Towards a Global Predictive Model of Trust in Science

Oscar Lecuona, Tobias Wingen

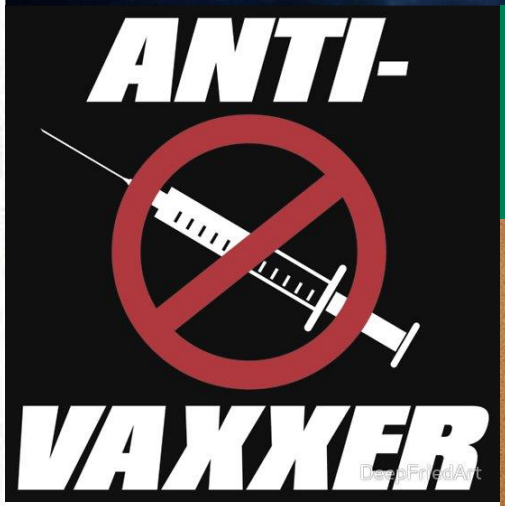
Complutense University of Madrid

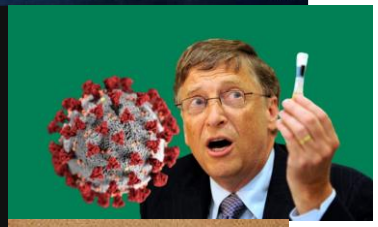
FernUniversität in Hagen

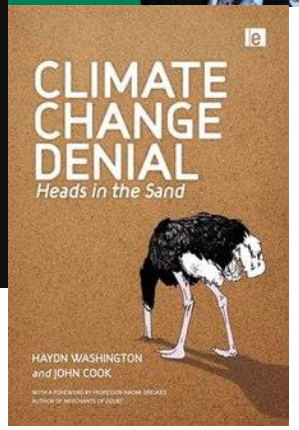
olecuona@ucm.es

tobias.wingen@fernuni-hagen.de

World has seen the rise of anti-science

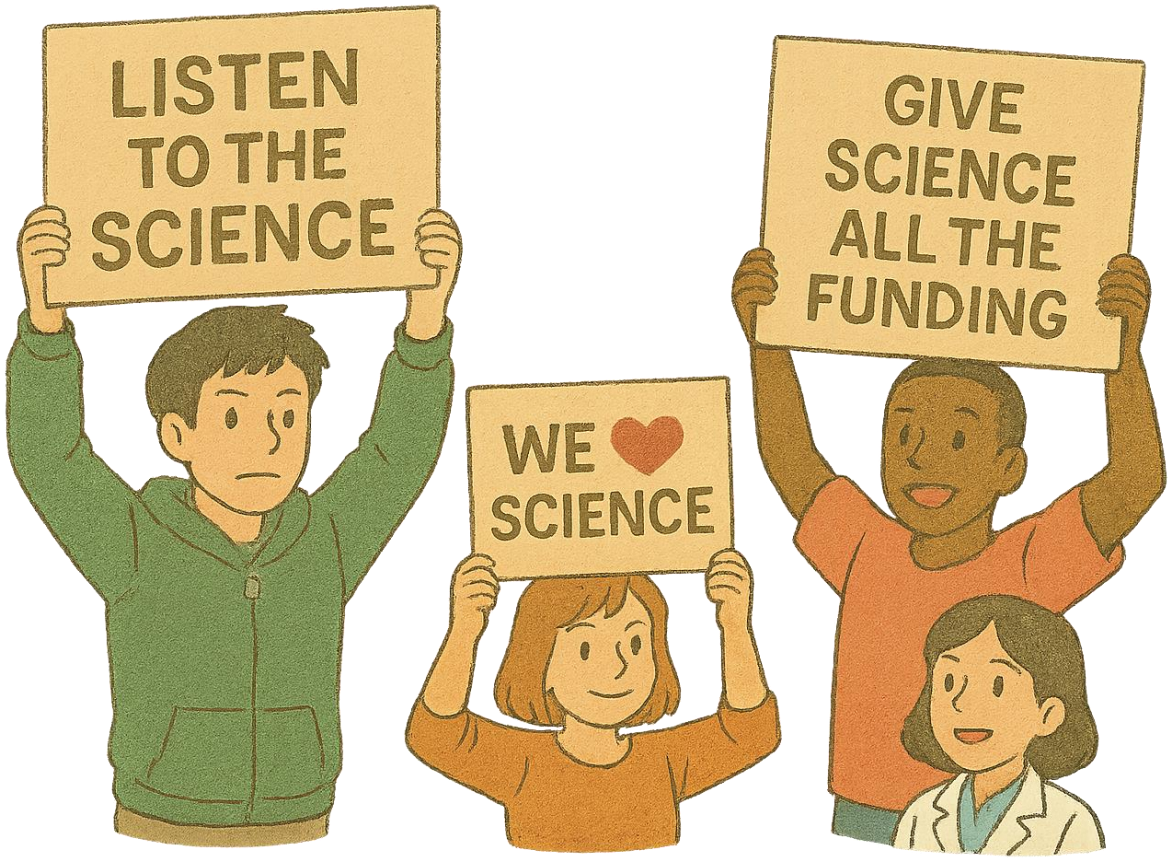






However, majority listens to science

Trust in science seems as a core aspect of supporting science



(Cologna et al., 2025; Mede et al., 2025)

People who trust scientists are more likely…

To protect the climate (Cologna et al., 2025)

