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Prerequisites to Combat Climate Change:

A study of differing response capacities

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ABSTRACT:

A legally binding global successor to the Kyoto Protocol is set to be implemented by the year of 2020, but the opinions about how to divide the responsibilities to fight climate change vary greatly. Based on previous research, this study uses the concept of response capacity as a basis in the creation of a foundation for a framework determining the prerequisites to fight climate change; a framework that could be used as a potential tool for the division of responsibilities across parties. The paper specifies four factors of economic-, institutional-, socio-cultural-, and technological nature as the determinants of the response capacity. In particular it focuses on how the response capacities vary across the four income groups of High Income, Upper Middle Income, Lower Middle Income, and Low Income. Even though some exceptions exist, we find that a higher level of income seems to be an element favorable for many of the components forming the response capacity. The conclusion is that the High Income group seemingly has the highest capacity to respond to climate change. Economies included in this group should therefore presumably have the largest prerequisites to take the lead in reducing global warming, simultaneously encouraging other income groups to follow in the same direction.

Key Words: response capacity; climate change; policy formation; climate debate
JEL Codes: F53, F59, Q54, Q58

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“ No-one is immune to climate change—rich or poor. […]
We must take ownership. We, <u>collectively</u>, are the problem.”

Ban Ki-moon, United Nations Secretary-General, 2012.
Statement made during the opening of the High-Level Segment at UNFCCC COP 18,
Doha, Qatar, December 4, 2012.

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1. Introduction

Our planet is warming up. Facts show that the anthropogenic greenhouse gas emissions[1] have grown immensely over the past fifty years. Researchers agree that it is very likely[2] that the increased concentration of greenhouse gases is the main cause of the average global warming (IPCC, 2007, p.72).

Who is to bear the main responsibility in reducing the greenhouse gases is, however, a question that the global community has not yet been able to solve. The main question is whether the developed and industrialized countries should be the ones taking the lead in the global emission reductions. For example the UN Secretary-General Ban Ki-moon proclaimed during the last UN Climate Change Negotiations in Doha 2012, that as these countries are considered to have caused the climate change, it is motivated that they would therefore carry the largest responsibilities for climate actions (The Guardian, 2012b). Other opinions suggest that it is necessary for the global community to put even greater pressure on also the developing world, in order to cut the emissions sufficiently. An advocate for this view is for example the former World Bank chief economist, Nicholas Stern (The Guardian, 2012a). After all, poor and middle-income countries already produce more than half of the total emitted greenhouse gases and are worryingly catching up to the emission levels of the developed world. Additionally, it has been estimated that already by 2030 the developing countries will account for two-thirds of the total emitted greenhouse gases, a considerable increase from the time when the Kyoto Protocol was established and the contribution of the developing world was one-third of the total emissions (The World Bank, 2010a; Romani, Rydge and Stern, 2012).

It is clear that climate change is a global problem that is hard to fight merely on a national level. Consequently, in 1992 during the United Nations Conference on Environment and Development, an international environmental treaty, the United Nations Framework Convention on Climate Change (UNFCCC), was established. The aim with this convention was to stabilize the greenhouse gas concentrations at a level that allows the ecosystem to adapt naturally to climate change without hampering sustainable economic development. Although the UNFCCC treaty still is an important framework in the climate policy discussions, it is not legally binding, and by 1995 parties realized that this non-legally binding convention was an insufficient tool to force nations to reduce their emissions. Therefore, international negotiations, called the Conference of Parties (COP), were launched and by 1997 the first legally binding protocol, The Kyoto Protocol, was introduced. This protocol set a, by international law binding, target for the developed countries to reduce their emissions between 2008 and 2012 to a level below the 1990 level, an average reduction of 6 to 8 percent. In 2010 a further emission target was introduced: UNFCCC agreed in the Cancun Agreement that the overall global emissions needed to be reduced to ensure that the average rise in temperature would not exceed 2 °C. This agreement was voluntarily signed by seventy-six countries, incorporating both developed and developing nations (UNFCCC, 2013). Lately,

[1] Emissions caused by human activity

[2] A likelihood greater than 90 percent according to expert judgment

however, parties have started to recognize that the developed world is not going to be able to combat climate change on its own (Manne and Richels, 1997; Romani, Rydge and Stern, 2012). Thus, in 2011 the climate change negotiations held in Durban advanced, resulting in consensus to introduce a global and legally binding agreement incorporating all nations, developed as well as developing ones. The Protocol has to be established by 2015 and to be effective no later than in 2020 (UNFCCC, 2013).

Already the first climate convention from 1992 proclaims that the parties should

> "…protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof." (United Nations, 1992, p.4).

Although these common but differentiated responsibilities state that all countries should strive to fight global warming according to their level of economic development, consensus is yet to be found on the implementation and quantification of these differentiated responsibilities. Nonetheless, models trying to describe factors affecting a country's ability to reduce its emissions have emerged. Researchers have for example introduced the concept of *adaptive-*, *mitigative-*, and *response capacity* to the research field. The definitions of the concepts vary somewhat between different papers, but the core idea is that different countries have different assets regarding for example technological-, natural-, financial-, and institutional resources. Researchers try to identify and isolate these assets to see how they influence countries' capacity to cope with climate change. Depending on these assets both the impacts of global warming and the ability to reduce emissions vary widely across economies and regions (Winkler, et al., 2007; IPCC, 2001). This is the stepping-stone to our study.

The purpose of this paper, inspired by the common but differentiated responsibilities and capabilities across the economies of the world, is to evaluate the response capacity for different groupings of economies according to their income level. This topic is of interest as these response capacities might be a clue to finding consensus for the division of responsibilities in the new global climate protocol. The specific research question is twofold:

1. *Which factors determine a group of economies' response capacity*?

2. *Which groups of economies have the largest prerequisites to fight climate change, prerequisites that potentially also can be used in the allocation of requirements for taking climate related actions?*

The core of the analysis is to evaluate how certain conditions, characterizing specific income groups, will affect the response capacity of these groups. As the assumption for this paper is that a high response capacity reasonably translates into larger prerequisites to fight climate change, we could thus indirectly also estimate which requirements could be considered as reasonable to place on a certain income group. The Kyoto Protocol, as well as much research, is built on a rather simplified division of the world, splitting it plainly into developed and developing economies. Clustering all developing economies into only one group does not appear to be sufficient; the disparities within this group are too immense to draw any clear conclusions. Therefore, this paper divides all economies in the world into four groups according to their income level. As we do not focus on just a specific economy's response capacity, the findings of this paper are hopefully valid also on a worldwide scale. In that sense, we also hope to achieve external validity for the results found herein.

The rest of this paper will be organized as follows: Section 2 presents and discusses relevant previous research in the field of climate change. In Section 3 and 4 we discuss the method for conducting the study and the fundaments of the paper. In Section 5 we present the data and its sources. Section 6 and 7 are dedicated to the analysis of the results, pulling the essential findings together. Section 8 concludes and discusses the important implication for future research and policy formation.

2. Previous Research

The early days of climate research

The idea of a "natural greenhouse effect" is not new. The French mathematician Jean Baptiste Fourier introduced the concept already in the late 18th century (Page, 2006, p.23), and hundred years later a concrete relationship between pollution and global warming was presented by the Swedish scientist Svante Arrhenius (Grubb, et al., 1999, pp.3-4). Arrhenius suggested that the growing carbon dioxide emissions from the factories emerging during the industrial revolution would increase the fraction of greenhouse gases in the atmosphere, resulting in a warmer climate. Although Arrhenius was on the right way, almost hundred years were to elapse until global warming gained any wider attention (Grubb, et al., 1999, pp.3-4). Roger Revelle and Hans Suess's paper from 1957 is regarded as a seminal piece in the climate research stating that "human beings are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past nor be reproduced in the future" (Page, 2006, pp.23-24). The concerns about this "geophysical experiment" became even more evident as the UN Secretary-General in 1970 brought up the possibility of a "catastrophic warming effect" in his Report on the Environment (Grubb, et al., 1999, pp.3-4), but it was not until IPCC's First Assessment Report in 1990 that the UN and most of its member states officially acknowledged the anthropogenic climate change as a substantial threat to the global community (Page, 2006, p.24). In these early days of climate research climate change was predominantly viewed from a natural science perspective, mainly focusing on the relationship between emissions and global warming (Burch and Robinson, 2007). Today the discussion is far more multifaceted and even though much progress still has to be made, research has nevertheless come far.

The Environmental Kuznets Curve and emissions

A subsequent milestone in the research field was to include economic activity in the analyses (Holtz-Eakin and Selden, 1995; Neumayer, 2004; Grubb, Butler and Feldman, 2006). Instead of merely looking at the relationship between carbon dioxide emissions and climate change, researchers started to focus on the relationship between per capita income and emissions, implanting for example the theory of the Environmental Kuznets Curve (EKC) into the research. This theory states that the relationship between GDP and environmental impact is inversely u-shaped (Shafik and Bandyopadhyay, 1992; Grossman and Krueger, 1995; Stern, 1998). By implementing the EKC to climate change many papers also introduced a turning point: a certain level of the per capita income at which the emissions relative to income start to decline. In other words, it was found that greenhouse gas emissions relative to income do not grow forever, but rather, when income reaches a certain level the emissions per income actually start to decrease (Grossman and Krueger, 1995; Holtz-Eakin and Selden, 1995; Pan, 2002; Neumayer, 2004).

Common but differentiated responsibilities and burden sharing

As previously mentioned, even the first climate convention from 1992 proclaimed that countries should strive to mitigate climate change by taking on "common but differentiated" responsibilities. The concept implies that economies should be imposed with different obligations to reduce emissions based on their level of development. Consequently, trying to quantify these differentiated responsibilities became the next area of focus for climate researchers. Some of the researchers discussing these topics were Gupta and Bhandari (1999), introducing a simple model describing each county's actual responsibility to cut emissions. The model stems from pre-determined percentage reductions in emissions but depending on a certain country´s efficiency index, calculated as CO_2/GDP over the average efficiency of the world, the actual percentage reduction will differ from the pre-determined level. The bottom line of their paper is that inefficient economies have more room to reduce their emissions than efficient economies. Further, researchers also tried to find models enabling a division of the shared responsibilities. Manne and Richels (1997) for instance introduced a concept of a "burden sharing scheme", suggesting that emissions should first be cut in the regions where reductions could be achieved at the lowest cost. Blanchard (2002) specifies that there are three scenarios of "differentiated commitments" being used; the "Per Capita Convergence scenario" sharing the allocation of emission allowances based on population size; the "Relative Responsibility scenario" allocating the allowances according to each countries' responsibilities for climate change; and finally the "Emissions-intensity Target scenario" basically quantifying mitigation efforts based on the achieved reductions in carbon intensity. Further, overall criteria for differentiating commitments were suggested. Such criteria were per capita GDP, per capita emissions, emissions per unit GDP, population, historical emissions, current amount of total emissions, and membership in organizations like the OECD or the IEA (Bodansky, Chou and Jorge-Tresolini, 2004). In addition three methods for burden sharing were proposed: an allocation-based approach where burdens should be shared according to a general principle such as common levels of per capita emissions; an outcome-based approach focusing on the expected outcomes of such various arrangements;

and finally a process-based approach specifying how to allocate the burden following a certain rule (Bodansky, Chou and Jorge-Tresolini, 2004).

