Master's Programme in Economic Growth, Population and Development (Economic Development Track)

Climate Change Performance as a Proxy for Transformative Capacity

A quantitative study of the relationship between the cognitive, structural and agency dimension of transformative capacity and climate change performance of 43 countries (2008-2022)

by

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Abstract: In this study, the quantitative relationship between the three dimensions of transformative capacity – cognitive, structural and agency – and the climate change performance of countries is examined. To do this, indexes are created and panel data regressions conducted. The result indicates a significant negative relationship between the cognitive and diversity dimension index and climate change performance. Results are less significant for the structural dimension but are also negative. Despite the negative relationship, the dimensions could still be important if considering their interrelation.

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1   Introduction

Past decades, the unsustainability of human impact on the planet has received an increasing amount of attention by both academics and the public. The scientific evidence pointing to the enormous magnitude of climate change and the threat it poses for human civilization has grown ever clearer over time. Today, climate change cannot be disputed (IPCC, 2021).

Many solutions, big and small, have been suggested. Still, surprisingly little has been done on a global and national level to relieve the pressure on the planet imposed by human activity to mitigate climate change. Moreover, efforts to build resilience towards what is to come if mitigation fails have largely been meager. To date, the level of action is nowhere near what scientists suggest is required to reach climate goals necessary for a sustainable future (IPCC, 2021). Because of this, the risk of a failure to make necessary changes on time to avoid climate disaster is becoming more and more real.

Transferring to so called *green growth,* economic growth that is decoupled from carbon emissions and natural resource use, has been a formulated goal of many organizations and governments. Since global carbon emissions and natural resource use is what counts, and it is already unsustainably high, an absolute decoupling is required. However, a study shows that even the most ambitious scenarios would not lead to an absolute decoupling of growth globally with today's consumption patterns. Hence, authors believe its promotion of green growth is misguided. Instead, lessening the pressure on resources and emissions is likely to happen without growth rather than with it. This calls for more radical changes regarding either consumption patterns or the level of consumption (Hickel & Kallis, 2020).

As a response to the need of more radical changes needed as well as the (so far) inefficiency of suitable responses, a part of the literature on climate change has focused on the institutions and institutional structures necessary for implement suitable changes and spark action more efficiently. Rather recently, the concept of transformative capacity of systems has been lifted as crucial for effective tackling and handling of climate change more efficiently (Wolfram,

2016; Folke, 2016; Walker et al., 2004; Herrfahrdt-Pähle et al., 2020). It is defined here as the "capacity to create fundamentally new systems of human-environmental interactions and feedbacks when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004).

Ultimately, transformative change is about breaking the path dependency by changing the institutions that create it (De Haan and Rotmans, 2018). Three dimensions that are distinguished regarding transformative capacity is the cognitive, structural and agency capacity, which has to do with the actors of change and how they bring it about (Herrfahrdt-Pähle et al., 2020; Ziervogel, Cowen & Ziniades, 2016).

This article aims to examine whether performance in these dimensions is related to climate change performance. Climate change performance is in turn argued to be a suitable proxy for transformative capacity. This is done by constructing indexes that reflect the dimensions and conducting panel data regressions to examine their quantitative relationship to climate change performance.

1.1   Research Problem

Scientists are in consensus that action against climate change is urgent. Despite this, the response of governments around the world have been too slow. The inaction of governments highlights an inefficiency of institutions regarding their responsiveness to new challenges. The argument has been made that reaching the goal of a global warming within 1.5 °C is no longer likely to be possible even if emissions are cut abruptly. Hence, even if efforts were sped up, rapid climate change is to be expected (IPCC, 2019, 2021; Mann & Wainwright, 2018, p. 8).

With this as a background, speeding up the process by improving the ability of institutions to transform to face changing circumstances – their so-called transformative capacity – seems vital. Most importantly, to do what can still be done to mitigate climate change. Even if failing to do so, transformative capacity is likely important to efficiently face the new reality

of quickly changing circumstances that rapid climate change would embody since there is now a large risk of this happening (IPCC, 2019; Mann & Wainwright, 2018, p. 8).

Transformative capacity can be divided into three dimensions: a cognitive, a structural and an agency dimension. Each of these are argued to be important on their own and in combination for transformative capacity (Herrfahrdt-Pähle et al., 2020). While there is a wide array of research on the transformative capacity of countries as well as on its three dimensions, most have been of a qualitative nature – creating theoretical frameworks to conceptualize the concept and finding empirical support in case studies. While case studies enable a more thorough understanding of specific cases and allowing for deeper analysis, it is also meaningful to examine whether there are some general patterns to be found. To do this, a quantitative approach could be of use. By this reasoning, the aim of this article is to examine whether a quantitative relationship between the three dimensions and the transformative capacity of a country is found.

To reflect the dimensions, indexes are constructed based on the literature regarding the most important aspects in each one. The proxy for transformative capacity used in this article is the Climate Change Performance Index (CCPI). The reasoning behind using CCPI as a proxy is that a country with higher transformative capacity is theoretically more likely to undergo more extensive climate action since it per definition is to "reorganize the system when an old state has become ineffective to meet present challenges". Since climate change is one of the major present challenges to be faced and current systems have been shown to be unsustainable the response to climate change, in the form of CCPI, is believed to be a suitable proxy. Based on the assumption that CCPI successfully reflects transformative capacity, the previous theory presented suggests that a higher performance in the cognitive, structural and agency dimensions should be related to a better climate change performance. That is, a higher CCPI. Whether this is the case or not is examined in this study.

Specifically, the main research question of this article is:
"Is a higher performance in the cognitive, structural and/or agency dimension related to a higher transformative capacity (measured here as a better climate change performance) of a country?"

If a relationship is found, another question of relevance is the relative importance of each dimension for climate change performance. The next question is therefore:

"What is the relative importance of each dimension in determining climate change performance?"

1.2   Aim and Scope

The aim of this thesis is to add to the literature on the transformative capacity of nations. That is, the ability of a country or society to reorganize its systems when an old state has become ineffective to meet present challenges. In this article, the challenge in focus is climate change. In this study, transformative capacity is therefore associated with a more effective response to climate change (Walker et al., 2004).

The work on transformative capacity is extensive and not limited to a single discipline. However, most of the work has been of a qualitative nature. Focus has been on theory, such as theoretical frameworks, and empirical support has been searched for in case studies. This is understandable since multiple of the aspects that transformative capacity arguably depends on are highly complicated and broad. Quantifying them is not by any means straightforward or easy. However, I believe it is meaningful to test the qualitative frameworks of transformative capacity that has emerged quantitatively to see if empirical support can be found on a more general level. Moreover, I believe the concept of transformative capacity would become more easily applicable on a broad level and put in practice if quantitative measurements reflecting the dimensions are identified. However, the aim is not to construct a comprehensive quantitative framework of the transformative capacity of countries. Rather, it is to test one interpretation of them and see if there is any empirical support for this specific interpretation.

