explore historical adaptation using two approaches:

- Unconditional Estimation: Stability of estimates over time
- Conditional Estimation: explore co-determinates (e.g. income)

1.) How much Adaptation has happened in the past?

Unconditional Estimation: Parameter Stability over time

- Currently most models assume a stability of the estimates over time (bottom: Pretis et al 2018)
- However, using recursive window estimates, we find that coefficients exhibit a trend (are non-constant) (right; here to 1982-2012)

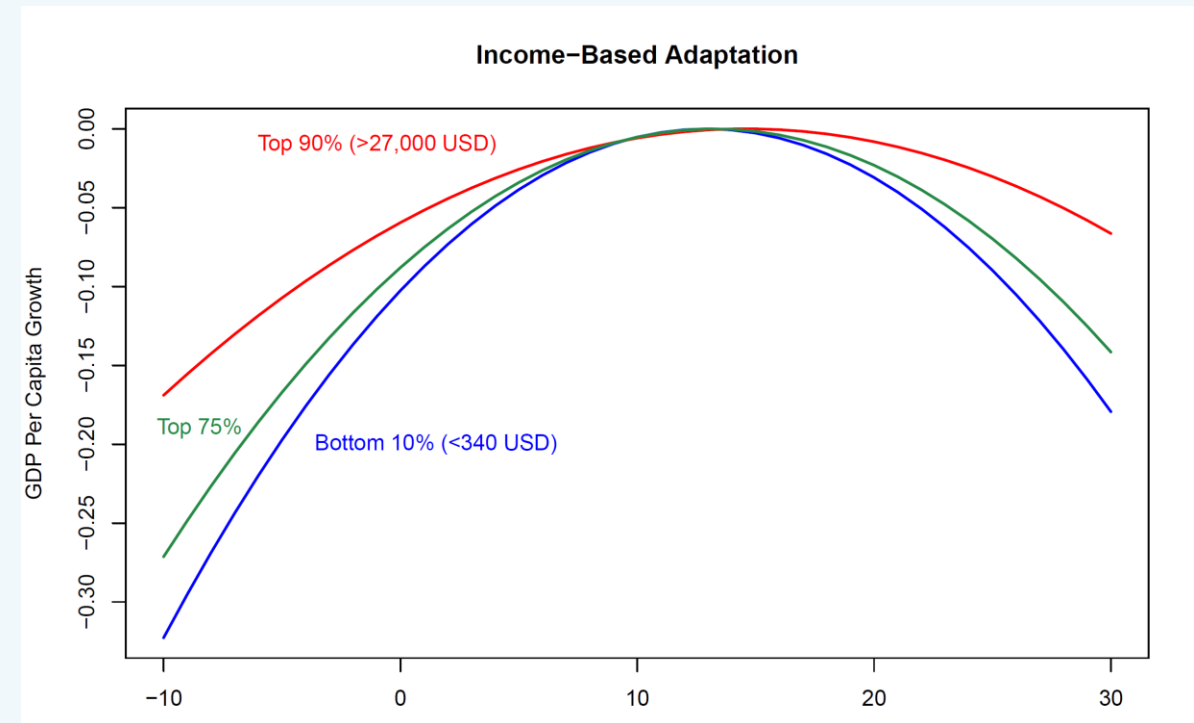


1.) How much Adaptation has happened in the past?

Conditional Estimation:

Co-Modelling of socio-economic variables

- Estimation using interaction effects between climate variables and socio-economic variables
- In our preliminary results, higher incomes seem to have an attenuating effect on overall economic growth effect
- Approach could be carried out with other variables as well



2.) How much Adaptation can we expect in the future?

- Key Assumption of existing damage projections:
The estimated historical relationship is constant and holds into the future
- Given the results of our conditional as well as our unconditional estimation, this might not be valid
- This would have considerable implications for future damage projections

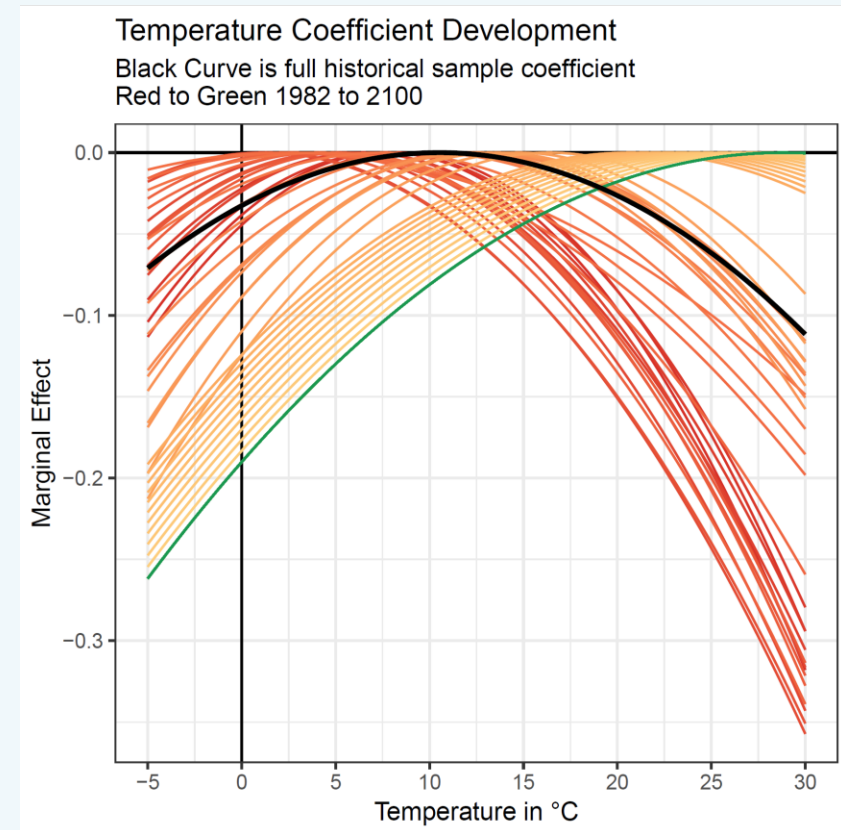
2.) How much Adaptation can we expect in the future?