The introduction of an integrated approach

Moreover, different approaches to mitigation started to emerge in the beginning of the 21st century. Generally, two approaches in mitigating emissions were, and are still, recognized; a top-down approach, where emissions basically are to be cut by the same amount, regardless of the country; and a bottom-up approach, where emission cuts are more pledge-based and consequently more country based (Winkler, et al., 2002). Winkler, et al. (2002) continue that countries in this pledge-based scenario will base their negotiations on their self-interest and thus propose indicators most efficient for the countries themselves. This approach focuses primarily on policy implementation of sustainable development. Further, Winkler, et al. (2002) suggest that as developing countries are more concerned about development policies than climate change, this approach chooses to focus on implementing policies for sustainable development instead of solely setting emission targets.

Nowadays researchers agree that it is hard to apply a single rule for mitigation and adaptation to climate change; the phenomenon, with numerous factors playing in, is considered far too complex (IPCC, 2001; Yohe, 2001). Indeed, instead of aggregated models the focus has shifted towards the conceptualization of different factors that might impact a certain country's ability and willingness to reduce its greenhouse gas emissions, with prevailing circumstances and future opportunities also taken into account (Bodansky, Chou and Jorge-Tresolini, 2004; Munasinghe and Swart, 2005, pp.112-115; Sathaye, et al., 2007; Winkler, et al., 2007). The first ones to introduce such an integrated approach in order to better understand climate change were Hope, Anderson and Wenman in 1993. In this report they concluded that global warming is hard to overcome solely by preventive policies and that also adaptive policies are required to cope with climate change (Hope, Anderson and Wenman, 1993). Building on this integrated approach, Yohe (2001) was one of the first prominent researchers to introduce the concepts of mitigative and adaptive capacities in his groundbreaking piece "Mitigative capacity—the mirror image of adaptive capacity on the emissions side". As integrated approaches became more common researchers started to view climate change in a different light and included also more human-based perspectives such as social-, cultural-, political-, or institutional factors into the research (Burch and Robinson, 2007).

Mitigative and adaptive capacities

The paper written by Yohe (2001) moreover takes the next step in conceptualizing the factors affecting the capacity on how a certain country is able to handle climate change. The paper elaborates the determinants of mitigative and adaptive capacity, which Yohe describes as two sides of the same coin. Further, Yohe claims that both capacities are determined by a variety of characteristics, which themselves are framed by the historical and possible future factors.

These two capacities are considered to be clearly related as both have the same aim: to reduce the risks of negative climate change effects. Whereas mitigation emphasizes decreasing consequences of the climate change, adaptation instead focuses on diminishing the vulnerability of these consequences (Swart and Raes, 2007; Winkler, et al., 2007). It is also emphasized that the two concepts of adaptive and mitigative capacity need to be used in an integrated way (Yohe, 2001; Burch and Robinson 2007; Swart and Raes 2007). Seeking to conceptualize the factors Yohe (2001) specifies six domains for evaluating mitigative and adaptive capacity. These domains are: technology, policy and institutions, resource availability, human capital stock, social capital stock, and "quality"/or credibility of decision makers. Factors affecting the ability to reduce greenhouse gases are categorized into three factors: economic-, institutional, and technological factors (Winkler, et al., 2007), which we will discuss more comprehensively in later sections.

Winkler, et al. (2007) also introduce a conceptual framework where mitigative capacity is linked to a country's sustainable development path and thus to a broader, more integrated approach to fight climate change. A development path is a concept defined as "a complex array of technological-, economic-, social-, institutional-, cultural-, and biophysical characteristics that determines the interactions between human and natural systems, including consumption and production patterns in all countries, over time at a particular scale…" (Sathaye, et al., 2007, p.696). Depending on the chosen paths, the level of emissions will differ given the same level of development. The goal is to steer developing countries onto the more sustainable development paths (Robinson, et al., 2006). Nowadays, some researchers suggest that a reduction in emissions does not necessarily hamper economic growth and it is even suggested that welfare could increase as a result of reducing emissions (IPCC, 2001; Yohe, 2001; Azar and Schneider, 2002; Burch and Robinson, 2007).

Climate change in an interdisciplinary light

More recent papers within the field of climate research state that in order to combat climate change, the phenomenon has to be observed in a more integrated and interdisciplinary light than before was realized (Burch and Robinson, 2007; Swart and Raes, 2007; Burch, 2011). Yohe (2001), for instance, concludes that the most effective mitigative policies might be the ones actually meant for fostering welfare and thus have nothing to do with climate directly, something that also the IPCC stresses in its third assessment report stating that "The effectiveness of climate change mitigation can be enhanced when climate policies are integrated with non-climate objectives…" (IPCC, 2001, p.12). Linkages between mitigation and adaption on economic-, institutional-, and environmental level might be one tool to develop more powerful policies to fight climate change (Swart and Raes, 2007). Burch and Robinson (2007) formally integrated these two capacities by introducing the concept of response capacity. Response capacity is a capacity built on the underlying socio-cultural-, technological-, and institutional tracks, which then in turn form the mitigative and adaptive capacities. Whether both capacities will be considered equally important or if the other one will have a predominant position over the other relies heavily on the institutions and policies in that specific setting, leading to a dominance of either adaption, or mitigation, or a more even representation of both, in the actual response activities (Burch and Robinson, 2007; Burch, 2011). Further Burch (2011) adds a supplementary dimension to the existing research; instead of focusing just on the linkage between mitigative and adaptive capacities, she also takes into account the true climate change actions taken by countries, in that way also concentrating on the possible barriers hindering these efforts to tackle climate change. In addition, factors that are likely to create barriers and in that way constrain nations from taking actions in the fight of climate change, have been identified (IHDP, 2009). More specifically this paper emphasizes the importance for policy makers to understand these barriers in order to be able to create viable future policies and innovative adaptation strategies.

Instead of only looking at the barriers to take actions in the fight of change, some research turn to the factors that motivate climate actions. For instance Biesbroek, et al. (2010) list eleven factors that are likely to motivate the development of national adaptation strategies. These include international policies, international climate negotiations, experience of extreme weather, availability of knowledge, political will and identification of compatibility with other policies. Furthermore, this study stresses the importance of communication to inform about the impacts of climate change. Moreover, Hegger, et al. (2012) take these interdisciplinary approaches from the rather theoretical level to a more practical one by focusing on the implementation of these approaches. The paper discusses concepts such as "joint knowledge production" and "environmental governance", in that way developing frameworks for good practices and management in projects across disciplines. The aim with such projects is to foster richer decision making in the combat against climate change through exchanges and joint construction of knowledge involving both scientists as well as policy makers and other crucial actors in the process (Hegger, et al., 2012).

Due to the need of viewing climate change in an interdisciplinary light, studies stemming also from socio-cultural and behavioral disciplines are emerging (Adger, 2003; Heyd, 2010; Gifford, Kormos and McIntyre, 2011; Wolf and Moser, 2011). For example Heyd (2010) claims that traditional factors to mitigate and adapt, like technical and scientific development, will not by themselves be enough in successfully fighting climate change. Instead, the cultural frameworks guiding the thoughts and actions of people will also have to be given more space in the discussion of climate change actions.

Latest research

In general, much of the research in the field today tends to shift to a more local scale, taking the adaption and mitigation to a grass-root level (Adger, 2003; Bond, 2010; Tang, et al., 2010). Researchers have also come to question the fact whether all adaptive measures are automatically beneficial in the broader, sustainable development context. For example Eriksen, et al. (2011) argue that a policy seemingly favorable for adaptation may in fact subvert more comprehensive sustainable development aims, like social-, economic-, and other environmental objectives. In addition, researchers have started to recognize that developed countries cannot conquer climate change on their own (Manne and Richels, 1997; Romani, Rydge and Stern, 2012). Therefore more recent studies emphasize that it is justified to also allocate a part of the burden to also the developing countries (Romani, Rydge and Stern, 2012). Rooted in this complex discussion, justice aspects have been given more space. Questions addressed in these papers are for instance what factors determine a country´s vulnerability and adaptive capacity and consequently dictate its eligibility or prioritization to receive funding (Page, 2006; Rayner, 2010; Bowen, 2011; Horstmann, 2011; Tubi, Fischhendler and Feitelson, 2012). Additionally, Bowen (2011) discusses how these funds best should be raised. Consequently we can see that research now stands at a point where it also takes the difficult aspects of justice into consideration. The common but differentiated responsibilities seem to go from merely being a concept to becoming something realizable.

3. Method

The aim with this study is to evaluate the response capacity for different groups of economies. Even though the existence of differing response capacities is acknowledged in the research, only a few studies actually back-up these differing capacities with data and thus make an attempt to quantify them, something that this paper strives to do. As, to the best of our knowledge, no pure economic models applicable for our specific research question prevail, an inductive rather than deductive approach is used in order to answer the research question.

To describe the differing response capacities across income groups in a more nuanced way, this study starts by dividing the economies of the world into four categories according to their income level, more specifically their GNI per capita calculated by the World Bank Atlas method of country classification (The World Bank, 2012). The distinction of the categories is the same as the one defined by the World Bank, and is as of July 1, 2012, the following:

- Low Income (LIC): $1,025 or less
- Lower Middle Income (LMC): $1,026 to $4,035
- Upper Middle Income (UMC): $4,036 to $12,475
- High Income (HIC): $12,476 or more

Appendix 1 lists the economies in each income category. We are aware of that as all economies have their distinct features, clustering economies into the four categories is still a simplified method. However, as an individual analysis would be rigorous and not a valid option, neither for us nor in the implementation process of future climate conventions, this clustering is necessary for our approach.

The base for the procedure of determining the response capacities for the four income groups takes its start in the specific characteristics affecting mitigative and adaptive capacities described in Yohe's seminal piece (2001). The list of these characteristics can be found in Appendix 2. As these characteristics are neither easily quantifiable nor possible to estimate by a single value, we have to use proxies to approximate the determinants. Hereafter these characteristics are divided into four factors that together determine the overall response capacity following the work on mitigative capacity by Winkler, et al. (2007). However, as Winkler's piece was written when the socio-cultural factors were not yet widely acknowledged as factors influencing the response capacity, we have chosen to add also this factor to our study. In conclusion this paper recognizes the four following factors as determinants for response capacity: economic, institutional, socio-cultural, and technological factors. Additionally, based on the most recent of previous research, some determinants have been added to Yohe's list (Appendix 2) of characteristics for adaptive and mitigative capacities. These are proxies describing efficiency, vulnerability, risk perception, and the level of infrastructure. The paper is structured around the four factors and each step in the analysis is validated and exemplified by the chosen proxies as well as by previous research.