People who trust scientists are more likely…

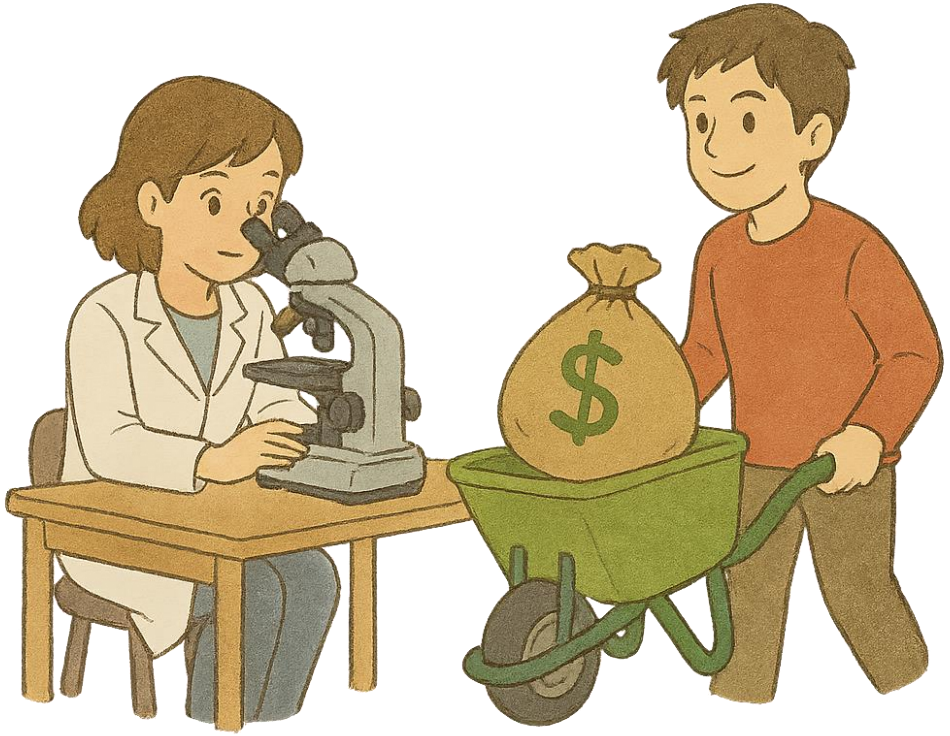
To protect their own (and others‘) health (Dohle et al., 2020)

People who trust scientists are more likely…

To reject problematic conspiracy theories (Tonković et al., 2021)

People who trust scientists are more likely…

See our work as valuable and support us, for example, with funding (e.g., Wingen et al., 2020, 2022)



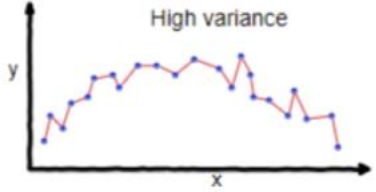
However, past work on trust in science had two major issues

- Focus on single interesting effects
  - E.g. effect of replicability (Wingen et al., 2020)
  - Effect of easiness (Scharrer et al., 2016)
  - Effect of me-search (Altenmüller et al. 2021)
- Only very little focus on systematic theory building (e.g., Wintterlin et al., 2022)
- Focus on WEIRD countries (Cologna et al., 2025)

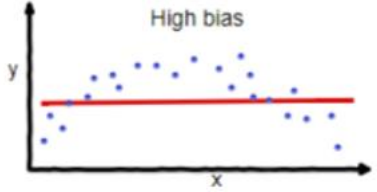
Building and comparing theories using predictive modeling

- Good theories should make strong predictions about unseen data (Hehman et al. 2024)
- Building predictive models is thus an important way to build and compare theories
- We here seek to build such a model, contributing to future theory building in this field
- We use LASSO regression to reach an interpretable model, more useful for early stages of theory building

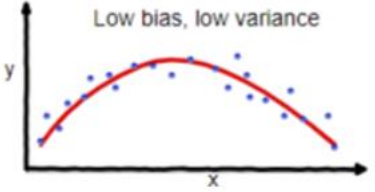
LASSO regression



Overfitted (λ = 0), non-regularized

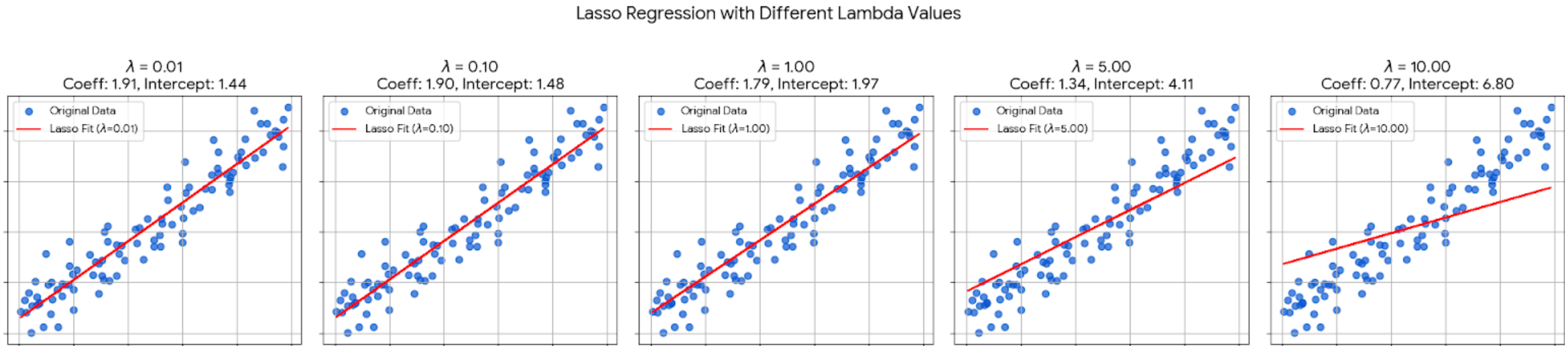


Overfitted (too large λ), over-regularized



Good balance (adequate λ), regularized

- Least Absolute Shrinkage Selection Operator (LASSO)
- A **penalized** regression that shrinks small coefficients to zero
- Shrinkage controlled by a Tuning parameter λ (arbitrary, normally set to 0.5)
  - Creates a sparse solution of coefficients (avoids overfitting)
  - Higher λ → more parsimonious (less variance) but more bias
- Useful with high dimensional data and a suspected sparse true model
- Caution: Underestimation of coefficients, unstable if collinear



LASSO regression

- Which tuning value we must use?