While it has been argued that this study is meaningful, there are several limitations associated with it. First, transformative capacity is a highly complicated concept that could be conceptualized quantitatively in countless ways. Moreover, there are likely several aspects of it that are not easily measurable. Because of this, a general quantitative framework cannot credibly be argued to catch all aspects that measures the transformative capacity of a country.

However, this does not mean that it is not meaningful to attempt to find measures that reflect it.

Based on the above, the aim of this study is therefore not to reject or accept the theory of the three dimensions of transformative capacity and their importance. Rather, the results are limited to the aspects tested and the assumptions that are made in this study. Hence, the aim of this study is to test if the theory holds for these specific aspects and with the assumptions made. This is – to examine whether higher human capital and level of innovation, widespread networks that enable the participation of many actors as well as diversity of actors (limited to gender diversity in this study) in government contributes to a higher transformative capacity in terms of a more adequate climate change performance.

1.3 Outline of the Thesis

The thesis will first continue with a theory section. This section initiates with a summary of previous research on climate change and up-to-date efforts to mitigate it are briefly presented to motivate why it is important. The concept of transformative capacity is then presented as well as arguments for why it is important to meet the challenges that climate change embodies. Special focus lies on the framework of the three dimensions of transformative capacity – cognitive, structural and agency – since they are the focus of this study.

After this, the theoretical approach that emerges from the previous literature is presented. In this section, the conceptualization of the study based on the literature is described and discussed. Then, a data section follows where the variables as well as the data sources of the study are described and motivated. This is followed by a methodology section where the methods and models used to conduct the quantitative analysis are presented. This also includes a presentation of the statistical tests that are used to examine the reliability of the chosen method and model. The empirical results of the quantitative analysis are then presented and discussed. Lastly, the article finishes with a conclusion section.

2   Theory

In this section, previous research on climate change and transformative capacity of nations or systems is presented to motivate and provide a basis for the theoretical approach which follows.

2.1   Previous Research

2.1.1   Climate Change

The threat of climate change and its magnitude is no longer up for dispute. There is a wide consensus among scientist on that rapid climate change is already ongoing. Moreover, on that the opportunity window to counteract a climate crisis is rapidly closing. Still, efforts on a national and global level have been slow and insufficient to meet climate goals (IPCC, 2021; Mann & Wainwright, 2019).

While climate action of governments has been insufficient, there has not been a shortage of proposed solutions for a more sustainable future. For example, many scholars have focused on how to achieve so called *green growth*. The concept refers to a scenario where economic growth has become decoupled from natural resource use and carbon emissions. The scenario has been a formulated goal of many organizations and governments in the quest for sustainable economies and societies. Since carbon emissions and natural resource use on a global level is what counts and it is already unsustainably high, an absolute decoupling would be required for growth to truly be green (Hickel & Kallis, 2020). Advocates of green growth more or less assume that such an absolute decoupling is possible.

Hickel and Kallis (2020) approach this question. They make a comprehensive literature review of studies on decoupling to examine the practical prospects of green growth. Their focus is on both decoupling of natural resources from economic growth in general and of

carbon emissions specifically. Their finding is that even the most ambitious future scenarios would not lead to an absolute decoupling of growth from either natural resource use or carbon emissions on a global scale with today's consumption patterns. Although an absolute decoupling from carbon emissions is found to be theoretically possible on a national level, this is not enough since global carbon emissions is what matters for climate change. Moreover, it is only argued to be possible in the short run since carbon efficiency improvements can only go so far and would eventually not be able keep up with economic growth. In summary, the authors do not find support for the above assumption green growth being possible in their study (Hickel and Kallis, 2020).

Consequently, the authors object to the promotion and reliance on green growth since they believe it is highly misguiding. Instead, they argue that lessening the pressure on natural resources and carbon emissions is likely to happen without growth rather than with it. Alternatively, it would require a major re-composition of consumption patterns through a shift towards activities and goods that are carbon-neutral and require less intensive use of natural resources in absolute terms (Hickel and Kallis, 2020).

Similarly, other scholars argue that small alterations over time or adaptations (in a reactive sense) to climate change will likely not be enough to achieve sustainable societies (Olsson et al., 2017; Westley et al., 2011). It is also suggested that infrastructure that cause a lock-in of carbon emissions higher than the suggested maximum levels to avoid major global warming has already been built. Hence, creating a path dependence that makes the possibility of reaching climate goals on time bleak (International Energy Agency, 2012). Based on the above, the prospects of achieving a global reduction of emissions large enough to limit extensive global warming is rather poor. Even if this happens – it would most likely be insufficient to limit global warming to 1.5 °C (Mann & Wainwright, 2018, p. 8; IPCC, 2021).

The above suggests that, looking forward, more radical changes are needed to tackle climate change. Considering the slow and (so far) insufficient climate action around the world, countries and societies must become much more effective in their responses to changing circumstances. Explicitly, countries need to improve their ability to transform institutions and systems and break away from the path dependence of old ones. This notion has culminated in a wide stream of literature on a concept called *transformative capacity*. The concept is presented further below.

2.1.2 Transformative Capacity

The exact definition of transformative capacity has differed somewhat among authors and across disciplines. Among several definitions, it has been defined as "the transformative capacity of individuals, networks, organizations, sectors or nations to be able to both transform themselves and their society in a deliberate, conscious way" (Ziervogel, Cowen & Ziniades, 2016). Another definition that has been used is "the capacity to create fundamentally new systems of human-environmental interactions and feedbacks when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004). One such challenge that emphasizes the untenability of existing systems – calling for their transformation – is climate change. While the concept of transformative capacity did not necessarily develop as a response to climate change, it has become closely related to it. Its advocates argue that it is necessary to mitigate and face climate change effectively.

The emergence of the transformative capacity concept is partly a response to the critique of institutional theory for not being able to explain how institutions change over time or treatment of institutions as constants. Hence, it is essentially an effort to conceptualize how institutions change (Sotarauta and Pulkkinen, 2011). Ultimately, one could say that transformative capacity is about the capacity to break away from the path dependence, lock-ins or self-reenforcing nature that past or present institutions create (de Haan and Rotmans, 2018). As such, transformation derives from non-linear processes (Feola, 2015). The transformation can be desired or intended but can sometimes also be a consequence of unintended changes that are potentially undesired. Transformation can thereby be a result of either deliberate or non-deliberate action (Wilson et al., 2013). Since transformation can be deliberate, it is relevant to identify what drives it. That is, what conditions are beneficial for transformative capacity and who are the agents or agency of change? This will be discussed further below.