The starting point in our data processing is the World Bank World Development Indicators (WDI) data set (The World Bank, 2013a). Since the aim of the study is to evaluate the response capacity of the current state of the world, we try to use the most recent data available in this data set. As we try to maximize the number of observations for each proxy available we have, after investigating the number of observations for different years, chosen to use data from 2010 for all proxies, except for one. The majority of the proxies used in this study stem from the World Bank WDI data set, but when we have not found data for our proxies from this data set, we have consulted other sources. In some cases we have divided proxies by the population in the corresponding economy, for the purpose of increased comparability. In order to choose the most appropriate proxies according to both the list presented by Yohe (Appendix 2) and the additional determinants added, we screened the World Bank WDI data set and reduced the large number of indicators until only the most descriptive ones could be singled out. By using several proxies to estimate the impact of each factor on a specific income group's response capacity, we aim to keep our analysis as multifaceted as possible.

In order to be able to draw conclusions from the data, an average value for each proxy and each income group is calculated. Further, as average values are sensitive to outliers, it is reasonable to detect and exclude economies with abnormal values within their income group from the calculations. We therefore detect the outliers for each income group and each proxy by calculating the standardized residual, studentized residual and Cook´s distance for each proxy. If an observation has standardized and studentized residuals larger than plus or minus 3 and a Cook's distance larger than 4/N, it is excluded from the sample (Uslaner, 2004). Furthermore, if two of the three criteria are fulfilled and the third is close to the critical point, we have excluded that observation from our data set. The calculations of the residuals and Cook's distance can be found in Appendix 3. Appendix 4 thereafter presents the datasets used to calculate the average values for the proxies for each income group and additionally indicates the observations considered as outliers. To determine the response capacity for each of the four income groups these adjusted figures are then analyzed and compared.

To wrap up the analysis and illustrate the result graphically we conduct a factor analysis on each of the four factors, reducing the proxies for each main component into a single factor score for the economic-, institutional-, socio-cultural-, and technological factors. As the composition of the generated factors is predetermined by our categorization of the proxies, the factor analysis should be seen as a descriptive tool rather than an analytical one. The factor analysis is conducted by the multiple regression method. This method is chosen as it standardizes the factor scores with a mean of zero and a variance of the squared multiple correlation between the items and factor, an advantage in our case as the proxies are scaled differently. Additionally, this method maximizes the validity of the factor (DiStefano, Zhu and Mîndrilă, 2009). The average factor scores for each income group are rescaled in order to generate positive values for all scores. This is done by adding the absolute value of the lowest average factor score to all the other average scores. In this way the relative differences between the four income groups, the elements of interest, are kept constant at the same time as we get a scale starting at zero. Moreover it is important to stress that the proxies having a negative impact on response capacity, in our case the GDP per energy used, poverty headcount ratio and annual climate related natural disasters per million people, are inversed before they are used in the factor analysis. By doing this we are able to directly interpret the factor scores as determinants of response capacity. The scores are plotted in radar charts through which we will be able to illustrate both the relative differences across the factor scores as well as the overall response capacities of different income groups. Lastly, using the same method of factor analysis we briefly assess an alternative approach to evaluate response capacities, this time with a membership of cooperation organizations as a criterion for grouping the economies. This alternative analysis is based on a sample of the five cooperation organizations: the ASEAN, the AU, the EU, the MERCOSUR, and the OECD. The purpose with this analysis is merely to widen the perspectives of the ways to estimate response capacities and open up for further discussion.

In the upcoming Section 4 we will present the chosen proxies influencing the response capacities, the arguments underlying the choice of these proxies, and the implications of these proxies for the response capacities of the four income groups.

4. Presentation of proxies

As previously stated, the response capacity of each income group is in our study determined by the four factors: the economic-, institutional-, socio-cultural-, and technological factors. Each factor is thereafter described by a number of proxies. In this section we will describe and argue for our choice of these proxies and how they are likely to affect the response capacity.

Economic factors

Our first component of the response capacity, the economic factors, is, in order to structure the analysis, divided into two subcategories: pure economic factors and an efficiency factor. The economic factors are important in mitigation and adaption as they indicate an economy's income and thus determine the economy's "ability to pay" for adaptation and mitigation (Winkler, et al., 2007).

The pure economic factors are described by GDP per capita, trade, and foreign direct investment (FDI). GDP per capita, given in purchasing power parity rates, (PPP) is the proxy directly stating the wealth of a nation and thus its ability to pay the amounts required to actually mitigate or adapt to climate change. The higher the ability to pay, the better the ability to both mitigate (Winkler, et al., 2007) and adapt to climate change (Yohe, 2001; Burch and Robinson, 2007). Further, Burch and Robinson (2007) argue that open markets are beneficial for both mitigation and adaption as they for example increase the access to new innovations and efficient technologies. The openness of the market is estimated by the share of the GDP stemming from trade. Additionally, the openness presumably increases foreign direct investments, which is our second proxy for the economic factors. This proxy explicitly explains the level of net inflows of capital into the economic system enabling investments in for example climate-sound activities and technologies. In particular for developing nations, which otherwise might lack the ability to pay for climate related activities, this form of external financing might be crucial (Munasinghe and Swart, 2005, pp.370-371; The World Bank, 2010a; Bowen, 2011) .

Efficiency is an important factor to assess when evaluating a nation's ability to respond to climate change, especially when it comes to mitigative activities. The literature, for example, argues that economies with low efficiency levels will have more "room" to cut emissions (Gupta and Bhandari, 1999), consequently suggesting a larger mitigative capacity for low efficiency economies. These economies have not yet reached their full production potential meaning that the emissions from production can be lowered without necessarily reducing the output. In these inefficient economies production has still room for improvement, in contrast to high efficiency economies where production is already as streamlined as it can get. The proxy chosen to indicate efficiency is GDP per unit of energy use (PPP $ per kg oil equivalent), showing how efficiently one unit of energy is used in the production of one unit of welfare (GDP). The higher the efficiency, the smaller the ability to mitigate any further, therefore corresponding to a smaller response capacity.

Institutional factors

Researchers agree that institutions are important determinants of an economy's response capacity (Banuri, et al., 2001; Burch and Robinson, 2007; Winkler, et al., 2007; Keys, Thomsen and Smith, 2010). The capacity to combat climate change is shaped by for example the government's ability to formulate and implement necessary climate related policies (Winkler, et al., 2007). The success of, for example, the implementation of foreign direct investment and funding is largely determined by the nature of the policies, the fiscal stance, the governance institutions, and the openness of international trade flows (Banuri, et al., 2001). Institutions such as public authorities are also important in managing the risks of investing in innovations of mitigation-, adaptation-, and technological character, stimulating the private finance especially important for adaptive capacity (Bowen, 2011). We choose to describe the institutional factors with three proxies associated to legal and governmental characteristics.

To measure a government's ability to take on and implement policies potentially beneficial for the climate we use an index describing the functioning of the government, ranging from 0-10. A higher index means a better functioning of government and thus more efficient and sound decision-making, fostering the response capacity (Winkler, et al., 2007).

Additionally, strong collateral and bankruptcy laws are considered as important institutional factors as they might facilitate lending and thus increase foreign investors' willingness to invest (The World Bank 2013b; Winkler, et al., 2007). We choose to estimate the strength of these, for the response capacity beneficial, regulations by an index for the strength of the legal rights. A high value indicates stronger legal rights, protecting the rights of borrowers and lenders potentially enabling an enhanced access to capital markets and credits. As access to credits increase one can presumably argue that this could lead to heavier investments and thus a larger ability to adapt or mitigate.

Clear property rights enhance the enforcement of new technologies and methods to mitigate climate change (Munasinghe and Swart, 2005, p.271) and are, therefore, another important institutional aspect influencing response capacity. The stronger the property rights, the larger the ability for the nation to acquire necessary innovations for mitigation and adaptation, increasing the response capacity. Additionally Yohe (2001) argues that stronger property rights imply a higher risk spreading and an increased ability to accumulate capital, which in turn lead to a higher capacity to both adapt and mitigate. The chosen proxy for estimating the property rights is the CPIA property rights and rule-based governance rating. This rating is defined as the degree to which an effective legal system and rule-based governance structure, with reliably respected and enforced property and contract rights, facilitate economic activity.

Socio-cultural factors

One of the most widely mentioned socio-cultural proxies is the skill base of an economy (Yohe, 2001; Burch and Robinson 2007; Westerhoff, Keskitalo and Juhola, 2011). An economy with a high level of education is more likely to have higher ability to both adapt to and mitigate climate change, for example through innovations, more climate friendly technologies, and renewable energy sources (Burch and Robinson, 2007). To estimate the skill base of an economy we choose to use the literacy rate (% of people in the age of 15 and above) and the number of annual science and engineering degrees per million people. The proxy for science and engineering degrees is chosen because we consider that skills in the science and engineering sector are arguably essential as expertise in these fields is necessary in the development and production of new climate friendly technologies. Additionally, a higher-educated population is more likely to be better informed about the climate issues and thus also more willing to take on actions to fight climate change. The skill base can thus be related to our next socio-cultural proxy; awareness.

The awareness of climate change among citizens is considered as an important component affecting response capacity (Winkler, et al., 2007; Biesbroek, et al., 2010) and raising awareness is especially important when building public support for climate change actions and to further enforce these policies in reality (Westerhoff, Keskitalo and Juhola, 2011). Information and awareness are also important contributing aspects to behavioral change (IPCC, 2007; Winkler, et al., 2007) and might possibly lead to a larger willingness and perhaps also larger capacity to mitigate. To evaluate the awareness of climate change we use data from a poll revealing the percentage of the respondents in the given economies reporting awareness of global warming. A higher percentage of citizens reporting awareness of global warming would indicate a higher ability to mitigate and adapt to climate change, and thus resulting in a higher response capacity.

Not only the skill base has impacts on the socio-cultural factor. Underlying norms and values in the society also dictate which measures are probable to be taken in fighting climate change (Burch, 2011). An important determinant for these conceptions, and thus also for the response capacity, is vulnerability, in our study measured by the risk-perception and the degree of poverty. A high risk-perception might increase the willingness to adapt mitigative or adaptive policies or put pressure on policy makers, in that sense increasing the response capacity. The existence of an underlying threat of climate related disasters might create a risk perception, which through social forces can spark adaptive and mitigative actions, raising the probability for economies to take actions against climate change (Burch and Robinson, 2007). Biesbroek, et al. (2010) present the same reasoning in their report comparing national adaptation strategies in the EU. Vulnerability can also be related to poverty, and as Bowen (2011) rather harshly states "climate change is likely to hit poorer countries sooner and harder than it will hit developed nations…" (Bowen, 2011, p.2). If a large part of the population is poor, the economy has a limited ability to respond to climate change as the major priority of a poor economy is unlikely to be geared towards fighting climate change. The funds in these economies are more probable to be invested in more urgent development issues. Because of high opportunity costs for climate related actions in poorer economies, vulnerability can therefore also decrease the response capacity (Yohe, 2001; Page, 2006, p.35). The proxies chosen to illustrate the risk perception is the average annual number of climate related natural disasters[3] per million people for the years of 2000-2010. The level of poverty is estimated by the average percent of the population living under $2 a day.