- Fine-tuning penalty
  - Search for optimal values of λ via Cross-Validation or other techniques
  - Creates repeated random splits of data for training and validation datasets
    - Example: Split data into 5 equal parts (folds).
    - For each λ:
      - Train on 4 folds, validate on the 5th.
      - Repeat 5 times, rotating the validation fold.
      - Average the validation errors.
    - Pick the λ with the **best average performance**.

  - Provides more unbiased λ values at the cost of computation intensiveness

Overcoming WEIRD focus

- This model shall be a global model:
- Using the same predictors in all countries
- With an equal predictive performance in each country

Dataset

- The TISP Dataset (https://www.nature.com/articles/s41597-024-04100-7.pdf)
- More info: https://www.nature.com/articles/s41562-024-02090-5
- Full sample:
  - N(individuals) = 69534
  - N(countries) = 68

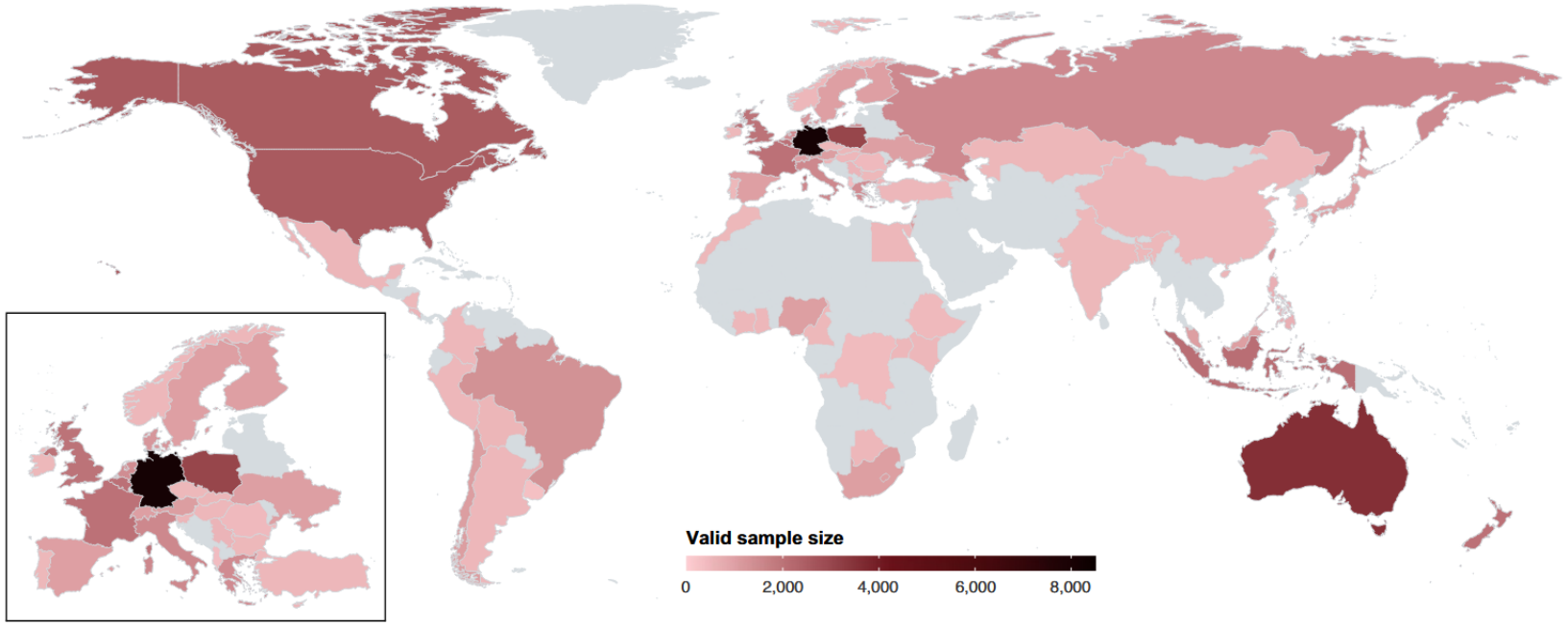
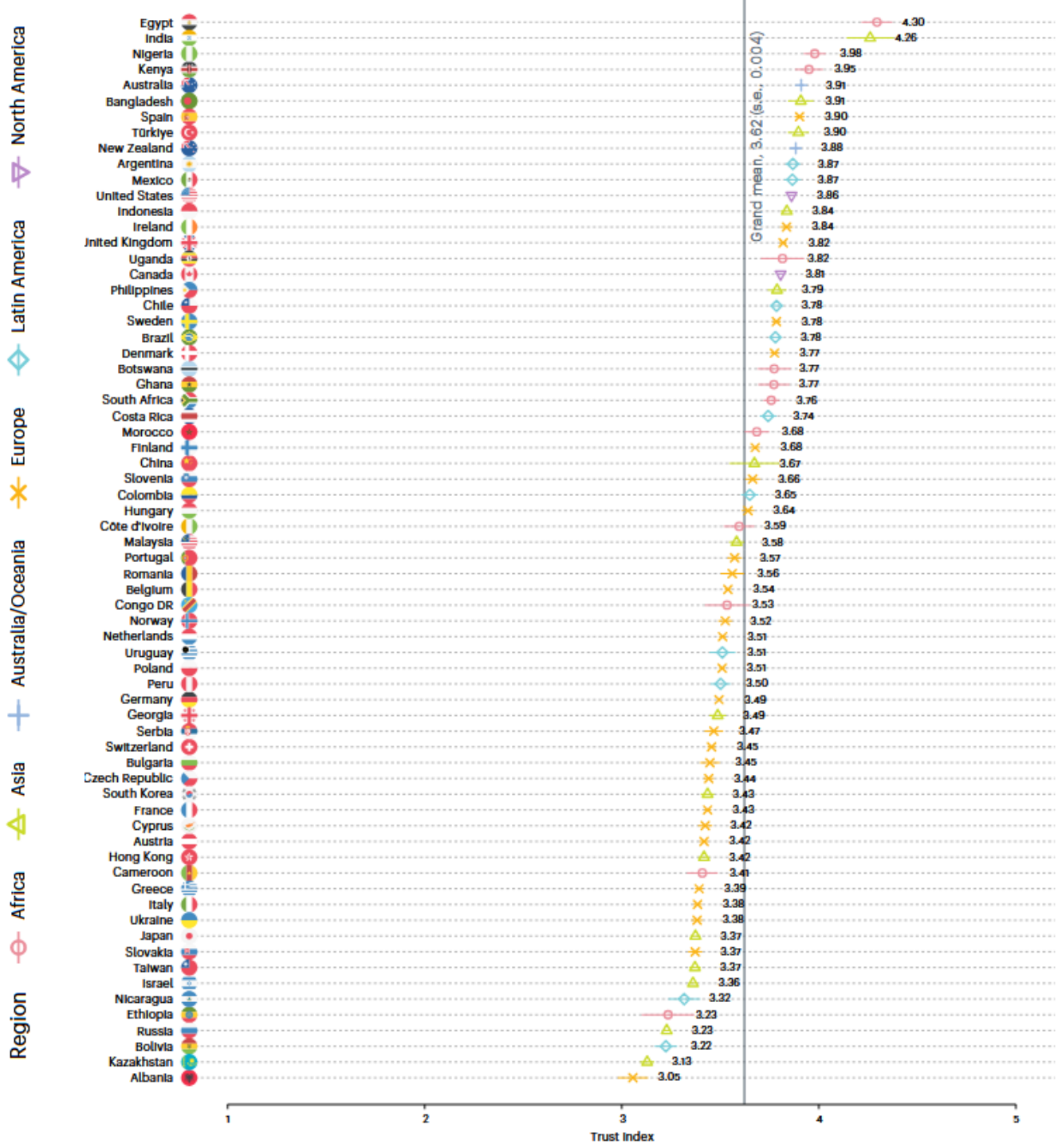