The transformative capacity of a country can be divided into three dimensions: the *cognitive*, *structural* and *agency* dimension. The dimensions are not necessarily present or active drivers of change at any point in time but are all argued to be important elements of transformative capacity. The cognitive dimension is about knowledge and the use of it. The structural dimension highlights the importance of networks and institutions that create the conditions for innovation as well as knowledge building and knowledge sharing. Lastly, the agency dimension is about the actors of change. It is important to note that the dimensions are both

argued to be important in themselves but also highly interrelated and dependent on each other (Herrfahrdt-Pähle et al., 2020). Since the three dimensions are the focus of this study, they are explained in more detail below.

The Cognitive Dimension

The cognitive dimension emphasizes the importance of knowledge since knowledge is essential to identify challenges and solutions. Moreover, to identify windows of opportunity for when efforts of change are more likely to be feasible (Herrfahrdt-Pähle et al., 2020). Knowledge building and sharing, diversity of knowledge as well as innovation capacity are also emphasized in the cognitive dimension (Olsson, Bodin & Folke, 2010).

Regarding diverse knowledge, knowledge on different levels such as scientific and on a local level as well as experimental knowledge are brought forward. It is important to combine these to create a broader understanding of systems (Folke et al. 2003; 2005). The importance of social learning and social memory is also emphasized. These matter for how knowledge is used and interpreted, which make them important in this dimension. Hence, what is important is not only the underlying knowledge base but rather how this is knowledge is used and understood (Folke et al. 2005). Regarding innovation capacity, innovation has been seen as an important driver of economic development for a long time, with Joseph Schumpeter as one of the most important proponents. In 1911, he argued that innovation is vital to enable new paths (Schumpeter, 1911, p. 1-15). This relates well to the concept of transformative capacity since it involves breaking away from path dependence (Olsson, Bodin & Folke, 2010).

The Structural Dimension

The structural dimension focuses on institutional structures and relations. Because these often take time and are difficult to change, this could be argued to be the dimension that is the main cause of the path dependence of the transformative capacity of countries. Such institutions can be both formal and informal. One main feature emphasized in this dimension is networks. One such network can be bridging organizations, that bring actors of different areas and hierarchical levels together. Such diverse networks are important for creating innovative solutions to complex problems (Herrfahrdt-Pähle et al., 2020). Trust and empowerment are also emphasized since they are important for networks to work effectively (Olsson et al, 2006).

The Agency Dimension

The agency dimension is about the actors of change. For example, the actors can be individuals, networks, organizations, sectors or nations. The importance of the inclusion and empowerment of a diversity of actors is strongly emphasized. A mapping of the literature on transformation showed that out of a sample of 50 articles on the subject, 41 were deemed to be strongly correlated with the subject of "diverse governance and network forms". Moreover, 37 out of 50 were connected to the subject "participation and inclusiveness" (Wolfram, 2016, p. 3) This reflects a clear consistency among scholars regarding the importance of diversity for transformative capacity. Weller (2017) even argued that diversity is one of the key elements for transformative capacity. The focus is not only limited to this dimension but is vital in all dimensions – both of actors, networks and of knowledge (Weller, 2017; de Haan & Rotmans, 2018; Westley et al. 2016; Cástan-Broto et al., 2019; Pelling, O'Brien & Matyas, 2015; Chaminade, 2020). It is also important for bridging the dimensions to each other (Herrfahrdt-Pähle et al., 2020).

Outside of the transformative capacity literature, there is also strong empirical support for that diversity is important for creating innovative solutions. There is a general consensus in the literature that diverse groups can improve in groups and organizations. However, the positive effect is far from inevitable. Several studies suggests that the positive effect of diverse teams is not unconditional - there are some conditions that need to be fulfilled. For example, evidence shows that the positive effect of diversity on creativity is only up to a certain degree after which the effect was no longer visible (Dayan, Ozer & Almazrouei, 2017). It is also suggested that too-much-of-a-good-thing often leads to undesirable outcomes (the TMGT-effect) even with things that have very positive effects in moderation (Pierce & Aguinis, 2013).

Another study shows that, for diversity to be positive for creativity, there also needs to be a culture of knowledge sharing present. Moreover, the effect is stronger in groups that are less dense (but still involved many actors) and that are more interconnected in terms of email communication intensity (Gilson et al., 2013; Zhang, Gloor & Grippa, 2013). Additionally, the positive effect tends to be stronger when creative and intrapreneurial individuals are a central in a network and when communication is clear (Akthar & Kang, 2016). In other words, the relation between diversity and creativity does not seem to be unconditional

The agency dimension can be divided into three types. These are: Schumpeterian innovative entrepreneurship, institutional entrepreneurship and place leadership. Together, these are referred to as the trinity of change agency. These are argued to contribute separately and in interrelation to regional development and breaking away from path dependence by creating new regional growth paths. Creating new regional paths is in turn important for transformative capacity. The type of action that is in focus is transformative agency, defined as actions "of relevance for the emergence of regional growth paths, and in particular actions aiming to break from existing patterns and work towards the establishment of new ones" (Grillitsch & Sotarauta, 2020).

Windows of Opportunity

Within the literature of transformative capacity, windows of opportunity (or opportunity spaces) are frequently mentioned. The concept connects transformative capacity to time and space. Windows of opportunity is especially connected to the agency dimension, since the actors of change are the ones that can potentially create, identify and/or make use of these windows to form alternative growth paths (Grillitsch & Sotarauta, 2020). These windows are important since they affect the possibility of making use of transformative capacity. If an opportunity space is not present at a certain point in time, transformation is argued to be less likely to take place despite a high transformative capacity at that specific point (Herrfahrdt-Pähle et al., 2020). Windows of opportunity often open as a result of different forms of crises. For example, in the wake of a food-, political- or social crisis or similar (Chapin, 2009; Herrfahrdt-Pähle et al., 2020; Grillitsch & Sotarauta, 2020). Since this aspect has large implications for the success of agency towards transformation, it is important to keep in mind and understand how and why transformation occurs in some cases but not in others even when underlying preconditions for transformative capacity are the same.

2.2   Theoretical Approach

The literature presented on climate change emphasizes its severity as well as the importance of flexible institutions that are able respond to changing circumstances effectively (IPCC, 2021; Mann & Wainwright, 2019; Hickel & Kallis, 2020). The literature on transformative capacity suggests that this is an important feature to achieve such flexibility (Ziervogel,

Cowen & Ziniades, 2016; Walker et al., 2004; Sotarauta and Pulkkinen, 2011; de Haan and Rotmans, 2018; Feola, 2015).