Technological factors

The access to technology and feasible technological options are important prerequisites for economies to develop and implement new, innovative ways of tackling climate change (Yohe, 2001; Burch and Robinson, 2007; Winkler, et al., 2007). Not only the development of new-to-the-world products is important, the ability to adapt already existing climate- friendly technology is also crucial (Winkler, et al., 2007). Additionally, technological factors are seen as important components when creating alternative, more sustainable development paths (IPCC, 2001; Burch and Robinson, 2007). Access to scientific information is also crucial in developing climate change policies (Biesbroek, et al., 2010).

Moreover, the level of infrastructure affects the capacity to adapt to climate change (Munasinghe and Swart 2005, pp.231-261 ; Eakin and Patt, 2011). Without a well-functioning basic infrastructure, it is harder to build or adapt to more complex and climate-friendly, technological solutions, simultaneously decreasing vulnerability (Winkler, et al., 2007; Eakin and Patt, 2011). If we more specifically discuss the energy infrastructure in an economy, the carbon intensity is by a large extent determined by technological factors too (IPCC, 2001). To approximate the level of infrastructure we use the gross fixed capital formation (% of GDP). This proxy includes land improvements; plant, machinery, and equipment purchases; and other fixed capital formation such as construction of roads, schools, hospitals. In order to evaluate the infrastructure of energy-systems and the capability to adapt to new stricter energy policies, we use the percentage of alternative and nuclear energy use related to the total amount of energy used as a proxy. A number of other prerequisites also make it more likely for an economy to adapt and develop new technologies. One of the fundamental conditions fostering technologic development is the access to electricity. The higher the level of electricity access, the more likely it is for technological innovations to spur.

More direct indicators on an economy's ability to generate innovations and new technology in order to cope with climate change are high-technology exports as a percentage of manufactured exports and patent applications submitted by residents, per million people. High values for both of these proxies indicate a high technological ability, enabling more climate friendly technologies to be innovated and used. This can arguably be translated into a higher response capacity.

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[3] Here defined as drought, extreme temperature, flood, mass movement dry (rockfall, avalanche, landslide, subsidence), mass movement wet (rockfall, landslide, avalanche, subsidence), storm and wildfire).

Discussion of proxies

We are aware of that the choice of our proxies might be influenced by bias, provided by the very nature of the research question as well as the selection process. Since there is no clear model for the response capacity and its determinants, the selection process of our proxies can be seen as the Achilles heel of this paper. We aim at maintaining objectivity by trying to closely tie our chosen proxies to previous research, with Yohe's list of determinants (Appendix 2) as the base. Possible critique of our approach lies however in the way we choose to interpret our proxies. Many of our proxies can have multiple consequences on the society and can thus be interpreted in other ways than done here. However, we have chosen to only interpret and analyze these proxies from a climate related perspective. For instance, we assume that investments are a factor enhancing the response capacity rather than decreasing it by investments in non-climate friendly activities. Our reasoning for the impacts of the proxies is likely to be colored by the research question and might hence sometimes be considered as one-sided. These assumptions have however been necessary to make in order to conduct the study. Additionally, we have seen that similar assumptions have been made in previous research as well, which can be considered as a factor validating our method. As we are trying to quantify and assemble a framework to determine the response capacity, this model, as all other models, is a simplified version of reality.

5. Sources of data

As presented in the introduction, our research question is to be answered by evaluating and analyzing a number of proxies. Appendix 5 defines the data and presents the corresponding data sources for the proxies. The majority of the proxies stem from the World Bank World Development Indicators (WDI) data set, consisting of the most current development indicators from several officially recognized international sources. The data set comprises 214 economies and 1,264 world development indicators, with coverage from 1960 to 2012. For this analysis, however, merely data for the year of 2010 has been used, with an exception for the indicator for the access to electricity where data stems from 2009. An average value for each income group is calculated for all proxies using unmodified data, with an exception of patent applications. To increase the comparability of this indicator we have, in an intermediate step, divided the number of patent applications by the population in millions before calculating the average value. Data for the population is retrieved from the World Bank World Development Indicators data set and the figures exhibit the number of inhabitants for 2010 (The World Bank, 2010b). The same data is used in the calculations for the number of climate related natural disasters per million people and the number of science and engineering degrees per million people. These two proxies are discussed below.

When data was not found in the WDI data set other sources were consulted. Data for the proxy estimating the functioning of the government is retrieved from an index created by The Economist Intelligence Unit in the report "Democracy index 2010" (The Economist Intelligence Unit, 2010). The report is acknowledged and used by for example the Sida (Swedish International Development cooperation Agency). The data on the awareness of climate change comes from a survey coordinated by Gallup, a company conducting global research and analysis. The data for the survey is collected between 2007 and 2008 and comprises most of the countries. The survey measures the percentage of the respondent who reports knowledge of Global Warming (Gallup World, 2009). The sample size is approximately 2,000 adults per country (with a range of 500 to 8,256) (Gallup World, 2009). To estimate the vulnerability and risk perception, data for the total number of climate related natural disasters from 2000 to 2010 is retrieved from The International Disaster Database (EM-DAT, 2013). To make this proxy more comparable we have recalculated it as the average annual number of climate related natural disasters per million people for each income group. The data for the number of total first university degrees in science and engineering comes from the report "Science and Engineering indicators 2012" (National Science Board, 2012). To also make this proxy comparable across income groups we have recalculated it by dividing the number of degrees by the population in millions. An average number is thereafter calculated for each income group. The sample size ranges from 11 to 41 observations per income group.

Important to remember is that for our chosen proxies we are restricted by the sample size. For the WDI data set missing values for specific economies is the constraining factor, whereas for the rest of the sources we are restrained by the scope of the study that is the number of economies included. The data is presented in Table 1 and will be analyzed in Section 6. Nevertheless, before moving on to the analysis of the results, weak links in the data are briefly discussed.

Discussion of data

The analysis in this paper conducted is based on average values for each income group for the chosen proxies. As average values by their very nature are sensitive to extreme values and to the number of observations available, the reliability of some of the chosen proxies may be questioned. In order to reduce the errors that the properties of the mean calculations imply, we have adjusted the proxies for outliers. However one must be aware of that this may not be sufficient to yield values completely free from errors. The number of observations in some of our proxies are very low (below 10) resulting in weaker estimations of the average values. The proxies where the average value is estimated with less than or equal to ten observations are indicated with a star in the upcoming Table 1. It is also important to remember the possible impact of the human error factor. It should also be noted that we are not able to fully control for the reliability of the data sources. However, we want emphasize that qualified and well-known data sources have herein carefully been chosen in order to minimize this risk and enhance the reliability.

6. Analysis

As we all know resources are not evenly distributed across the world. This section will analyze the, for response capacity vital, differences in the attributes across the four income groups. All four factors are assessed based on the results presented in Table 1. Tables 6.A-D in Appendix 6, provides descriptive statistics per income group for all proxies.

Table 1: The four factors and the corresponding average values of the proxies, by income group and adjusted for outliers

		Income group			
Factor	**Proxy**	Low Income	Lower Middle Income	Upper Middle Income	High Income
Economic					
	GDP per capita, PPP (current international $)	1,237.34	3,858.86	11,846.07	34,711.09
	Trade (% of GDP)	70.20	83.74	89.77	104.17
	Foreign direct investment, net inflows (% of GDP)	4.59	4.55	4.40	4.80
	GDP per unit of energy use (PPP $ per kg oil equivalent)	3.93	6.28	8.06	7.87
Institutional					
	Functioning of government (0=low, 10=high)	2.80	4.46	5.14	7.29
	Strength of legal rights index (0=weak, 10=strong)	4.67	5.13	5.35	6.91
	CPIA property rights and rule-based governance rating (1=low, 6=high)	2.67	3.01	3.38*	n/a
Socio-cultural					
	Literacy rate, adult total (% of people ages 15 and above)	63.35	82.91	94.60	96.84
	Science and engineering degrees (per million people)	144.18*	540.91	1,252.34	1,485.49
	Percentage of citizens reporting awareness of global warming	42.57	52.82	66.55	91.43
	Climate related natural disasters (average, per million people)	0.15	0.45	0.43	0.40
	Poverty headcount ratio at $2 a day (PPP) (% of population)	65.59*	35.67*	5.52	n/a
Technological					
	Gross fixed capital formation (% of GDP)	21.92	22.65	22.56	19.51
	Alternative and nuclear energy (% of total energy use)	4.68	8.09	5.31	11.16
	Access to electricity (% of population)	22.07	64.01	89.65	99.35*
	High-technology exports (% of manufactured exports)	2.81	5.02	6.31	12.61
	Patent applications (residents, per million people)	4.75*	13.67	31.56	167.94

**fewer than or equal to 10 observations*

Data sources: The World Bank World Development Indicators, Gallup World, EM-DAT:The OFDA/CRED International Disaster Data Base, The Economist Intelligence Unit, National Science Board.

Economic factors

Table 2: Extraction of Table 1, Economic factors

Factor	Proxy	Income group			
		Low Income	Lower Middle Income	Upper Middle Income	High Income
Economic					
	GDP per capita, PPP (current international $)	1,237.34	3,858.86	11,846.07	34,711.09
	Trade (% of GDP)	70.20	83.74	89.77	104.17
	Foreign direct investment, net inflows (% of GDP)	4.59	4.55	4.40	4.80
	GDP per unit of energy use (PPP $ per kg oil equivalent)	3.93	6.28	8.06	7.87

Beginning the analysis by looking at the economic factors it becomes evident that many of the proxies show striking differences. A natural starting point for the analysis is to start by examining the large difference in GDP per capita. Table 2, an extraction of Table 1, reveals that the High Income group has on average 28 times higher income than the Low Income group. Moreover, major differences can be seen between closely lying income groups. For instance the Low Middle Income group has over three times higher GDP per capita than the LIC group, and the difference between the two highest income groups is also substantial; the High Income group has an average GDP per capita of $34,711 whereas the corresponding figure for the Upper Middle Income group is $11,846. As GDP per capita is used to estimate an income group's general ability to pay, this proxy comprises the ability to pay for both climate related adaptation and mitigation actions. Thus, these results are important components when assessing the response capacity of each income group. Not surprisingly, a lower GDP can directly be translated into a lower ability to pay and vice versa. Therefore we can argue that as the high income economies have the highest average GDP per capita they should thus have the highest ability to pay for climate related measures, strengthening their response capacity. The fact that the differences in average GDP per capita between the income groups are so large should correspondingly, when it comes to the ability to pay, indicate large discrepancies in the response capacities for the different income groups.