Fig. 1 Valid sample size across countries.

(Cologna et al., 2025; Mede et al., 2025)

Measures for demographic model

- Trust in Scientists: average 12 items
  - e.g. „How honest or dishonest are most scientists?“



Measures for demographic model

- Trust in Scientists: average 12 items
  - e.g. „How honest or dishonest are most scientists?“
- Demographic variables:
  - Gender & Age
  - Education: did not attend school (1) – higher education (4)
  - Income in USD & log income
  - Religiosity: Not religious at all (1) – very strongly religious (5)
  - Place of residence: Urban vs. Rural
  - Political orientation: strongly liberal (1) – strongly conservative (5)

- Psychological measures:
  - We later included various other measures, including how often people come acress information about science, engage with scientific content, what goals scientists should prioritize etc.

Method and Performance demographic model worldwide

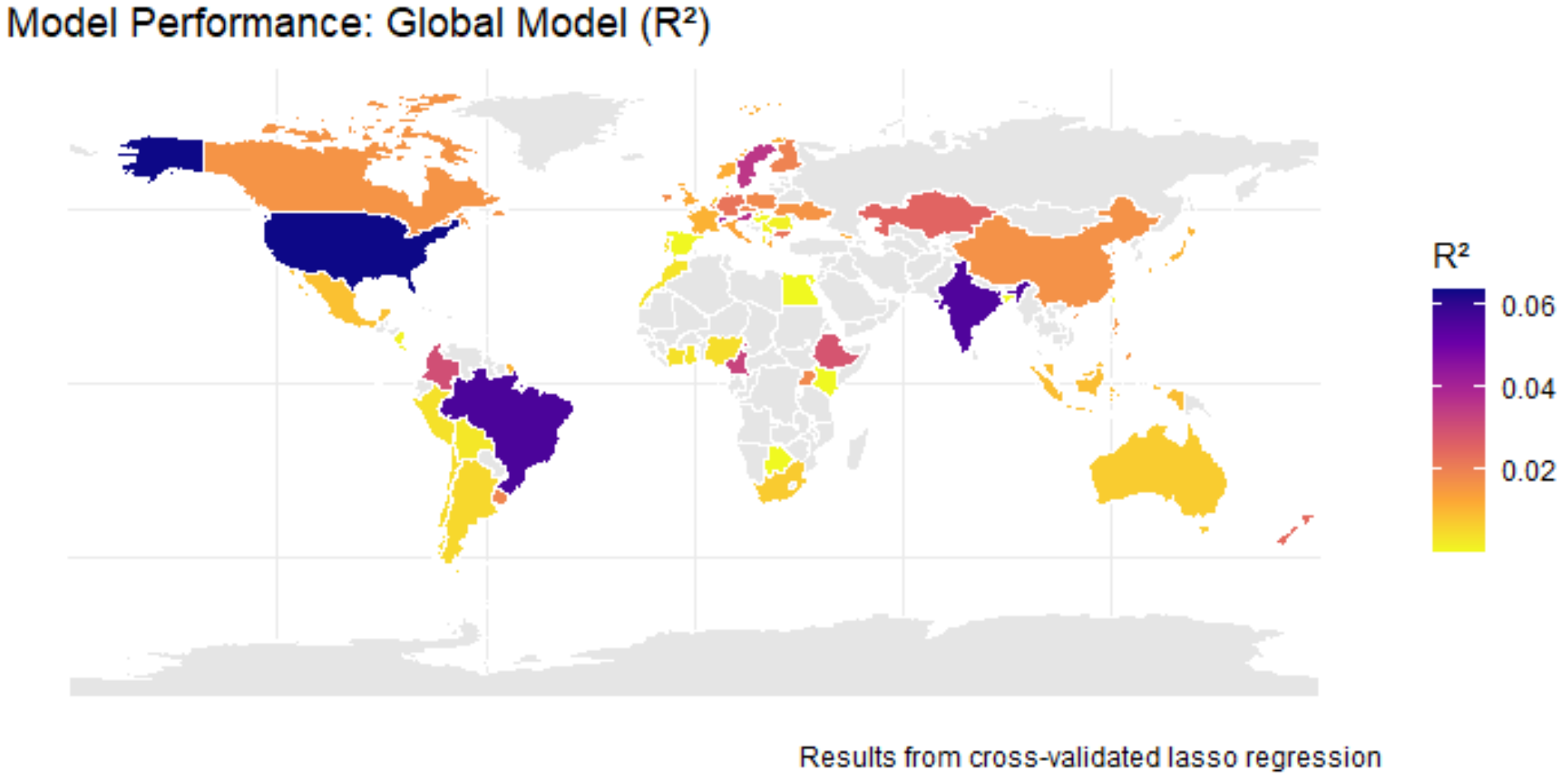
- Cross-validation lasso regression with mixture = 0.5 and fine-tuned penalty (apply on a trainings data set with N = 55655)