As mentioned, several definitions for transformative capacity have been stated. In this article, the definition used is "the capacity to create fundamentally new systems of human-environmental interactions and feedbacks when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004). Although other stricter definitions exist, this rather broad definition is what is referred to when mentioning transformative capacity in this article. It is reasoned to be a suitable definition since the focus of this study in relation to transformative capacity is on climate change performance. Moreover, the focus in this article is on the transformative capacity of nations, although the concept of transformative capacity in general can refer to both more limited entities as well as more broad ones.

The division of transformative capacity can be made into three different dimensions – the cognitive, structural and agency dimension. The framework is theoretical and descriptive, looking at qualitative case studies for empirical support (Herrfahrdt-Pähle et al., 2020; Grillitsch & Sotarauta, 2020). Based on this division, the idea of this study is to test the importance of the three important dimensions quantitatively since previous focus have mainly been theoretical and case specific.

To do this, suitable indexes, that are assumed to reflect how well countries are doing on the three dimensions, are identified and used to test if there is any general relation between the indexes and transformative capacity of countries in terms of climate change performance. Climate change performance is seen as a relevant proxy for transformative capacity since climate change action largely requires breaking away from path dependence, and countries with a better climate change performance could be assumed to generally have done a better job at breaking away from old ways. Moreover, climate change performance reflects how well countries have responded to changing circumstances that the challenge of climate change embodies, which is also an important characteristic of transformative capacity based on the literature review above. By this reasoning, a country with higher transformative capacity is assumed in this study to generally have improved its climate change performance more than those with a lower transformative capacity.

The indexes identified to reflect dimensions are determined with the literature review as a base. Since there are aspects of the dimensions that are difficult to measure, the focus is on capturing the main aspects that each dimension refers to. In the cognitive dimension, knowledge and innovation capacity are brought up as central (Herrfahrdt-Pähle et al., 2020).

To reflect the knowledge level in a country, a human capital index is used. To reflect the level of innovation in a country, the share of GDP spent on research and development is used since this reflects the effort of promoting innovation. For the structural dimensions, conditions that are reasoned to positively affect the efficency of networks are used. For the agency dimension, a diversity of actors involved in networks is emphasized (Weller, 2017; de Haan & Rotmans, 2018; Westley et al. 2016; Cástan-Broto et al., 2019; Pelling, O'Brien & Matyas, 2015; Chaminade, 2020). To reflect diversity, the proportion of women in national governments and in ministerial positions are used. Diversity of actors within the literature of transformative capacity is not limited to gender but for example also involves the inclusion of actors across disciplines and across hierarchical levels (Wolfram, 2016). However, suitable measures other aspects than gender diversity that go back long enough in time for this study were not found. Hence, the agency diversity in this study is limited to gender diversity, although acknowledging that other types of diversity are likely important.

In summary, indexes are constructed for each of the three dimensions of transformative capacity consisting of the variables above. The relationship between these and the proxy used for transformative capacity itself – climate change performance –is examined with the help of a regression analysis. This is done in order to see if empirical support for the theory on the importance of the three dimensions (limited to how they are measured in this study) is found on a general level.

3 Data

In this section, the variables and data sources are first presented. The data sources are presented both in text and in a separate table for clarity. The data sources and choice of variables are then discussed as well as their reliability. Then, the handling of missing data is described. Lastly, some of the data limitations of this study are identified.

3.1 Variables

3.1.1 Climate Change Performance Index

The proxy for transformative capacity used in this study is the climate change performance of countries. The variable CCPI, the Climate Change Performance Index is collected from the reports with the same name (Germanwatch et al. 2008-2022). The reports have been released annually since 2005. The index aims to measure the performance of countries relative to each other by comparing their emission levels, share of renewable energy efficiency as well as national and international policies regarding climate change. Based on how well countries are performing in these aspects, a score is given. Based on the score of a country compared to other countries, a rank is also given.

In this study, the score is what is used rather than the ranking. This was deemed suitable since a lot of information goes missing using only the ranking, such as the performance of a country in absolute terms. For example, a country doing better after one year could still rank lower if other countries also improved their performances during the same period. Moreover, not all countries with a CCPI score and rank are included in the sample due to limitations in other variables, which would make the rank misleading.

3.1.2 The Three Dimensions

The three dimensions of transformative capacity aimed to be measured in this study are the cognitive, structural and agency dimension. Several measurements that are deemed to reflect the dimensions are used to construct an index for each one. The elements used to construct the indexes are all standardized for comparability. Then, all index scores are also re-scaled from 0-10 for facilitating interpretation of regression results.

Cognitive Dimension

For the *cognitive* dimension, two measurements are used to construct the index. First, a human capital index from Penn World Tables 10.0 is used to reflect the knowledge level of a country (Feenstra, Inklaar and Timmer, 2015). The human capital index is based on data on the average years of schooling collected by Barro and Lee (2013) and returns to education. Returns to education is based on the Mincer equation which aims to measure the private returns to an individual if they receive one additional year of schooling (Psacharopoulos, 1994). Second, the expenditure on research and development in terms of percent of GDP is used to reflect efforts of promoting innovation in a country. Data on this is collected from the World Development Indicators (World Bank, 2022a).

Structural Dimension

For the *structural* dimension, four estimates are used aiming to reflect the underlying circumstances for networks to work effectively. Three of these are collected from the UN E-Government Knowledgebase (UN, 2022). E-government is short for electronic government which refers to a government that uses technology to enable citizens to participate and communicate with the government. This is argued to be important for a more direct and effective communication between the government and its citizens (UN, 2022). Telecommunication ability is not explicitly mentioned regarding the structural dimension in the literature. However, networks, specifically of a diverse and multidisciplinary nature, are argued to be the key feature of this dimension (Wolfram, 2016).Moreover, the possibility of accessing information is emphasized (Folke et al., 2005). Since the three E-government indexes aim to reflect the ability of citizens to participate and access information, these are included in the structural dimension.

The first of these is an e-participation index (EPI), reflecting how well information is shared as well as how well citizens are promoted to engage in decision-making. As such, it is a measure of the basis for social inclusion of governance in a country. The second is an online service index, measuring the "a government's capability and willingness to provide services and communicate with its citizens electronically" (UN, 2022). Third, a telecommunications infrastructure index (TII) is used. It measures the ability of a country's current infrastructure to enable the participation of citizens in e-government. Lastly, the Economic Complexity Index (ECI) by Atlas is used to reflect the economic complexity of a country (Atlas of Economic Complexity, 2022). The ECI is deemed suitable since it gives an indication of whether there are preconditions for more diverse networks. An index for the structural dimension is created based on these five measurements.