The results for trade and net inflows from foreign direct investment (FDI) as a percentage of GDP look slightly different. In contrast to GDP per capita the differences in FDI are relatively small across the income groups. Notable is that the Low Income group boasts with the second highest percentage of FDI (4.59). The largest FDI can be found in the High Income group. Trade as a fraction of GDP seems on the other hand to clearly increase with income, and even though the differences are not as striking as in GDP per capita, the High Income group exhibits 1.5 times larger values for trade as a percentage of GDP than the Low Income group. As low income economies exhibit relatively high values for both trade and FDI this could imply that the openness of an economy is not strictly dependent on the income level of a group. Thus a lower income does not, in the sense of openness, necessarily restrict the response capacity. It is important to remember that although the percentage term for the FDI is relatively high for the lower income groups in absolute values, the investments are still much smaller in the lower income groups compared to the higher due to their lower level of GDP. From this point of view, as the high income economies clearly have the highest FDI in absolute terms, this proxy should contribute to an increased response capacity. An explanation for the relatively high FDI-percentages of GDP for the lower income groups might be the domestic financial constraints; foreign capital inflows are more crucial for investments in lower income countries than in countries with a higher income. It is also important to note that with a smaller GDP the impact from the same amount of foreign direct investment will, due to the smaller denominator in lower income countries, be translated into a higher percentage of FDI for low income countries than for high income countries. All in all, we can conclude that as openness does not seem that strongly restricted by the income level, low income economies seem to have an opportunity to take advantage of financial transfers beneficial for enhanced response capacities. Therefore, also lower income groups should have the possibility to gain access to innovations and new efficient technologies supporting them to respond to climate change, as suggested by Burch and Robinson (2007).

Looking at the efficiency levels across the income groups indicated by GDP per unit of Energy Use one can observe that the relationship between income and GDP per unit of Energy Use seems to be positive; the Low Income group exhibits the lowest value and the efficiency levels are increasing according to income with one notable exception; in the High Income group one unit of Energy Use produces 0.19 units less GDP than in the Upper Middle Income group. This might imply that higher income does not automatically translate into a higher efficiency. As the Upper Middle and High Income group have the highest efficiency-scores these groups will have the largest difficulties in cutting their emissions without simultaneously decreasing their output. High efficiency will therefore have a negative impact on an income group’s mitigative-, and correspondingly also on its response capacity.

In conclusion, three of the four proxies for the economic factors: GDP per capita, trade as a percentage of GDP, and FDI as a percentage of GDP, indicate that a higher level of income would have a positive impact on the response capacity. The proxy for efficiency suggests the opposite; for this proxy a higher income is related to a lower response capacity. However the proxy estimating FDI, where the Low Income group exhibits the second highest value, requires a deeper interpretation than simply looking at the values in the extracted Table 2. An important aspect to take into consideration is that higher income groups still have larger net inflows of FDI in absolute terms. Therefore a completely clear picture of the response capacity in terms of the economic factors cannot be given and much remains done before conclusions can be drawn about the different income groups’ degrees of response capacity and the prerequisites to fight climate change. The next step in the analysis is therefore to move from the economic factors to the field of institutional factors.

Institutional factors

Table 3: Extraction of Table 1, Institutional factors

Factor	Proxy	Income group			
		Low Income	Lower Middle Income	Upper Middle Income	High Income
Institutional					
	Functioning of government (0=low, 10=high)	2.80	4.46	5.14	7.29
	Strength of legal rights index (0=weak, 10=strong)	4.67	5.13	5.35	6.91
	CPIA property rights and rule-based governance rating (1=low, 6=high)	2.67	3.01	3.38*	n/a

As we can see, all three proxies used to estimate the strength of the institutional factor exhibit a similar trend; a high income seems to be associated with high scores for all of the three proxies.

To estimate a government's ability to take on and implement climate beneficial policies we use as a proxy an indicator for the functioning of the government. As can be seen in Table 3, an extraction of Table 1, the variations are large between the two extreme income groups of High Income and Low Income; the functioning of the government is rated on average 4.5 index points higher for the former group compared to the latter one. The notably low average score of 2.8 index points for the Low Income group reveals that the majority of the economies in this income group seem to have weak institutional settings, at least when it comes to the functioning of their governments. According to our data, the decision-making and its effectiveness consequently seems to increase with income level. This would imply that the higher income level, the larger is the contribution of the functioning of the government to the response capacity.

Related to the discussion about the importance of policies when fighting climate change are the strengths of the collateral-, and bankruptcy laws. We can see from the extracted Table 3 that the level of the index for strength of legal rights is rather even for the two middle income groups (5.13 versus 5.35), but similar to other proxies it varies quite substantially between the two extreme groups; the High Income group is scored on average 1.5 index points higher than the Low Income group. This implies that in the High Income group lenders and borrowers are better protected, suggesting that the willingness to invest in these markets is higher, enabling the response capacity to evolve in the same direction.

As discussed in Section 4 it is important to enforce new climate friendly technologies and methods in order to mitigate and adapt to climate change. In this process the importance of property rights are crucial. Even though we lack data on the proxy for the CPIA property rights and rule-based governance rating for the High Income group, the trend seems clear. The higher the income, the higher the property rights are scored. Consequently, the Upper Middle Income group is scored the highest, whereas the Low Income group exhibits the lowest value. One noteworthy aspect is that the scores given for the income groups are all relatively low; the highest score of 3.38 barely reaches half of the maximum score of 6. Elaborating on this reasoning, we can conclude that economic activity and an effective legal rights system seem to be interconnected, but that the legal rights are rated at an overall rather low level. In conclusion, the response capacity seems to be stronger supported by the effective legal rights systems in the higher income groups than in the lower ones. However, it is important to bear in mind that as data for the High Income group is missing, the comparison across the four income groups is somewhat incomplete.

Before moving on to the socio-cultural factors, some main conclusions from the institutional factors can be drawn. Overall all three institutional factors exhibit highest values for the highest income groups and lowest values for the lower income groups. This means that for the institutional factors having a higher income seems to imply a higher response capacity, consequently suggesting higher prerequisites to fight global warming as well. Building on the previous analysis for the economic factors, institutions are another crucial factor in diminishing the risks and the frictions of economic transactions. As low income countries exhibit weak institutional settings, stronger institutions could diminish the risk and therefore arguably enhance both trade and foreign direct investment. Thus we get an important linkage between the economic and the institutional factors; in some settings they seem to be complements rather than purely independent determinants of the response capacities. Keeping this in mind we are now ready to take on the analysis to the socio-cultural factors.

Socio-cultural factors

Table 4: Extraction of Table 1, Socio-cultural factors

Factor	Proxy	Income group			
		Low Income	Lower Middle Income	Upper Middle Income	High Income
Socio-cultural					
	Literacy rate, adult total (% of people ages 15 and above)	63.35	82.91	94.60	96.84
	Science and engineering degrees (per million people)	144.18*	540.91	1,252.34	1,485.49
	Percentage of citizens reporting awareness of global warming	42.57	52.82	66.55	91.43
	Climate related natural disasters (average, per million people)	0.15	0.45	0.43	0.40
	Poverty headcount ratio at $2 a day (PPP) (% of population)	65.59*	35.67*	5.52	n/a

As previously stated, both the level of vulnerability as well as the skill base of an economy are important determinants in the evaluation of the response capacity. In this paper we choose to integrate the proxies describing these components under the umbrella-term of socio-cultural factors.

The first broader group of the socio-cultural factors is the skill base. As previously presented the skill base in this study will be evaluated by the literacy rate and by assessing the average number of science and engineering degrees in an economy, measured per million people. The differences in the literacy rates are notable; roughly 1.5 times more people are literate in the High Income group compared to the Low Income group. Besides indicating a high educational level, as literacy rate can be interpreted as a factor determining the potential to successfully educate and raise awareness on climate related issues, high income countries might also have a higher awareness of such issues.

A more specific measure to estimate the response capacity in terms of skill-base is to examine the annual number of science and engineering degrees in an economy. Compared to the differences in the literacy rates, the variations for this proxy are even more striking: whereas only approximately 144 persons in a million annually receive a Science and Engineering degree in the Low Income group, the corresponding number in the High Income group is 1,485, more than 10 times higher. Consequently, if transfers of knowledge between the income groups does not take place, it is defendable to state that the response capacity in terms of the skill base will be lower in lower income groups compared to groups with higher income.

Related to the skill base of an income group is also the awareness about global warming, in this paper indicated by the percentage of a nation's citizens reporting awareness of global warming. As illustrated in Table 4, an extraction of Table 1, the variations between the income groups are notable; the difference between the Low Income group and the High Income group is nearly 49 percentage points (on average 91.43 versus 42.57 percent of the population reported awareness of global warming respectively). In general, a gradual trend where awareness tends to increase with income, can be seen. As discussed in Section 4, a high awareness can be related to a greater public support and more favorable attitudes towards climate change actions. Therefore, as awareness is an important component of the response capacity and as higher income groups tend to have higher awareness, we can conclude that the contribution from awareness to the overall response capacity will be higher the higher income level the group has.

The second broader group in the socio cultural factors is the degree of vulnerability. As presented in Section 4 in this paper a high vulnerability can be interpreted as a factor both increasing and decreasing the response capacity. Vulnerability, and the risk perception associated with it, is indicated by the average annual number of climate related natural disasters per million people. Surprisingly, the extracted Table 4 reveals that the lowest average number of climate related natural disasters per million people occurs in the Low Income group. Even though, when blindly examining the figures, the economies in the Lower Middle, Upper Middle-, and High Income segment seem to be more vulnerable than economies in the Low Income group, it is important to take into consideration the financial constraints in the lower income groups. Disasters of similar magnitude probably have completely different consequences depending on the income level of a country, directly affecting the degree of vulnerability. On the other hand, as stated in Section 4, risk perception can in high income countries also be seen as a factor beneficial for the response capacity (Biesbroek, et al., 2010). Whether the same reasoning is applicable for nations with lower income can however be discussed. Although the risk perception would increase due to a higher number of climate related natural disasters, financial constraints might limit the possibility to take true actions against tackling climate change. Thus a higher risk perception might not have the same favorable impacts on the response capacity for lower income groups than for higher income groups (Biesbroek, et al., 2010).

In this paper, vulnerability is additionally estimated by the poverty headcount ratio. The trend in this ratio is, not unforeseen, highly consistent with the level of income in the income group. Our data set does not contain data on the poverty headcount ratio for the High Income group but the tendency is still visible; in the low income nations almost 66 percent of the population live under $2 per day, a fraction nearly 12 times higher than the corresponding figure for the Upper Middle Income group. Because poverty increases the vulnerability of an income group it also diminishes the response capacity of it.