Metric	Cross-validated performance measures
RMSE global	0.650
R^2 global	0.113

- However, R^2 largely due to country dummies

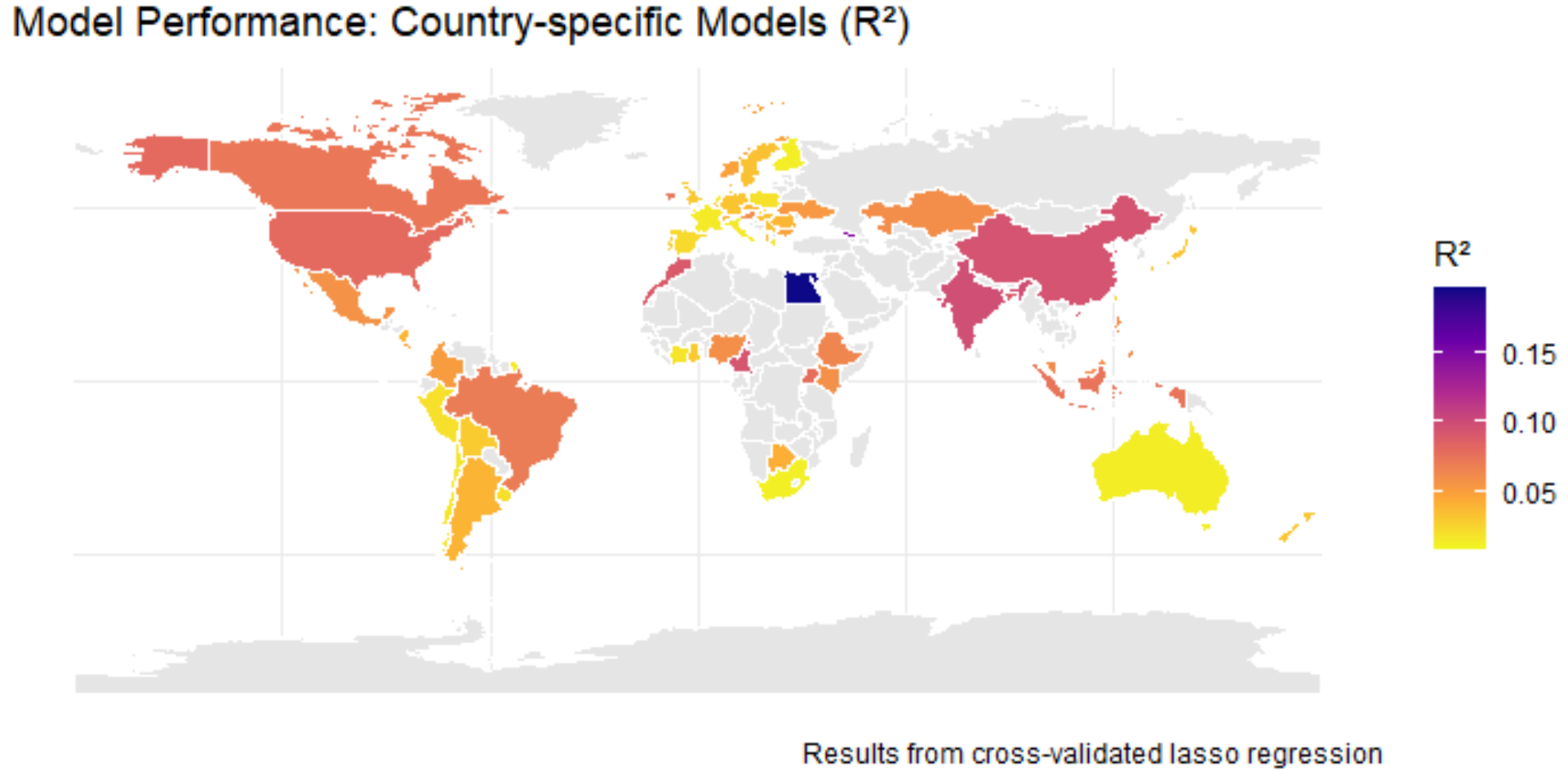
Performance: global analyses per country demographic model