Agency Dimension

The *agency* dimension aims to reflect the diversity of actors in positions of power. To reflect this the proportion of seats held by women in national parliaments as well as the proportion of women in ministerial level positions in percent are used. Data for the two variables is collected from the World Bank's gender data portal (World Bank, 2022b). An index for the agency dimension is created based on these two measurements.

3.1.3   Control Variable

It is reasonable to think that either climate change performance or the indexes are related to income level. Therefore, GDP per capita is used as a control variable in the model. To reflect it, the variable rgdpe divided by country population, both collected from the Penn Tables 10.0 2021 edition is used. Rgdpe stands for "output-side real GDP at current PPPs" (Feenstra, Inklaar & Timmer, 2015). A purchasing price parity (PPP) GDP measure is used for the sake of comparability.

Table 3.1 Variables, proxies and data sources

Variable	Proxy	Data Source
The cognitive dimension	Human Capital Index	Penn World Tables 10.0
	Research and development expenditure (% of GDP)	World Development Indicators

The structural dimension	Online Service Index	UN E-Government Database
	Telecommunication Infrastructure Index	
	E-participation	
	The Economic Complexity Index (ECI)	Atlas of Economic Complexity
The agency dimension	Proportion of seats held by women in national parliaments (%)	World Bank Gender Data Portal
	Proportion of women in ministerial level positions (%)	
Transformative capacity	Climate Change Performance Index (CCPI)	Germanwatch, Climate Action Network Europe/International & NewClimate Institute
Control variable: Income level	Expenditure-side real GDP at chained PPPs (RGDPE) per capita	Penn World Tables 10.0

3.2 Source Material

The data used for conducting the quantitative study is collected from sources that are deemed highly reliable. The Penn World Table is a widely used database among economists. The same is true for the data collected from the World Bank and the UN. The World Bank database collect data from recognized international sources and base their measurements on internationally accepted standards. Moreover, the groups that collect the data are guided by professional standards. This should make them a credible source. However, even the World Bank itself admits that there are some problems involved in producing reliable data. For example, under-investment in statistical practices in developing counties countries can lead to data of poor quality. Still, this is not a problem specifically to the World Bank but for all data

sources (World Bank, 2022c). Hence, this is something that has to be kept in mind and makes it relevant to turn to several studies and methods before making conclusions about something.

3.3   Missing Data

Since the collection of data is not on a yearly basis for all variables, data is missing for some variables and years. For these years, the rule used is that data from the closest presented value is used. If the closest value is a previous one, this is prioritized. If a later value is closer, this is the value used. The reasoning behind this is that the closest value is the most likely to accurately reflect the missing one. While this assumed to be true in most cases, it does not necessarily have to be the case and is regardless a simplification of reality. However, it is deemed as an acceptable limitation since the variables are of a relatively stable nature in the very short-term outlook. For example, human capital or telecommunication infrastructure is not likely to change dramatically from one year to the next unless under very specific circumstances such as a crisis or a war. Likewise, the gender diversity in government and in ministerial positions likely does not change drastically every year.

However, if data is missing for more than two years in a row, all observations for that country is removed since assuming past or future values are deemed too speculative in this case, especially with regards to the rather short period studied. An exception is made, however, for human capital data since it is assumed to change rather slowly. For this, the closest past value is used unless there are more than four years in a row missing. Moreover, an exception is made for GDP per capita and share of investment on research and development. For these two variables, a mean of the past five years is used.

The countries included and the period studied in the sample are decided by data availability. Data on the climate change performance index is only available for about 60 countries, and thereby constitutes the largest data limitation in this study. For the dimension indexes, data limitations further reduced the sample. In the end, 43 countries had available data for all variables and data was available for the period 2008-2022. In Appendix A, the 43 countries that remain in the sample after removing the countries with missing data are listed. Since the

countries that remain are countries with relatively high income per capita, the data is less representative for countries with a lower income.

3.4   Data Limitations

Revisions have been done continually of the CCPI concerning the methodology behind constructing the index and this is also the case for some of the data behind the index. This is done to better reflect guidelines and to make the index more comprehensible. While this could affect the comparability of the index from year to year, it is likely that it still reflects the climate change performance of a country from year to year in a meaningful way. Nevertheless, it is a limitation that should be acknowledged (Germanwatch et al., 2021).

Additionally, there are weaknesses in using climate change performance as a proxy for transformative capacity since all action against climate change need not be transformative but can also be actions within present systems or simply adaption. However, it seems reasonable that countries with a higher transformative capacity would tend to have a higher level of action. Nevertheless, this is an assumption that should be acknowledged due to being a simplification of reality.

In more general terms, the dimensions are, as mentioned, complex in that there are almost uncountable aspects that could be related to each one. This makes it difficult, even in theory, to construct comprehensive quantitative measures of each one. Especially, since the aspects that are important in each country may not be the same. For aspects that are more straightforward to measure, there is a limitation of data availability. While there are numerous indexes and variables that could be of use, many of the datasets considered when conducting this study are limited in terms of the number of years available as well as number of countries included. Since a panel regression with fixed effects is the method used in the quantitative study, there is a minimum for the number of observations required for the usefulness of the model.

Regarding representation and validity of data, it is by no means perfect since the indexes do not cover all aspects of the dimensions. Still, this is not a major problem as long as this is kept in mind. As mentioned, it is not intended in this study to create a comprehensive quantitative framework or accept or reject the theory but rather to test the relationship between the construction of the indexes reflecting the dimensions in this study.

Additionally, several indexes considered were too comprehensive in that they included aspects of several dimensions in the same index. Because of this, more distinctive measures for each dimension were deemed more suitable. Since the point of the study is to separate them to study the contribution of each dimension as well as their relative importance, using these would have been counterproductive for the purpose and would likely have caused multicollinearity in the model.

Because of the above, data limitations have been quite extensive. Despite the limitations, however, indexes that were found suitable for reflecting at least some of the important aspects of each dimension were eventually found. Nevertheless, it must be acknowledged here once more that they are limited in terms of how much information they convey, but as long as this limitation is kept in mind, it is not necessarily a problem. The results of the study should be considered as reflecting the relationship between the specific aspects included in the indexes as constructed in this study and climate change performance.

4 Methods

In this section the methodology of the study is explained. That is, how the analysis examining the correlation between the three suggested dimensions of transformative capacity – cognitive, structural and agency – and transformative capacity (measured as climate change performance) is conducted empirically to answer the research question. The econometric model that is used and the variables it includes is presented and explained as well as how the data is collected. To answer the research questions of this article a quantitative method is used.

