

## Bachelor Thesis Research Proposal, Tim Dass

### Motivation and Research Question

Climate change threatens human wellbeing through a variety of channels, including an increase in extreme weather events, increasing temperatures and rising sea levels. Many of these effects disproportionately affect low-income, marginalized, and indigenous communities (IPCC, 2023b, pp. 48-51). Low-income nations often face significant financing constraints when it comes to climate mitigation and adaptation (IPCC, 2023b, p. 61). GHG emissions have historically been mostly emitted by developed western nations and those nations still tend to have very high per capita emissions. Due to this it can be argued that those nations have some responsibilities in aiding other countries to adapt to the consequences of climate change. This motivates the following research question:

**Do the countries that are the most vulnerable also receive the most adaptation funding to cope with climate change?**

This work should combine literature on defining adaptation and finding its determinants with literature on vulnerability. Linking the ND-GAIN vulnerability score to adaptation funding is something that has not been done to date and should be able to offer a comprehensive answer to the research question.

### Literature Review

Today, climate change related aid makes up a significant part of overall flows and this aid is not necessarily only distributed to the poorest countries. Reasons for this are a changing distribution of absolutely poor individuals living more and more in middle-income countries, and the mitigation potentials of middle-income countries (Arndt & Tarp, 2017). At the same time, the largest chunk of climate related aid goes to mitigation and not adaptation (IPCC, 2023b). Low-income countries facing high risks in the face of climate change encounter serious financing constraints in adapting to it adequately (IPCC, 2023b, p. 61).

Vulnerability is an important term in the debate around the allocation of development finance, and there exist conflicting definitions of how vulnerability should be defined (Brooks, 2003). Vulnerability can be described as an outcome state after exposure to a hazard. In this view, it is a function of hazard, exposure, sensitivity and adaptive capacity. An alternative view is vulnerability as the state of structural factors that determine how a society can cope with risks. Brooks uses the term “biophysical vulnerability” for the first definition, whereas the second one he calls “social vulnerability”. For this work, an IPCC definition will be used that closely follows the concept of “biophysical vulnerability”. According to the IPCC, vulnerability is:

“The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.” (IPCC, 2023a, p. 14)

Going by this definition, vulnerability must be characterized both in terms of the physical risk a system is exposed to, as well as its adaptive capacity. Both aspects will be approximated by appropriate indicators. Adaptive capacity in particular is difficult to define and to find appropriate measures for. Yohe & Tol (2002) mention among the determinants of adaptive capacity the structure of critical institutions and the stocks of human and social capital, including education, and properly defined property rights. The role of governments and their ability to fund necessary infrastructure projects is also crucial. Overall, there seems to be a relative consensus that indicators on health, literacy and governance are important determinants of adaptive capacity (Brooks et al., 2005; Weiler et al., 2018). The impact of wealth and inequality on adaptive capacity is less clear.

Existing literature on the impact of vulnerability on adaptation funding generally finds that vulnerability has a strong correlation on the amount of funding received (Donner et al., 2016; Weiler et al., 2018). Additionally, there seems to be a recurring effect of smaller states receiving more funding per capita than larger states. Measures of physical risk seem to have a clear relation to adaptation funding, whereas the connection becomes less clear for some measures of adaptive capacity. This might be because more developed countries with higher adaptive capacity are sometimes able to utilize resources more effectively than more vulnerable countries with lower adaptive capacity. This becomes especially pronounced when one looks at indicators for good governance and GDP per capita. Donor countries might have a preference to give more funding to countries with good governance, even though this means sidelining more vulnerable countries with worse institutions.

### Data Sources

Vulnerability can be measured by:

- Measures of overall vulnerability:
  - ND-GAIN vulnerability score (Chen et al., 2023): The ND-Gain vulnerability score is a composite index constructed out of the ND-GAIN exposure, sensitivity, and adaptive capacity scores. It serves as the variable of key interest for this analysis. Other indices will be used to model the different aspects of vulnerability individually to determine to drivers of funding more closely. The ND-GAIN vulnerability scores are constructed out of individual indicators from the sectors of human development of food, water, health, ecosystem service, human habitat, and infrastructure. Given that vulnerability is a very broad concept, it makes sense to measure it by using an indicator that is constructed from numerous indices. This does make the analysis less transparent, but lets one incorporate the different dimensions of vulnerability into one variable.
- Measures of physical risk
  - ND-GAIN exposure and sensitivity scores (Chen et al., 2023): The exposure and sensitivity scores of the ND-GAIN indicator account for the physical risks that countries face. Each of the two scores is composed of 12 individual indicators coming from the sectors of human development of food, water, health, ecosystem service, human habitat, and infrastructure as highlighted above. It can be expected that these scores work in a very similar direction to the ND-GAIN vulnerability score which is partly composed from these exact indices.
  - CRI, Germanwatch climate risk index (Eckstein et al., 2021): This indicator measures risk related to extreme weather events attributable to climate change. It serves as an alternative measure of exposure to short-term physical risks. It would be expected for this index to yield similar results to the ND-GAIN exposure score.
- Measures of adaptive capacity
  - ND-GAIN adaptive capacity score (Chen et al., 2023): Like the ND-GAIN exposure and sensitivity scores, this score is composed of 12 individual indicators from 6 relevant sectors. As discussed in the chapter above, the relation between adaptive capacity and adaptation funding is not entirely clear. On one hand, countries with lesser adaptive capacity are more vulnerable and more in need of funding. On the other hand, countries with higher adaptive capacity might receive more funding because they have the infrastructure in place to request and utilize more of it. The ND-GAIN adaptive capacity score involves indicators tracking health, sanitation, and infrastructure, but notably not governance. The ND-GAIN governance score is available as an additional indicator and will also be utilized in this work.

- GDP per capita: The relation of GDP per capita to adaptive capacity is unclear in the literature on vulnerability. While GDP per capita is roughly related to factors such as health, education or governance, its use as a proxy for adaptive capacity is disputed. By comparing its effect to those of other more explicit measures of adaptive capacity and vulnerability, some additional light will be shed on this issue.
- ND-GAIN governance score (Chen et al., 2023, pp. 35-36): This index is constructed from the world governance indicators (WGI) on political stability, control of corruption, regulatory quality, and rule of law. Governance has been identified as a key determinant of adaptive capacity (Brooks et al., 2005) and should therefore also be represented in this model. Like with adaptive capacity as a whole, there are counterbalancing effects in place that make the effect of governance on adaptation funding received difficult to predict. It is possible that donors reward good governance with more funding, even though this means giving to countries that are less vulnerable in this regard.

Other confounding factors include:

- Distance between countries: It can be expected that geographical proximity between two countries also increases their mutual interest in each other. This increased interest could lead to more funding flows between geographically close countries. Due to this, distance between countries should be included in all regressions as a control variable.
- Colonial ties: Colonial ties can lead to special relationships between donor-recipient pairs of countries that should be included as a control variable in this work. The data on colonial history is taken from the Quality of Government institute's database (Hadenius & Teorell, 2007).
- Population size: It has been shown before that there seems to be an effect of smaller countries receiving more adaptation funding per capita than larger countries (Donner et al., 2016). This effect should be accounted for by including population size as a control variable in all regressions.
- Total recipient exports: The number of exports of a recipient country can be another factor in the distribution of adaptation funding. It is possible that countries with high exports receive more funding because their development is seen as more relevant to the donor countries' interests. This effect can be corrected for by including recipient exports in the model.

Adaptation funding is tracked by the UNFCCC and can be found for the period of 2015 to 2020. Their data serves as the dependent variable of the regression problems solved in this work. Taking only their bilaterally disbursed adaptation funding one compiles a dataset of roughly 10'000 observations. This data consists of a set of donors of 25 countries and a set of recipients of 140 countries. When the data is expanded for all connections between donors and recipients where no funding flows (coded as a contribution of 0), this results in a total dataset of roughly 30'000 observations.

The data collected is of dyadic nature, meaning that one observation describes the flow from one donor to one recipient country each year. The variables GDP per capita, distance, population size, total aid received, and total recipient exports will be log-transformed, so that the final regression results can be interpreted in terms of percentage increases. GDP per capita will furthermore be modelled using a quadratic term following Alesina & Dollar (2000).

## Methods

To answer the research question, a two stage Cragg model will be used (Cragg, 1971; Weiler et al., 2018). This means that two separate regressions will be run for each of the variables used to measure vulnerability. The first regression consists of a logit model, where the target variable is coded as one,

when funding was given, and zero, when no funding was given during a single year. In the second regression, the target variable is the amount of funding given for the subset of all observations where funding was given. This approach is used because the decision to allocate funding can differ from the decision of how much funding is appropriate. With a Cragg-model, both effects can be looked at separately.

The ND-GAIN vulnerability score will be used to determine the overall effect of vulnerability on funding received. The additional indicators outlined above model different aspects of vulnerability and will be used individually to give more clarity to the picture. For example, it could be possible that the physical risk component of vulnerability is strongly connected to funding received, while the adaptive capacity components show a weaker link. If the different measures approximate different aspects of vulnerability closely, one expects that they would yield similar regression results. For example, if both the ND-Gain governance score and gdp per capita are good measures of adaptive capacity, they should yield similar results in the regressions.

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