R^2 of global model per country: M = 0.013, Min = 0, Max = 0.064

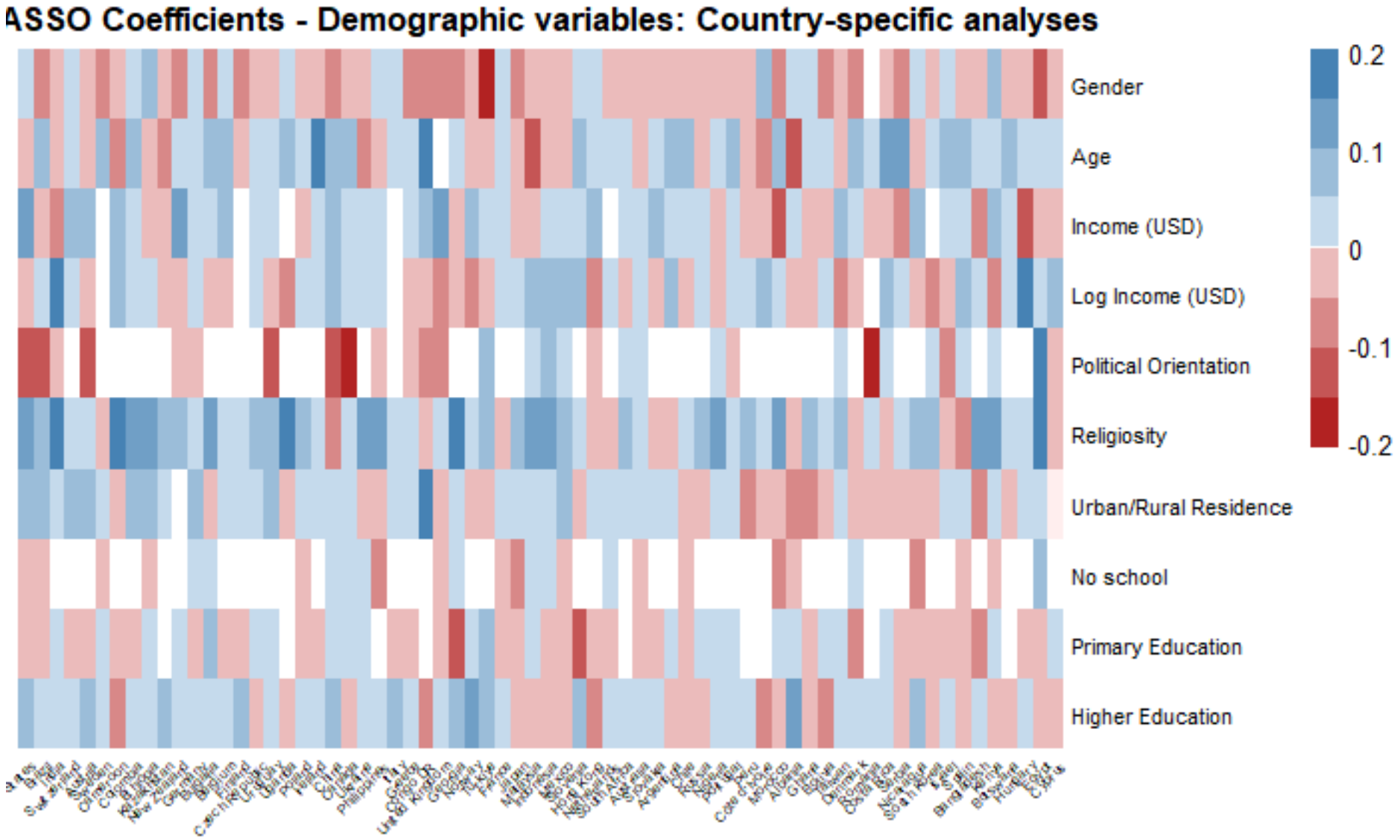


Performance: per country analyses demographic model

- R^2 separate country-analyses: M = 0.05, Min = 0.009, Max = 0.197



Variable plot



Measures for psychological model

- Demographics +
  - Social Dominance Orientation
  - How often have you come across information about science in the following places? (newspaper, radio, books…)
  - How often engagement with or related to scientific issues: (conversations with family, chatting in messaging apps, sharing or commenting on social media)?
  - What goals should scientists prioritize? & How strongly do you believe that science aims to tackle these goals? (health, energy problems, poverty, defense)
  - Range of climate change related questions (e.g. emotions, satisfaction with government, support of policies, perception on impact on weather events)
  - Trust in scientific *method*

- *In total 73 predictors*

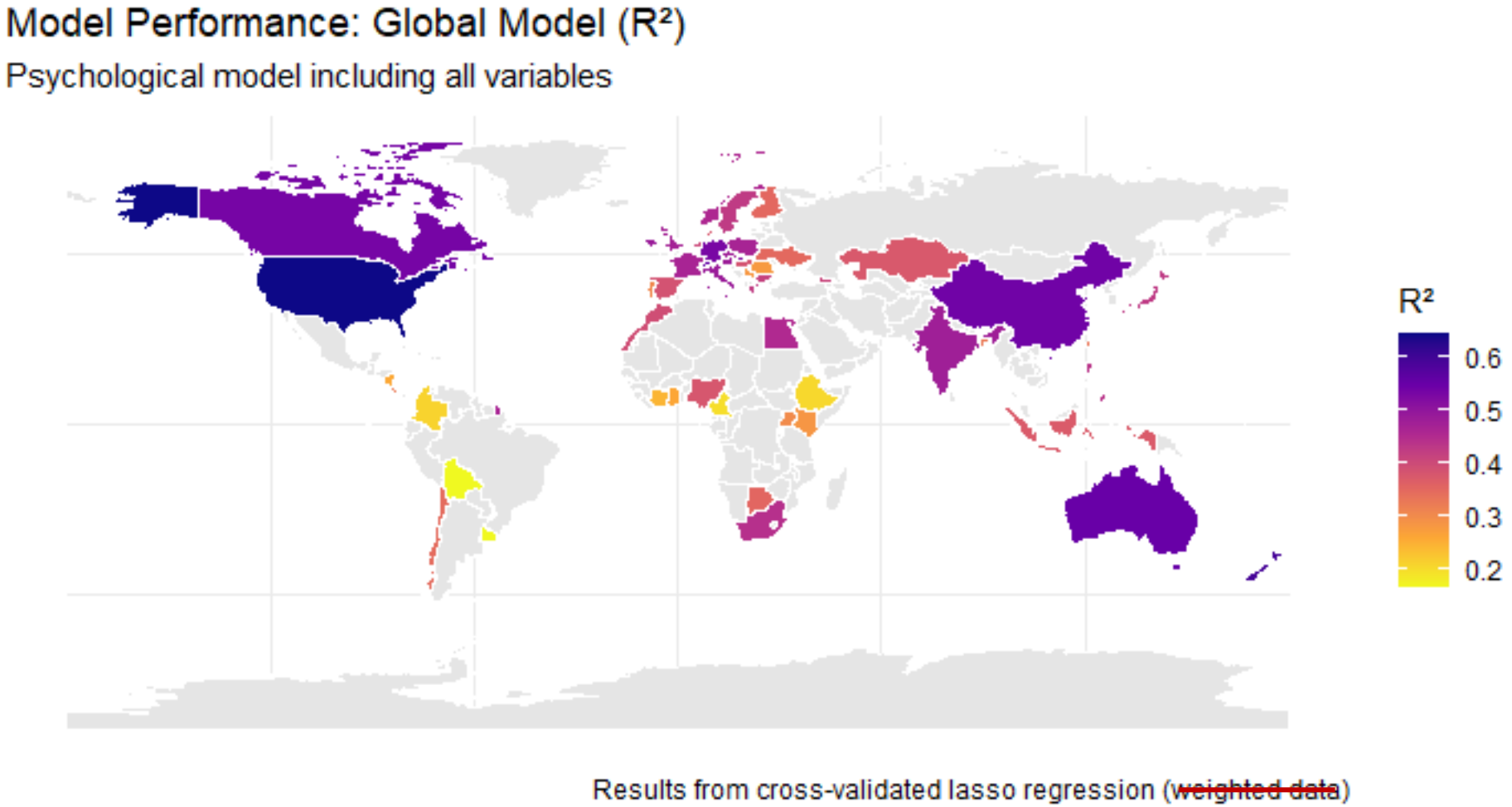
Method and Performance psycholoical model worldwide