In conclusion, a high income level seems to be translated into a higher response capacity for the majority of the proxies in the socio-cultural factor category. An ambivalent term is yet the one regarding vulnerability, where some theories suggest that an increased risk perception increases the response capacity, something we yet come to question is directly applicable for low-income countries. On the other hand, the figures of the skill base are coherent; the higher the income, the better the skill base. Thus the analysis suggests that the strength of the socio-cultural factors, contributing to the overall response capacity, should be higher for groups with higher income. This possibly indicates also larger prerequisites to fight climate change in the higher income groups. Next we turn to assess the last factor of the response capacity, the technological factors, in our pursuit of the determinants for the response capacity.

Technological factors

Table 5: Extraction of Table 1, Technological factors

Factor	Proxy	Income group			
		Low Income	Lower Middle Income	Upper Middle Income	High Income
Technological					
	Gross fixed capital formation (% of GDP)	21.92	22.65	22.56	19.51
	Alternative and nuclear energy (% of total energy use)	4.68	8.09	5.31	11.16
	Access to electricity (% of population)	22.07	64.01	89.65	99.35*
	High-technology exports (% of manufactured exports)	2.81	5.02	6.31	12.61
	Patent applications (residents, per million people)	4.75*	13.67	31.56	167.94

The technological factors can either be seen as pre-requisites or as more direct measures of the ability to actually produce and develop new climate friendly technologies needed in order to meet present and future climate targets. Of our proxies the access of electricity and the formation of fixed capital can be seen as proxies describing the prerequisites whereas the number of patent applications and high-technology exports can be seen as descriptive for the latter perspective. Besides these proxies we additionally analyze the percentage of total energy use that comes from alternative and nuclear energy sources.

As concluded in Section 4, appropriate infrastructure, in this paper measured as the fixed capital formation as a share of GDP, is one of the important factors contributing to the response capacity. The trend for these figures is not as evident as for some of the other proxies; comparing the income groups the High Income group invests the lowest fraction of its GDP to fixed capital formation. This can be explained by the fact that high income countries might have a sufficient level of infrastructure already, and thereby do not have to devote as big of a share of its GDP to further accumulate its fixed capital. Additionally, we have to remember that the High Income group still invests more in infrastructure in absolute terms than the other income groups. Interesting is however to notice that there seems to be a breaking point where the positive trend between fixed capital formation and income reverses to a negative relationship. The turn occurs between the two middle income groups.

The percentage of alternative and nuclear energy of total energy use can be seen as an indicator for both the willingness as well as the capacity to produce energy in less carbon-intense ways. Considering the rather advanced degree of technological knowledge that is required when constructing these energy plants this factor also comprises information about both the skill base and the level of infrastructure of an economy. As for the other proxies there seems to be a general trend; the High Income group produces approximately 2.4 times more energy in alternative ways than the Low Income group. It is interesting to notice that whereas the Lower Middle Income group produces 8.09 percent of their energy in alternative ways, the corresponding fraction for the Upper Middle Income groups is just 5.31 percent. As Lower Middle Income group produce a higher fraction of their energy in alternative ways than the Upper Middle Income group, this could imply that the alternative energy use is not strictly tied to the general income level.

The percentage of the population that have access to electricity exhibits an evident pattern; in the High Income group approximately 99 percent of the population have access to electricity whereas the equivalent number for the Low Income group is just above 22 percent. Notable is also the difference between the two lowest income groups; the percentage of the population that accesses electricity in the Lower Middle Income group is almost three times higher than the corresponding figure for the Low Income group; 64 percent compared to the fraction of 22 percent. Among the higher income groups the difference in the access to electricity seems to even out; the large gap exists only between the two lowest income groups. This could indicate that there is a breaking point at which economies, by just a modest augment in income, can increase their access to electricity substantially. Furthermore, it is interesting to see that this breaking point seems to occur at a rather low income level.

The two indicators that most directly indicate the strength of technological knowledge and innovation capacity are the high-technology exports given as a percentage of manufactured exports, and the number of patent applications submitted per million residents. The differences between the income groups are evident; the High Income group exports almost 4.5 times more high-tech goods than the Low Income group, and above 2.5 respectively 2 times more than the Lower Middle Income group and the Upper Middle Income group. Therefore, the production and development of high-tech goods seem to match with the levels of income. As previously presented the production of high-tech goods indicates a higher response capacity, and thus, similar to many of our other proxies, this proxy indicates that high income countries would have a superior capacity to respond to climate change. Also the results for number of patents per million people support this statement. The High Income group has on average above 35 times more patent applications per million people than the Low Income group. An interesting aspect is that the difference between the two highest income groups is that large; economies in the High Income group have on average 5.3 times more patent applications than the economies in the Upper Middle Income group have. An explanation for this large gap might not merely stem from the skills but can also be influenced by the strength of the institutions particularly concerned with patents.

To sum up, high income and strong technological factors seem to be strongly related when it comes to the pre-requisites and the actual production of high-tech products, as well as the number of patent applications. The only proxy not clearly supporting this trend is the formation of fixed capital as a percentage of GDP. This figure therefore needs some more analysis than a simple comparison; despite its low average value, the High Income group still invests more in the formation of fixed capital in absolute terms. On the other hand they can be explained as the High Income group might already have a well-developed fixed capital stock that does not have to be improved as much as in the lower income groups. Whatever the case may be, we can still conclude that overall the High Income group seems to have stronger technological capabilities than the lower income groups, enhancing the response capacity and the prerequisites to fight climate change for this group.

7. Tying together the analysis

In order to more clearly illustrate the differences in the response capacities across the four income groups analyzed in Table 1, the average values for the proxies are in this section converted to factor scores and plotted in radar charts displaying the factor scores for each income group. The factor scores generated from the factor analysis ranges from 0 to 3.03, where a higher value represents a higher contribution to the response capacity. These generated scores are the basis for the radar charts. It is important to stress that a value of zero does not mean a response capacity of zero. Instead, this value should be regarded as the lowest factor-score possible. The reason for having a value of zero is simply due to rescaling in order to get the initial factor scores on a positive scale. Important to notice in the radar chart for the institutional factor is that the proxy for CPIA property rights has been excluded due to missing data for the High Income group. For the same reason data has been excluded for the socio-cultural factor; in this case data is missing for the poverty headcount ratio in the High Income group. The average factor scores as well as the statistical output from the factor analysis and a discussion of the reliability of the extracted factors are presented in Appendix 7, and Appendix 8, respectively.

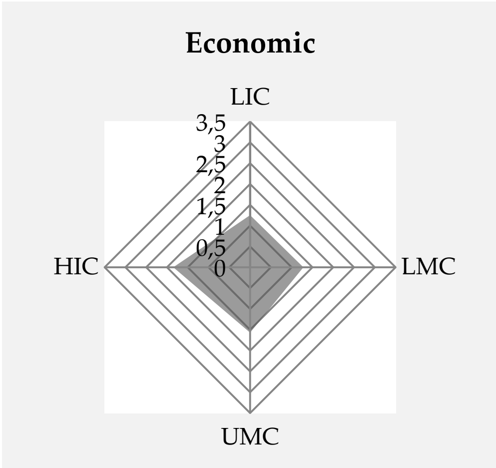

Figure 1: Radar chart describing the distribution of the economic factor.

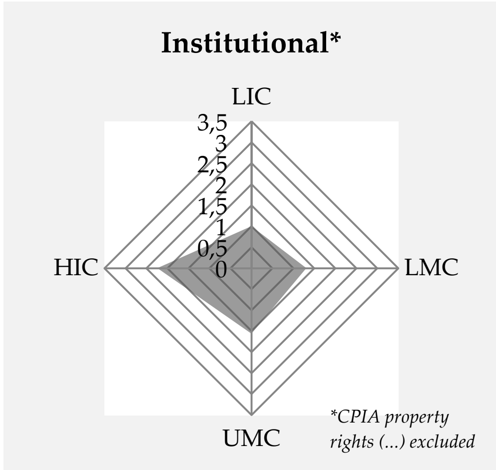

Figure 2: Radar chart describing the distribution of the institutional factor. The chart excludes the proxy for CPIA property rights and rule-based governance rating, due to missing data.

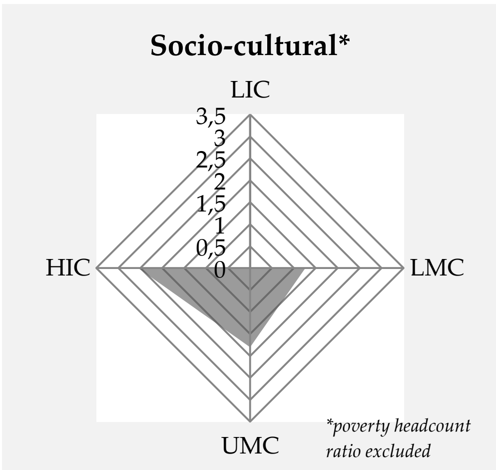

Figure 3: Radar chart describing the distribution of the socio-cultural factor. The chart excludes the proxy for poverty headcount ratio at $2 per day, due to missing data.

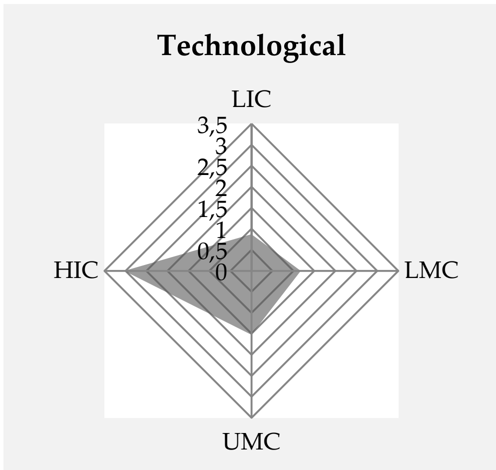

Figure 4: Radar chart describing the distribution of the technological factor.

Looking at the radar chart for the economic factors (Figure 1) we can see that the High Income group exhibits the highest score followed by the Upper Middle Income group and the Lower Middle Income group. In addition, the Low Income group scores the lowest, making the differences in the factor scores to follow the income levels coherently. What is notable is the rather symmetric shape of the area. Even though it is proved in Table 1 that the pure economic factors varies substantially, these differences seem to be neutralized by the supposed inverse impact of efficiency on the response capacity, evening out the largest differences in this particular factor across income groups.

The institutional factors (Figure 2) seem, just like the economic factors, to be strongest in the High Income group. The largest difference from the previous graph is however that the shape of the shaded area is more asymmetric with a tilt towards the High Income group. This is consistent with the conclusion from the analysis in Section 6, where it was stated that the institutional factors were the strongest in the High Income group, increasing the response capacity for this group compared to the other groups.