4.1 The Base Model

The base model approach is to measure the relation between the three dimensions – cognitive, structural and agency – and the transformative capacity of countries (proxied as climate change performance). Hence, the dependent variable of the model is climate change performance (CCPI), and the independent variables are the three dimensions of transformative capacity.

Indexes are constructed and are used reflect the different dimensions of transformative capacity. Each measure is standardized for comparability and weighted equally. For example, if there are two variables for one index these are weighted fifty percent each. Alternatively, if there are three variables for a measure these are given the weight of one third each. The reasoning of this is that there is no clear basis motivating why the variables should be weighted differently and that it would therefore become very speculative to do so.

 In addition to mentioned variables, a variable controlling for the potential importance of different income levels is included in the model. The method that will be used for this is a panel data regression with fixed effects using the program Stata, where the command *xtreg* is used. A panel data regression is chosen since it is suitable for studying cross-country analysis

over time. Fixed effects are used since it is assumed that the entities studies, countries, each have individual characteristics that could skew the results if not accounted for. The base model is specified below:

$$CCPI_{it} = \beta_0 + \beta_1 cognitive_{it} + \beta_2 structural_{it} + \beta_3 agency_{it} + \beta_4 GDPcap_{it} + \propto_i + \varepsilon_{it}$$

Where the dependent variable $CCPI_{it}$ is the climate change performance index and β_0 is a constant. The variable $cognitive_{it}$ is the index variable for the cognitive dimension, $structural_{it}$ for the structural dimension and $agency_{it}$ for the agency dimension. $GDPcap_{it}$ is the control variable controlling for income per capita. The variable α_i is the fixed or country-specific intercepts and ε_{it} is the error term. Below, the variables CCPI, cognitive, structural, agency and GPDcap are explained further.

4.2   Lagged Models

The three dimensions may not have an instant effect on climate change performance. This may also be true for GDP per capita. If this is the case, the effect on CCPI of a higher score in one of the dimensions or of income per capita may not be visible for the same year. To account for this possibility, regressions are conducted with lags up to three years for the dimension variable and for GDP per capita. That is, a regression is conducted without a lag (as shown in the base model above) as well as with a one-, two- and three-year lag. To specify the models accounting for the different lags, the model for each lag order is shown below. Apart from the lags, all else is the same as in the base model.

Model with a one-year lag:

$$CCPI_{it} = \beta_0 + \beta_1 cognitive_{it-1} + \beta_2 structural_{it-1} + \beta_3 agency_{it-1} + \beta_4 GDPcap_{it-1} + \propto_i + \varepsilon_{it}$$

Model with a two-year lag:

$$CCPI_{it} = \beta_0 + \beta_1 cognitive_{it-2} + \beta_2 structural_{it-2} + \beta_3 agency_{it-2} + \beta_4 GDPcap_{it-2} + \propto_i + \varepsilon_{it}$$

Model with a three-year lag:

$$CCPI_{it} = \beta_0 + \beta_1 cognitive_{it-3} + \beta_2 structural_{it-3} + \beta_3 agency_{it-3} + \beta_4 GDPcap_{it-3} + \propto_i + \varepsilon_{it}$$

4.3   Test Statistics

Two test statistics are conducted in this study. First a Hausman test is conducted. The test is conducted to make sure the error terms between countries are not correlated. This is done to make sure that fixed effects are suitable for the model rather than random effects. The Stata command used for to conduct the test is *hausman*. The null hypothesis of the test in Stata is that random effects are appropriate. Hence, the interpretation of the result of a Hausman test is that, if the p-value, or "prob > Chi2", is statistically significant, fixed effects are more suitable than random effects as mentioned in Torres-Reyna (2007). In this study, the p-value of the test is seen as statistically significant if it is greater than 0.05.

Secondly, a Jarque-Bera test is conducted to test whether the residuals of the regressions are randomly distributed. The Stata command used to conduct the test is *sktest*. The null hypothesis of the test in Stata is that the residuals are normally distributed. Hence, the interpretation of the test is that a statistically significant p-value would indicate that the residuals are not normally distributed. In contrast, a non-significant p-value would mean that the null cannot be rejected and that the residuals therefore seem normally distributed (Jarque & Bera, 1980).

Lastly, a test to make sure that there is not a perfect linear relationship between two of the independent variables is conducted. In other words, to check for multicollinearity in the models used. If there is a strong multicollinearity, their individual statistic significance could be undermined. The *vif* command in Stata is used after each regression for this. A vif-value lower than 10 is generally seen as acceptable in terms of multicollinearity. Hence, if the value is below 10 the model should not suffer from too much multicollinearity to undermine the statistical significance of the coefficients (UCLA, 2022).

5   Empirical Analysis

In this section the result from the regressions analyses that were conducted is first presented. Then, the results from the test statistics are presented. The result section is followed by an interpretation and discussion of the result and its implications. Moreover, how it relates to the theory on transformative capacity.

5.1   Results

5.1.1   Regressions

The regression results of the panel regression with fixed effects are presented in Table 5.1 below. In the table, each column shows the result of the models using different lags. For clarity, each regression is named after how many years the variables cognitive, structural, agency and GDPcap are lagged. That is, the regression without using lags is named (0), the regression with a one-year lag is named (1) and the one with a two-year lag is named (2). Lastly, the three-year lag regression is named (3). Below, each regression is commented in separate paragraphs. First, however, the constant and the control variable in all regressions are briefly commented on.

Table 5.1 Regression results for the period 2008-2022

CCPI	(0) No lag	(1) One-year lag	(2) Two-year lag	(3) Three-year lag
Constant	*69.84****	*79.41****	*84.04****	*87.35****
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*

Cognitive	- 1.28	- 2.45***	- 2.44***	- 2.93***
	(0.127)	(0.004)	(0.004)	(0.001)
Structural	- 0.46*	- 0.19	- 0.38	- 0.50*
	(0.072)	(0.469)	(0.158)	(0.080)
Agency	- 0.83***	- 0.86***	- 0.84***	- 0.79**
	(0.004)	(0.004)	(0.007)	(0.019)
GDPcap	- 0.00016**	- 0.00034***	- 0.00046***	- 0.00049***
	(0.025)	(0.000)	(0.000)	(0.000)
R^2 (overall)	0.0282	0.0271	0.0265	0.0254
N	43	43	43	43
Obs. (per country)	645 (15)	602 (14)	559 (13)	516 (12)

*Note: *, ** and *** represent 10%, 5%, and 1% significance levels, respectively.*

The constant and the control variable GDPcap are both significant at the one or five percent level for all regressions conducted. For the constant, this merely means that the null hypothesis of the constant being zero is rejected. For GDPcap, this indicates that there is a significant negative relationship between GDP per capita and the CCPI. However, the coefficients are extremely small – ranging from (-0.00016) to (-0.00049).