- Cross-validation lasso regression with mixture = 0.5 and fine-tuned penalty (apply on a trainings data set with N = 55655)

Metric	**Cross-validated performance measures**
RMSE global	0.484
R^2 global	0.507

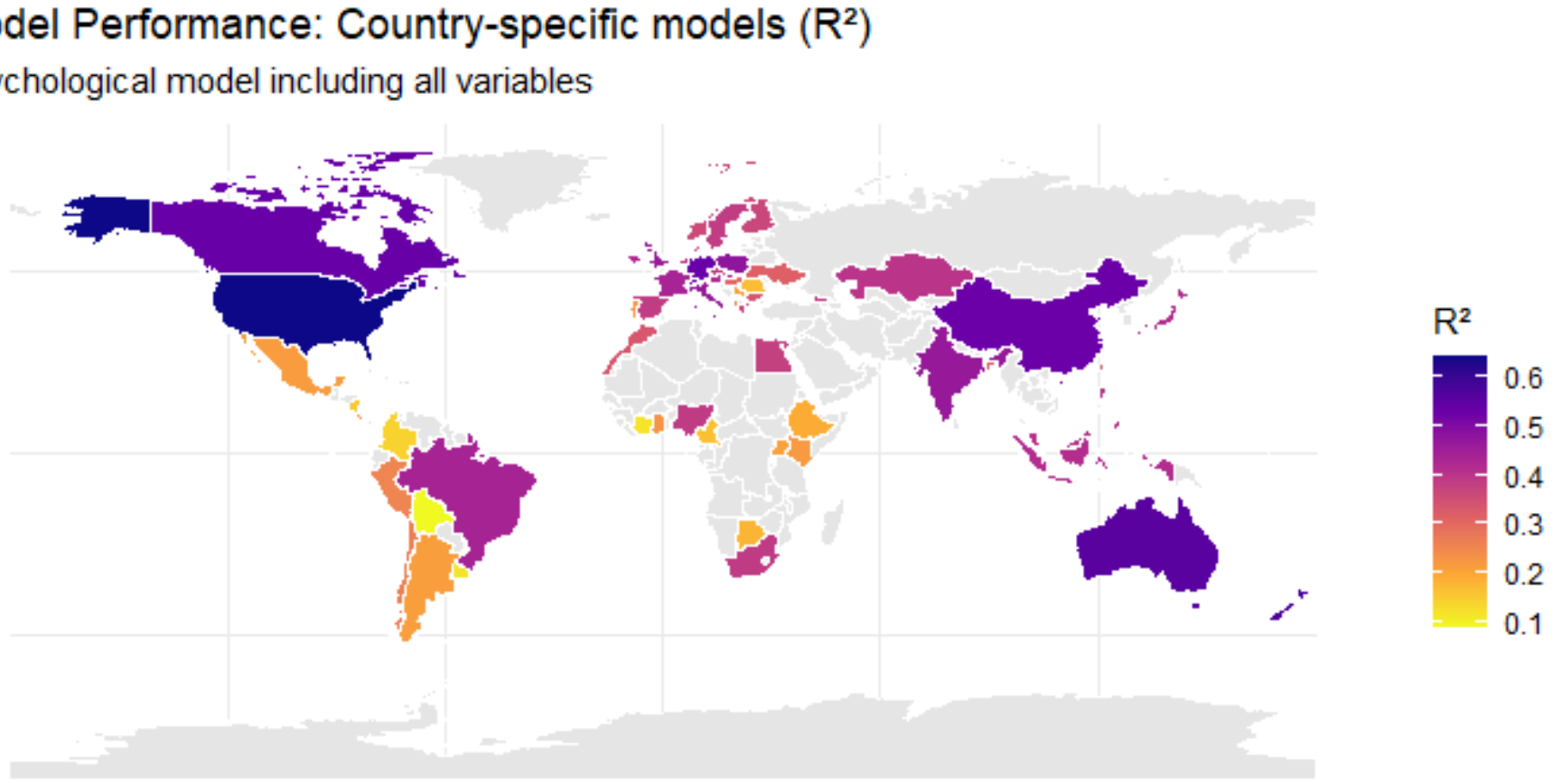
Performance: global analyses per country Psychological Model