When it comes to the radar chart for the socio-cultural factor (Figure 3) it is important to notice that the value of zero does not translate into zero response capacity, as previously explained. As for the previous two factors discussed above, the High Income group exhibits the highest scores also for the socio-cultural factor. However, what is strikingly different in this case is the shape of the area for this factor. The jump between the Low Income group and the next income level is extremely large, whereas the differences between the three other income groups seem more balanced. As the skill-related proxies are well represented in the extracted socio-cultural factor (Appendix 8, Table 8.L.) we can argue that there seems to be a threshold value for the skill base, occurring at a rather low income level.

The shape of the shaded area in Figure 4 illustrating the technological factors is coherent with the results in the analysis of the technological proxies in Section 6; the High Income group exhibits substantially higher values than all the other income groups. This becomes evident in the shape of this area; the shape for the technological factor is distinctly tilted towards the High Income group. Thus the largest difference between adjacent income groups is found between the Upper Middle Income- and the High Income group. Thus, also for the technological factor a threshold seems to exist, but this time at a higher level of income, somewhere between the two highest income groups.

The concluding radar chart

According to our study it can be argued that the High Income group seems to have the highest degree of response capacity. The analyses of the proxies as well as the scores from the factor analysis support this conclusion. However, in order to graphically illustrate the findings for the overall response capacity of the four income groups, we have constructed a radar chart combining all four factor scores for each income group. The higher the factor scores the larger the shaded area, indicating a larger response capacity and thus also stronger prerequisites to fight climate. Although, we have to remember that the shaded areas cannot directly be translated into the definite size of the response capacity, as this paper does not discuss the relative weights of each factor on the overall response capacity. The forthcoming analysis is built upon the assumption that each factor contribute evenly to the overall response capacity.

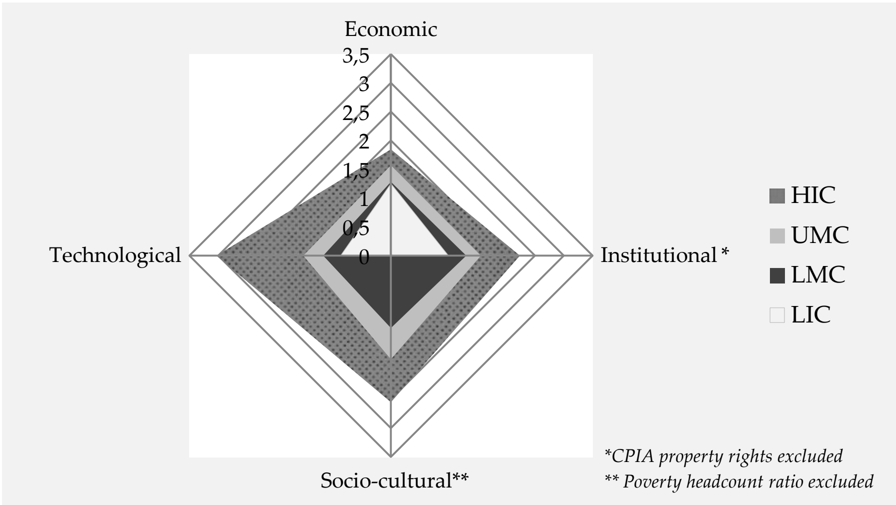

Figure 5: Chart describing the scores on each factor for the groups of High Income (HIC), Upper Middle Income (UMC), Lower Middle Income (LMC), and Low Income (LIC) respectively. The shaded areas indicate the response capacity for each income group. For the institutional-, and socio-cultural factors, CPIA property rights and rule-based governance rating as well as poverty headcount ratio respectively, are excluded.

If one looks at the concluding radar chart (Figure 5) for the Low Income group it becomes clear that the area is much smaller than the corresponding areas for the three other income groups. This would indicate that the Low Income group has an overall lower response capacity and thus also weaker prerequisites to fight climate change than the other income groups. The High Income group has the largest area, indicating, according to our analysis, the highest response capacity among the income groups. Also for the two middle income groups the response capacity seem to vary according to the income level of the groups, but the magnitude of the differences is smaller. To sum up, taking all factors into account this analysis of Figure 5 leads us to the important conclusion that the response capacity and the prerequisites to fight climate change seems to, if not depend on, at least strongly be influenced by the degree of income in a certain group.

Important to notice is also the differing shapes of the areas. If we look at the two middle income groups the shapes of their areas are seemingly quadratic, indicating a rather even contribution of all four factors to the response capacity. However, the settings seem to be rather different for the two extreme groups. The shapes of their areas are much more asymmetric; for the Low Income group the economic and institutional factors are the two largest contributors to the response capacity, while the socio-cultural and technological factors contribute less to the capacity to respond to climate change. For the High Income group the case is reversed; the two largest contributors to response capacity are the technological and the socio-cultural factors. Interesting to notice is that these two factors are strongly knowledge-related, determined by for example the skill base and technological know-how. In conclusion, it seems that the knowledge-based factors are scarcely represented in the Low Income group whereas in the High Income group these factors are abundantly represented. This finding yields an interesting indication that response capacity seem to consist of different compositions of components depending on income groups. This finding forms a noteworthy staring point to the discussion about how to fight climate change, with the prevailing differences across income groups kept in mind.

An alternative way to assess response capacities

As the purpose of this study is to evaluate the concept of response capacity from the perspective of four different income groups, no alternative approaches have been given space up till this point. However, as the results of this study might be drawn to the field of climate related policy discussions, it is justifiable to look at the response capacities across already existing cooperation organizations around the world, as an alternative approach. Analyzing response capacities from this perspective is of interest since membership states in cooperation organizations already collaborate in numerous fields and thus it would be likely that they would implement common climate change policies as well. Below we briefly discuss the implication for response capacity based on five organizations spread across continents. The sample of organizations examined are: the Association of Southeast Asian Nations (ASEAN), the African Union (AU), the European Union (EU), the MERCOSUR[4], and the Organization for Economic Co-operation and Development (OECD) (ASEAN, 2013; AU, 2013; EU, 2013, European Union External Action, 2013; OECD, 2013). The membership states of each organization are shown in Appendix 9. The average factor scores for each organization is tabled in Appendix 10, and graphically presented in Figure 6. Likewise in this analysis the size of the areas give indications of the response capacity, but now for the different cooperation organizations. A factor score of zero means the smallest score possible. Important is also to mention that the same proxies as in the previous factor score analysis are excluded due to missing data. These are indicated by the asterisks in the Figure 6.

[4] For MERCOSUR additionally the associate member states Chile, Colombia, Ecuador, and Peru, have been included in the sample.

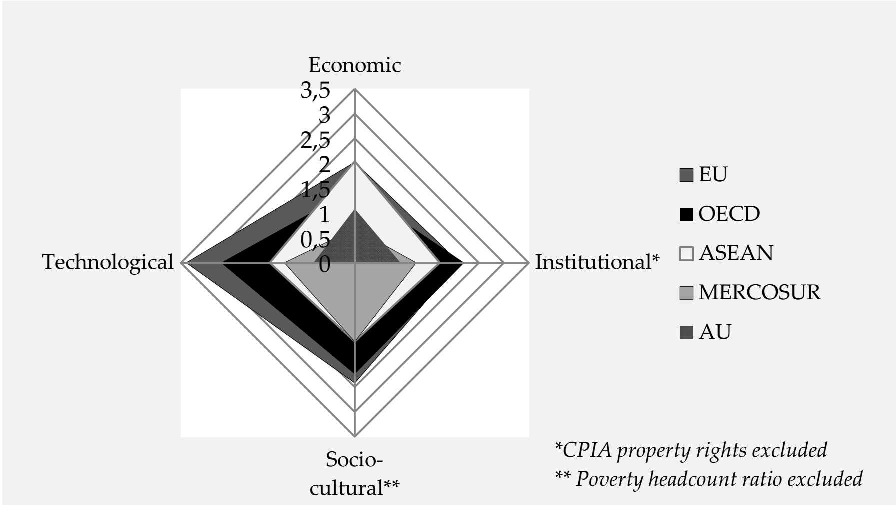

Figure 6: Radar chart describing the scores on each factor for the member organizations of the EU, the OECD, the ASEAN, the MERCOSUR, and the AU. Note that for the institutional-, and the socio-cultural factors, CPIA property rights and rule-based governance rating, and Poverty headcount ratio, respectively, are excluded.

The smallest area, indicating the lowest response capacity, can be found in the AU, a cooperation organization consisting of African states. The cooperation organization of the MERCOSUR presents a slightly larger area in the radar chart indicating a somewhat higher response capacity than AU. The ASEAN in turn shows a higher response capacity than the MERCOSUR by exhibiting the third largest area in the sample. The organization giving evidence of the highest response capacity is the EU followed by the OECD, organizations comprising nations of quite homogeneous character considering the level of development. The EU is scored higher than the OECD on all factors except for the institutional one where the OECD exhibits a somewhat higher factor score. Interesting is also to see that the ASEAN demonstrates almost equivalent scores for the socio-cultural factor as the group exhibiting the second lowest response capacity, the MERCOSUR, but nearly identical scores on the economic factor as the EU, the group with the overall highest response capacity.

In conclusion, according to the alternative analysis the EU seems to have the highest response capacity and thereby the best prerequisites to fight climate change, while the AU appear to have the lowest response capacity and coherently the weakest prerequisites to tackle global warming. Although the EU and the OECD already seem to have relatively high response capacities, compared to the AU, the ASEAN, and the MERCOSUR, it is still important for them not to suffice with their current state, but to continuously enhance their response capacities.

This alternative approach yields results that may have important implications for assessing response capacity from a policy related perspective. As economies in cooperation organizations already collaborate on multiple fields, the implementation of climate related policies in these groups might be a more viable option than implementing such policies into groups categorized according to pure income level. This approach might give a glimpse of which factors different cooperation organizations should assess in the discussion of climate related policies in order to enhance the response capacity. However, as we aim for as high external validity as possible, we do not want the applicability of the findings to be constrained by factors such as membership in specific cooperation organizations. When classifying economies according to income, we do not encounter such constraints and the results can therefore be regarded as applicable for all economies in the world.

8. Conclusion

This study attempted to assess the concept of response capacity defined as the ability to adapt to and mitigate climate change. In this paper we have sought to answer the question of which factors determine the response capacity and if the response capacities differ across the four income groups of Low Income, Lower Middle Income, Upper Middle Income, and High Income. The study also tries to evaluate the prerequisites for different income groups to fight climate change, and in that sense indirectly discuss the reasonable allocation of requirements for taking actions related to climate change. Based on previous research the response capacity is in this paper composed by four factors that in turn are determined by a number of proxies. The economic factor is represented by four proxies describing the pure economic factors and the efficiency. The institutional factor illustrates the functioning of, for climate related issues, critical institutions. The socio-cultural factor contains proxies estimating vulnerability and the skill base of a nation. The final factor is the technological one where the technological pre-requisites and the technological know-how are represented. Together all these different factors are determinants of the overall response capacity.