Unconditional Estimation: Parameter Stability over time

- Using the estimated coefficient trends of our unconditional estimation, we could construct a naïve long-term projection of this relationship
- Using only the estimation trend and some rough restrictions (in-sample limits and no change of sign), a simple forecast suggests that optimal temperatures could further shift to the right

Is this robust? No.

- Still large uncertainties and fairly sensitive to specifications – rather an interesting starting point



2.) How much Adaptation can we expect in the future?

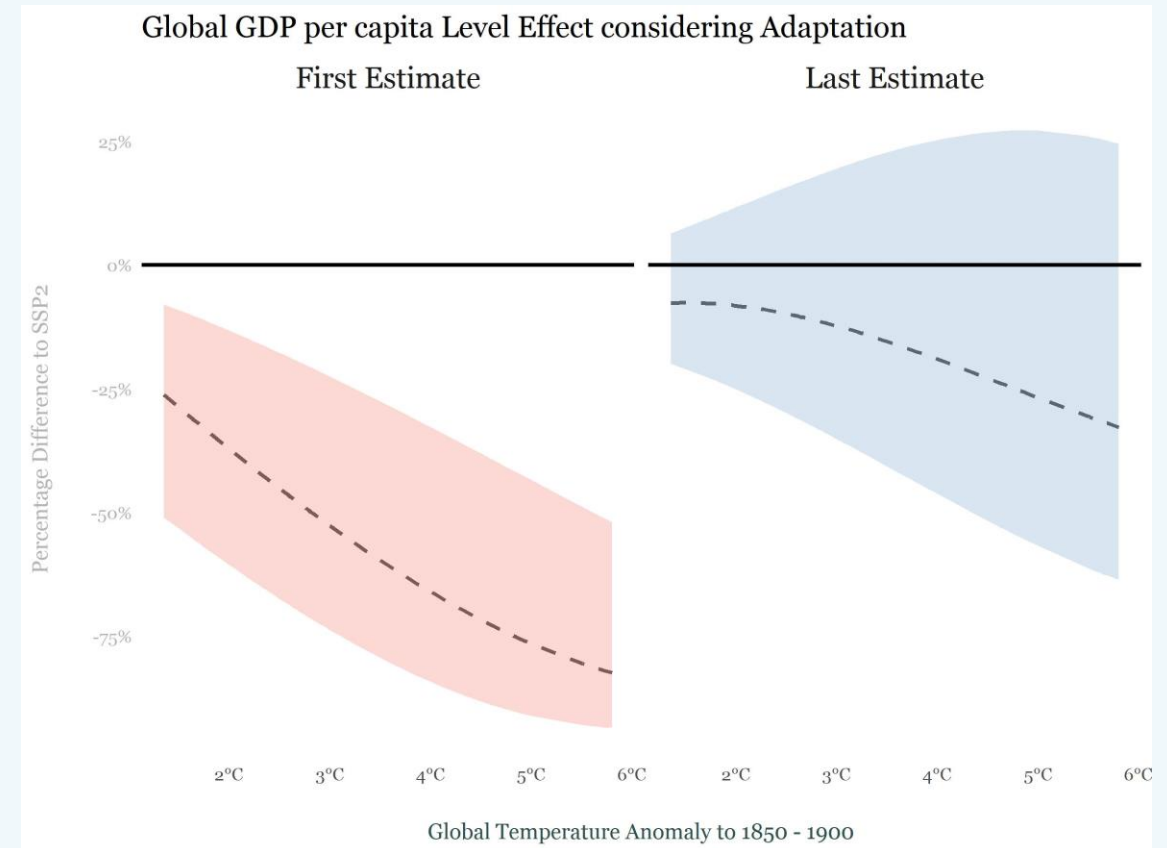
Exploiting different historical window estimates (hence not requiring forecasting/projection of the relationship) already indicates that this effect can have a major influence on damage estimates!

Figure:

Global GDP per capita % differences between a our damage estimates and SSP2 projected to 2100

Left: 1962-1982 estimation

Right: 1992 – 2012 estimation



Conclusion

- Historical adaptation on a macro-level fairly unexplored in econometric models
- Preliminary findings suggest potentially non-constant estimates of temperature on economic growth over time as well as heterogeneous relationships across socio-economic co-determinants
- Preliminary projections show that this non-constancy could have major implications for damage projections
- Potential future applications:
 - Adaptation Pathway Framework to make Adaptation choices explicit in projections
 - Determinant and Cost analysis of historical adaptation rates



Thank you.

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