R^2 of global model per country: M = 0.392, Min = 0.075, Max = 0.641

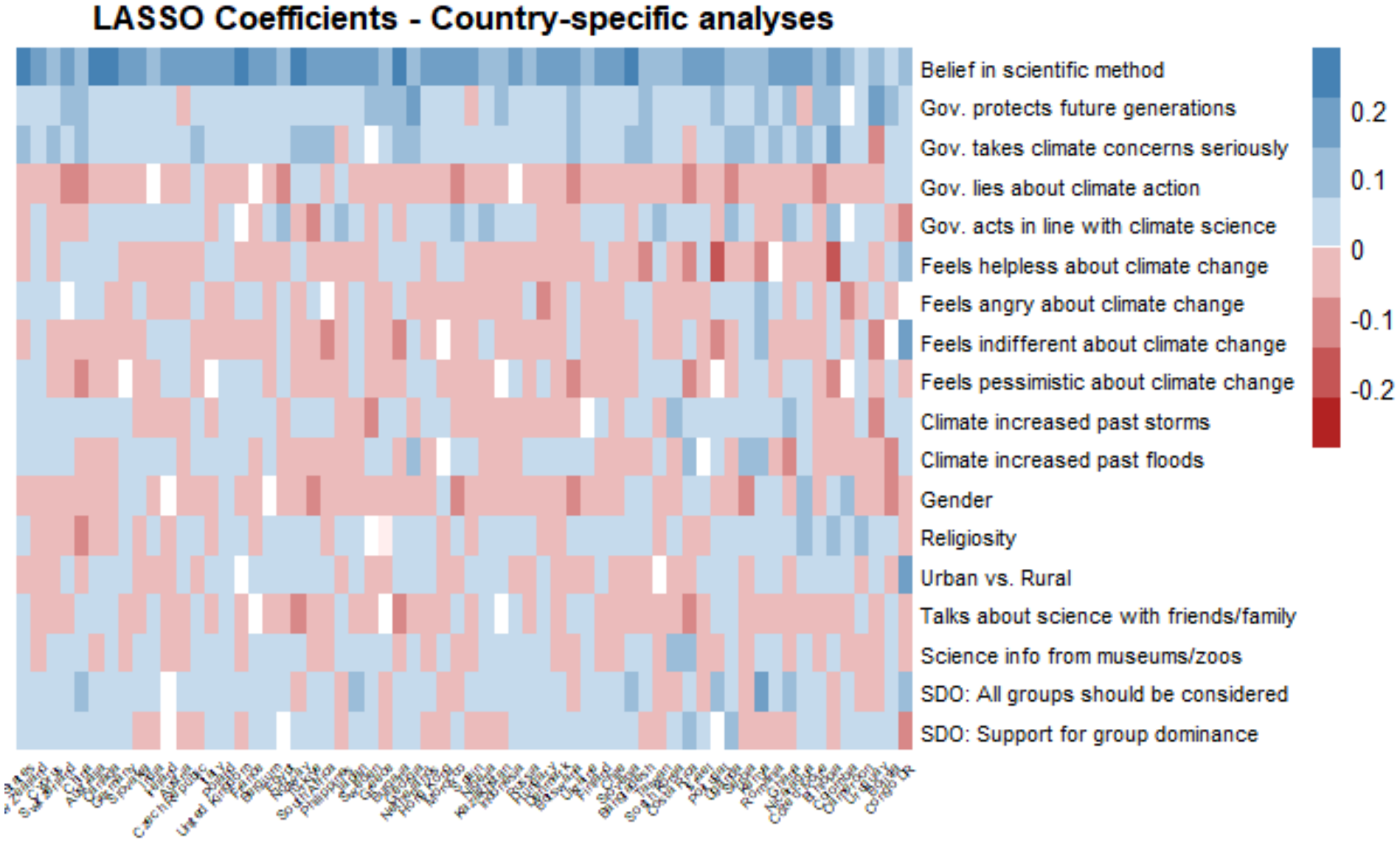


Performance: per country analyses Psychological Model

R^2 of global model per country: M = 0.347, Min = 0.09, Max = 0.641



Variable plot



Discussion

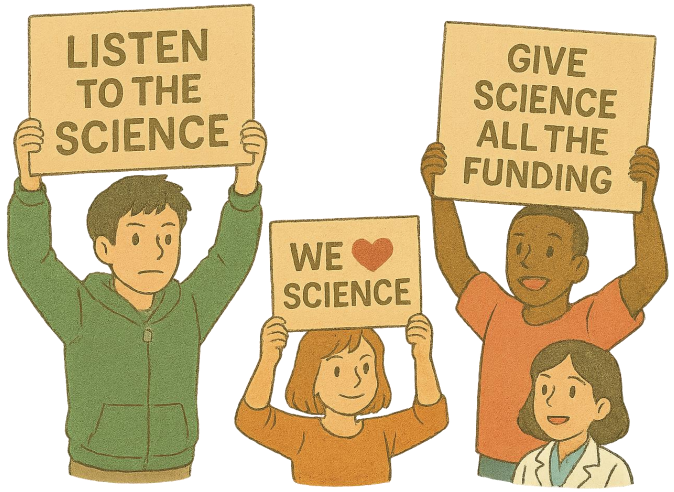
- Building a model based on mostly demographics is very difficult
- Bad model fit and huge variation across countries/predictors
- Model fit gets better when including psychological variables but still huge variation among fit and predictors
- And this „psychological“ model is somewhat trivial, for example including trust in scientific methods (best predictor)
- While interesting that this is difficult, probably difficult to build on

Discussion

- Thus, we interpret that up to date...
  - Trust in science is a deeply variable construct across countries
  - Each culture and history shows their own behavior
- Possible explanation is that science is also a social construct from the West
  - It is a global institution right now, but still WEIRD countries are majority
  - But cultures may continue to relate to them as an export of the West (e.g., African or Asian countries), or as a flagship of a particular moral of their culture (e.g., non-religious West)

Next steps

- Confirmatory studies to cross-validate the model
- In-depth studies in a single country to test applicability
- Explore how cultures may shape these relations
- Temporal associations are important: Cross-generations
- Test potential impact of political action



¡Muchas gracias!

Oscar Lecuona

Tobias Wingen

Andrea Wingen