The first regression without lags, (0), is presented in column two of Table 5.1. In this regression, the result is insignificant for the cognitive variable. For the structural, it is significant at the ten percent level. The structural coefficient is (-0.46), indicating that – all else the same - a country with a one-point higher score in the structural index tends to have approximately half a score lower in the CCPI the same year. The coefficient for the agency variable is significant at the one percent level. Its coefficient is (-0.83), indicating a negative

relationship between agency and the CCPI. Specifically, a higher score by one point in the agency index is related to close to a one-point lower score in the CCPI the same year .

Regression (1), with a one-year lag, is presented in column two of Table 5.1. The cognitive variable is significant at the one percent level with a coefficient of (-2.45). This indicates that a country scoring one point higher in the cognitive index is related to a CCPI of two and a half points lower the following year. In this regression, the structural variable is not significant. The agency variable, however, is significant at the one percent level with a coefficient of (-0.86). A higher score by one point in the agency index is thereby related to a CCPI of almost one point lower the following year.

The regression with a two-year lag is presented in column three in Table 5.1. In this regression, the cognitive variable is statistically significant at the one percent level. The coefficient is (-2.44), indicating a country with a one-point higher score in the cognitive index tends to have two and a half points lower score two years after. The structural variable is again non-significant whereas the agency variable is significant at the one percent level. The agency coefficient is (-0.84), which signalizes that a one-point score higher in the agency index is related to almost a point lower in the CCPI two years after.

Regression (3) is presented in column four of Table 5.1 and has a three-year lag. The cognitive variable is significant at the one percent level with a coefficient of (-2.93). In other words, a score of one-point higher score in the cognitive index three years prior is related to a three-point lower score in the CCPI three years after. The structural variable is significant at the ten percent level in this regression with a coefficient of (-0.5). Hence, a higher score by one point in the structural index in one year is related to half a point lower in the CCPI three years after. Moreover, the agency variable is statistically significant at the one percent level. Its coefficient is (-0.79), indicating a scoring of one point lower in the agency index is related to almost a point lower in the CCPI after three years have passed.

The effect of allowing for lags of the dimension index variables was generally very small. For the cognitive dimension index, the coefficient was not significant without the lags but for all regressions with lags. Additionally, it was somewhat stronger using a three-year than a one or two-year lag. For the structural index the result was not significant when using one or two-year lags but for the regression without and with a three-year lag. The significant coefficients

were, however, very similar in size. For the agency index the coefficient was approximately the same size regardless of which lag was used. The R^2-value was relatively similar for the different regressions but became weaker for each additional lag, which indicates that the model without a lag was the best fit. However, the regressions also had a smaller number of observations for each lag for each lag added, which could also influence R^2. Hence, due to the relatively similar values, not much weight will be put into this.

5.1.2   Test Statistics

Table 5.2 Result of Hausman tests

Hausman test	(0) No lag	(1) One-year lag	(2) Two-year lag	(3) Three-year lag
Prob > chi2	*0.000*	*0.000*	*0.000*	*0.000*

The result of the Hausman test is shown above in Table 5.2. The result of the tests for all four regressions is a p-value of 0.000, which means that the null is rejected. Since the null of this Hausman test in Stata is that a random effects model is appropriate, this is rejected. Instead, fixed effects are appropriate which is what was assumed. Consequently, the choice of using fixed effects can be deemed as the right choice.

Table 5.3 Result of Jarque-Bera tests

Jarque-Bera Test	(0) No lag	(1) One-year lag	(2) Two-year lag	(3) Three-year lag
Prob > chi2	0.4708	0.4093	0.2693	0.2252

The results of the Jarque-Bera tests are shown above in Table 5.3. Since the p-value is not significant, the null is not rejected. Because the null is that the residuals are normally distributed, the interpretation is that there is no statistical evidence to suggest that they are not so.

Table 5.4 Result of vif tests

vif	(0) No lag	(1) One-year lag	(2) Two-year lag	(3) Three-year lag
cognitive	2.56	2.60	2.66	2.75
structural	2.44	2.50	2.59	2.72
agency	1.93	1.95	1.97	2.00
GDPcap	1.34	1.34	1.34	1.34

Lastly, the results of the vif tests checking for multicollinearity are presenter in Table 5.4. Since all values are below 10, there should be no serious multicollinearity in the models.

5.2   Discussion

The coefficients for all statistically significant dimension variables are negative, even when controlling for GDP per capita. That is, a country with a one-point higher index in one of the dimensions, ceteris paribus, tends to have a lower climate change performance. The most negative relationship is between the cognitive dimension and climate change performance followed by the agency dimension and lastly, the structural dimension.

However, it has been repeated that, although the result shows a significant relationship between several of the dimension indexes and climate change performance, it cannot be concluded from this study that the relationship is causal. Additionally, the dimension indexes cannot be argued to fully represent the dimensions since they are defined in the literature. Hence, one should be very careful in making such conclusions. As have been argued repeatedly, the results can therefore not be used as a basis for accepting or rejecting the presented theory. Anyhow, the result is interesting in itself and still provides information about some aspects of the theory that could be of importance. The results suggest that a higher performance in either of the dimensions (as measured in this study) is not related to a higher transformative capacity in terms of climate change performance.

Specifically, regarding the cognitive dimension index countries, with a higher human capital in terms of years of schooling and returns to education as well as the share of GDP invested in research and development, have not performed better than those with a poorer performance in

these variables. Regarding the structural dimension, the interpretation is that the aspects that reflect the communication between citizens and the government, participation of citizens in governmental decision, citizens' access to information as well as the economic complexity of a country are not related to a better climate change performance. Lastly, since the agency dimension index reflects the gender diversity in high positions of governments and in ministerial positions, this means that a higher diversity is also not related to a better climate change performance. In contrast, all aspects are in fact generally related to a climate change performance that is somewhat worse.

Briefly assuming the indexes successfully reflect the dimensions, this could be argued not to be in line with the suggestion of the theory (Herrfahrdt-Pähle, 2020). The theory would instead suggest that countries performing better in the cognitive, structural and agency dimension should have a higher transformative capacity. Based on the argument of this study that there is reason to think that a higher transformative capacity should be related to a better climate change performance, the theory would suggest that countries performing better in the dimensions better should have a better climate change performance. This does not seem to be the case. Even if the indexes successfully reflect dimension performance, it does not necessarily mean that the aspects are not important for transformative capacity. Nevertheless, it does indicate that they are not sufficient in themselves.

There is a strong emphasis in the literature on interrelation of the dimensions when it comes to the transformative capacity, which is not accounted for in this study. Despite the results it may still be the case that the dimension indexes would be shown to have a positive effect on climate change performance conditionally on a good performance in the other dimensions. Since this is not studied here, it cannot be ruled out that this is the reason for their negative effects when measured separately. With this reasoning, the results could provide support for the importance of their interrelation. It still holds, however, that the result of this study provides empirical support that performance in the dimensions is not on their own positively associated with a better climate change performance. Hence, focusing on only one of the dimensions seems to be insufficient or even counterproductive with regards to the negative coefficients, at least concerning the aspects of the dimensions included in this study.

Windows of opportunity are also not considered in this study. As mentioned in the literature review, windows of opportunity (often caused by some form of crisis) are important for

making use of transformative capacity (Chapin, 2009; Herrfahrdt-Pähle et al., 2020; Grillitsch & Sotarauta, 2020). It could be argued that climate change is a crisis and could therefore potentially create a window of opportunity. However, it could be argued that it has not been treated as such, since it may not have been on the main agenda of governments until recently. Moreover, climate action is largely a collective action problem. That is, it may not be feasible for one country to change its systems radically if other countries do not. This could theoretically be true even if there is a willingness for radical change. Perhaps the absence of a positive effect on climate change performance of the three dimension indexes could be explained by this, since a more generally acknowledged threat is more likely to meet a fierce response. Countries with a higher transformative capacity could be argued to be more likely to treat climate change as a crisis, which would make this less of a problem.

Turning back to the interpretation dimension index coefficients, the structural dimension index is the least significant one in terms of both number of significant regressions as well as the significance level. This dimension was the most difficult to measure. This may be a reason for the less significant results if the indicators chosen for the index were not representative enough. It is also strongly correlated with GDP per capita, which could also affect the results. However, the multicollinearity test suggests that there is not a dangerously high level of multicollinearity in the model.

A potential reason for the suggested negative relation between the agency dimension (gender diversity in government and in ministerial positions) and a climate change performance could be that its positive effect is not unconditional. The literature suggests that some prerequisites are important for a positive effect of diversity on creativity. For example, a culture of knowledge sharing and for a group not to be too dense. Based on this, the result could indicate that these prerequisites tend not to be fulfilled. If this is the case, the result suggests that more work should be put into fulfilling these. It might also be the case that gender diversity is not enough to have an effect and that diversity of other types is also necessary, such as multidisciplinary actors, actors of different ethnicity or cultures as well as the cooperation of actors across hierarchical levels.

6   Conclusion

The purpose of this study was to examine whether there is a general quantitative relationship between the three dimensions of transformative capacity – cognitive, structural and agency – and the transformative capacity of countries during the period 2008-2022. The climate change performance was used as a proxy for transformative capacity. This was done to test their importance on a more general level than has previously been done (to my knowledge) on a case study level. With the dimensions, as reflected through the indexes constructed in this study, a significant negative relationship was found in almost all regressions for the cognitive dimension index and in all for the agency dimension index. For the structural dimension index, the result was less significant but still negative. The coefficients that were significant for the structural dimension index were also negative. The differences in result using different lags were very small.

The overall interpretation of the result is that the three dimensions as measured in this study are not positively related to transformative capacity as measured through climate change performance. This could be argued to be in contrast to what the literature suggests since it argues of their importance. However, there is a limitation to the aspects considered in each dimension in this study which means that this does not necessarily have to be the case. Moreover, the literature emphasizes their interrelation. Since the result suggest they are important separately, this may indicate the importance of their interrelation. Hence, the results could be argued to be in line with the literature from this point of view.

Turning back to the research questions of this study, the first one is whether a higher performance of a country in the cognitive, structural or agency dimension is related to a higher transformative capacity in terms of a better climate change performance. The results suggests that the performance of each dimension separately is not positively related to climate change performance. In fact, a higher performance in the cognitive or agency dimension is related to a poorer climate change performance. For the structural dimension, the results are

less significant, but the ones that significant there is also an indication of a negative relationship with climate change performance.

The second question was what the relative importance of each dimension is in determining climate change performance. As mentioned, the relation was indicated to be negative. The result suggests that the strongest negative correlation is between the cognitive dimension and climate change performance. The second strongest relationship is between the agency dimension climate change performance. The smallest coefficient was in relation to the structural dimension.

The result suggests each separate dimension does not have a positive relation to climate change performance. This was somewhat unexpected. Based on the literature, the logical assumption would that the relation should be positive. As has been discussed, there could be weaknesses in the construction of the dimension indexes since they cannot reflect all aspects. In addition, the interrelation of the dimensions as well as windows of opportunity are other aspects that could be important which are not part of this study. Hence, creating more comprehensive indexes as well as finding appropriate ways of including these aspects in a general quantitative study could be a possible subject for future research.

6.1   Future Research

The interrelation of the dimensions and their relation to climate change performance would have been interesting to study quantitatively on a detailed level. However, such a study is rather complicated since a strong interrelation of variables could cause measurement errors. Perhaps, consulting multiple methods could be of use to get a better view of their interrelation. To study potential regional-specific patterns, the sample could be divided into regions. In this study, the number of countries with available data was reasoned to be too small to do this.

Moreover, the approach for constructing the indexes reflecting the dimensions has been rather simplistic due to data and time limitations. Hence, a more comprehensive approach to measure the dimensions more in detail could be useful in future research. This way, the

measurement of the dimensions could become more standardized which would make it more approachable to governments around the world by enabling governments to see more clearly in which dimensions they are lacking. There are some great indexes that could be used or included in measuring the three dimensions. For example, the global knowledge index, a separation of power index and the global inclusiveness index could have been useful in this study. These would have provided a more comprehensive reflection of the cognitive, structural and the agency dimension, respectively. Due to their relatively recent emergence, these indexes were available for a too short period or for too few countries for a meaningful regression to be conducted based on them in this study. However, when the indexes have been around for longer, these or other more comprehensive indexes could potentially be suitable for reflecting the performance of countries in each of the three dimensions in a more comprehensive manner. Hence, these could be relevant to use in future studies at a later stage in time to conduct a similar study with more precision.

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Appendix A

List of countries included in the sample (N=43):

Argentina	Hungary	Republic of Korea
Australia	India	Romania
Austria	Ireland	Russian Federation
Belgium	Islamic Republic of Iran	Slovak Republic
Brazil	Italy	Slovenia
Bulgaria	Japan	South Africa
Canada	Kazakhstan	Spain
China	Lithuania	Sweden
Croatia	Malaysia	Thailand
Czech Republic	Mexico	Turkey
Denmark	Netherlands	Ukraine
Finland	New Zealand	United Kingdom
France	Norway	United States
Germany	Poland	
Greece	Portugal	