The assumption for this paper is that a high response capacity will reasonably be translated into larger prerequisites to fight climate change. This in turn would presumably imply that larger requirements could be put on those income groups presenting high response capacities. We find that groups with higher income seem to have higher response capacity, and thus also higher pre-requisites to fight climate change. There is found to be large differences within the response capacity across the income groups, but also the magnitude of the differences in the proxies and factor scores vary across income groups. Furthermore it is interesting to see that depending on the income group the factors that contribute the most to that specific income group's response capacity differ. However, we want to emphasize that although high income economies seemingly have the highest response capacities, this does not imply that they should be the only ones assessing climate change. Rather economies with higher response capacity could be seen as the ones taking the lead and initially the lion's share of the responsibilities to reduce global warming, simultaneously encouraging other income groups to create sustainable development paths.

One could suffice with the analysis above and merely look at the different income groups and how their response capacity differs. However, we would not recommend settling with solely this analysis. The implications of our results are encouraged to be regarded as a starting point in the construction of a framework theorizing the concept of response capacity. What is accomplished and concluded in this paper is only the beginning in the building of a fully-fledged model describing the response capacity. The specification of this model, its components, and its consistency are issues left for future research to investigate. One possible problem in the construction of such a model might be related to multicollinearity. As some of the factors used to estimate the response capacity might be interrelated this would cause difficulties to isolate the effect of independent variables on the response capacity, resulting in bias. However, as soon as these obstacles are overcome and a formula for modeling response capacity is found, the implications for the climate debate, the emission reductions, and the planet as a whole, could be immense.

Building on the potential possibilities realized by a theorization of a model for response capacity the conclusions in this paper could be taken a step further, to the scene of policies. What implications can the results get if put in the light of policies? Based on our results we can draw some conclusions of policies favorable in the long- and short run for the differing income groups.

In the short run we suggest policies to focus on those factors at which each income group is already relatively strong, whereas in the long run we propose a shift in focus toward the improvement of the factors that currently are relatively weak. For the Low Income group the short-run focus should be on stressing growth-enhancing policies for instance related to FDI and trade. The long run focus should instead be geared towards policies promoting the increase of knowledge. When it comes to the Lower Middle Income group, short run policies centered on strengthening the institutions would be suggested, improving stability and encouraging investments in their markets. As the skill base of the Lower Middle Income group is relatively high, the long run policies for this group could focus on the technological factors instead of pure educational improvements, as was the case for the Low Income group. The Upper Middle Income group has relatively strong socio-cultural factors, suggesting that it should continue to further improve the awareness and the skill base in the short run. As indicated by the results from the factor analysis, for this group all other factors contribute quite evenly to the response capacity. This makes it hard to state which factors should be focused on in the long run. For the High Income group the technological factor is the strongest contributor to the response capacity. Therefore, this income group could, in the short run, keep on investing into R&D and technological know-how. Policies can play an important part in steering these investments into climate friendly paths. When it comes to the long run, it is harder to draw similar conclusions for the High Income group than for the three other income groups. Although the economic factor for the High Income group has the relatively smallest contribution to the response capacity, this does probably not imply that the High Income group should only focus on improving the economic factor in the long run. Instead this relatively low score might indicate that a threshold value in the economic factor has been reached, enabling resources to be allocated to the three other factors. Hence, in the long run, it is hard to clearly determine which factors the economies in the High Income group should focus on in the long run.

As we have seen from the analysis the largest differences in factors scores prevail in the skill- and knowledge-related factors. If some income groups do not have the skills or the technological prerequisites and know-how, it might be more difficult for them to attain action against climate change. In addition, for groups to obtain these required levels of technological knowledge on their own might be time-consuming, an inertia in the accumulation of human capital that can be considered a problem as time is at stake. A possible solution would be knowledge transfers from income groups with higher contribution of knowledge-intense factors to income groups where the contribution from these factors is weaker. In other words, knowledge transfers from the High Income group to the Low Income group are proposed, enabling the Low Income group to build up its production facilities in sustainable and climate friendly ways, supported by the High Income group. To introduce policies facilitating and incentivizing such transfers could therefore be favorable. Besides incentivizing, these policies should also assure that the transfers would be implemented in the correct way.

In conclusion, in the short run it would be favorable to establish policies focusing on those factors where economies already have prerequisites. In the long run, however, economies have to assess all factors especially the weaker ones in order to reach a sustainable development path. To sum up, depending on the time frame, policies should have different factors as targets. Moreover, one can gain from shifting the focus from possible actions only within each income group, to a broader view with potential actions across the income groups. Knowledge transfers could be one such solution, but also other kinds of transfers from income groups with a high contribution of a specific factor on the response capacity, to income groups where the contribution of that specific factor is weaker, might be favorable to enhance the response capacity of the world as a whole.

We argue that as soon as the components of the complex issue of response capacity can be pinned-down also the creation of necessary policies for the division of the responsibilities can begin. This possible model could be a substantial building block in the formation of essential policies for climate change actions and additionally give guidelines for policy-makers in their creation and implementation of a new climate convention. Perhaps a model allocating responsibilities by using response capacities would even be able to break the deadlock currently prevailing in the climate debate.

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10. Appendices

Appendix 1: Classification of the four different income groups

	Low Income (LIC)		Lower Middle Income (LMC)		Upper Middle Income (UMC)		High Income (HIC)
1	Afghanistan	1	Albania	1	Algeria	1	Andorra
2	Bangladesh	2	Armenia	2	American Samoa	2	Aruba
3	Benin	3	Belize	3	Angola	3	Australia
4	Burkina Faso	4	Bhutan	4	Antigua and Barbuda	4	Austria
5	Burundi	5	Bolivia	5	Argentina	5	Bahamas, The
6	Cambodia	6	Cameroon	6	Azerbaijan	6	Bahrain
7	Central African Republic	7	Cape Verde	7	Belarus	7	Barbados
8	Chad	8	Congo, Rep.	8	Bosnia and Herzegovina	8	Belgium
9	Comoros	9	Cote d'Ivoire	9	Botswana	9	Bermuda
10	Congo, Dem. Rep.	10	Djibouti	10	Brazil	10	Brunei Darussalam
11	Eritrea	11	Egypt, Arab Rep.	11	Bulgaria	11	Canada
12	Ethiopia	12	El Salvador	12	Chile	12	Cayman Islands
13	Gambia, The	13	Fiji	13	China	13	Channel Islands
14	Guinea	14	Georgia	14	Colombia	14	Croatia
15	Guinea-Bissau	15	Ghana	15	Costa Rica	15	Curacao
16	Haiti	16	Guatemala	16	Cuba	16	Cyprus
17	Kenya	17	Guyana	17	Dominica	17	Czech Republic
18	Korea, Dem. Rep.	18	Honduras	18	Dominican Republic	18	Denmark
19	Kyrgyz Republic	19	India	19	Ecuador	19	Equatorial Guinea
20	Liberia	20	Indonesia	20	Gabon	20	Estonia
21	Madagascar	21	Iraq	21	Grenada	21	Faeroe Islands
22	Malawi	22	Kiribati	22	Iran, Islamic Rep.	22	Finland
23	Mali	23	Kosovo	23	Jamaica	23	France
24	Mauritania	24	Lao PDR	24	Jordan	24	French Polynesia
25	Mozambique	25	Lesotho	25	Kazakhstan	25	Germany
26	Myanmar	26	Marshall Islands	26	Latvia	26	Greece
27	Nepal	27	Micronesia, Fed. Sts.	27	Lebanon	27	Greenland
28	Niger	28	Moldova	28	Libya	28	Guam
29	Rwanda	29	Mongolia	29	Lithuania	29	Hong Kong SAR, China
30	Sierra Leone	30	Morocco	30	Macedonia, FYR	30	Hungary
31	Somalia	31	Nicaragua	31	Malaysia	31	Iceland
32	Tajikistan	32	Nigeria	32	Maldives	32	Ireland
33	Tanzania	33	Pakistan	33	Mauritius	33	Isle of Man
34	Togo	34	Papua New Guinea	34	Mexico	34	Israel
35	Uganda	35	Paraguay	35	Montenegro	35	Italy
36	Zimbabwe	36	Philippines	36	Namibia	36	Japan
		37	Samoa	37	Palau	37	Korea, Rep.
		38	Sao Tome and Principe	38	Panama	38	Kuwait
		39	Senegal	39	Peru	39	Liechtenstein
		40	Solomon Islands	40	Romania	40	Luxembourg
		41	South Sudan	41	Russian Federation	41	Macao SAR, China
		42	Sri Lanka	42	Serbia	42	Malta
		43	Sudan	43	Seychelles	43	Monaco
		44	Swaziland	44	South Africa	44	Netherlands
		45	Syrian Arab Republic	45	St. Lucia	45	New Caledonia
		46	Timor-Leste	46	St. Vincent and the Grenadines	46	New Zealand
		47	Tonga	47	Suriname	47	Northern Mariana Islands
		48	Ukraine	48	Thailand	48	Norway
		49	Uzbekistan	49	Tunisia	49	Oman
		50	Vanuatu	50	Turkey	50	Poland
		51	Vietnam	51	Turkmenistan	51	Portugal
		52	West Bank and Gaza	52	Tuvalu	52	Puerto Rico
		53	Yemen, Rep.	53	Uruguay	53	Qatar
		54	Zambia	54	Venezuela, RB	54	San Marino
						55	Saudi Arabia
						56	Singapore
						57	Sint Maarten (Dutch part)
						58	Slovak Republic
						59	Slovenia
						60	Spain
						61	St. Kitts and Nevis
						62	St. Martin (French part)
						63	Sweden
						64	Switzerland
						65	Trinidad and Tobago
						66	Turks and Caicos Islands
						67	United Arab Emirates
						68	United Kingdom
						69	United States
						70	Virgin Islands (U.S.)

Data source: The World Bank, 2012

Appendix 2: Yohe's determinants of adaptive and mitigative capacities

Adaptive capacity	Mitigative capacity
• the range of available technological options for adaptation, • the availability of resources and their distribution across the population, • the structure of critical institutions and the derivative allocation of decisionmaking authority, • the stock of human capital, including education and personal security, • the stock of social capital including the definition of property rights, • the system's access to risk spreading processes, • the ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers, themselves, and • public perception of attribution.	• the range of viable technological options for reducing emissions, • the range of viable policy instruments with which it might effect the adoption of these options, • the structure of critical institutions and the derivative allocation of decisionmaking authority, • the availability and distribution or resources required to underwrite their adoption and the associated, broadly defined opportunity cost of devoting those resources to mitigation, • the stock of human capital, including education and personal security, • the stock of social capital including the definition of property rights the country's access to risk spreading processes, and • the ability of decision-makers to manage information, the processes by which these decision-makers determine which information is credible, and the credibility of the decision-makers, themselves.

Source: Yohe, 2001, pp.250, 254-255

Appendix 3: Outliers per income group and proxy

For all tables in Appendix 3, the observation numbers can be matched with the number of each economy in each income group found in Appendix 1. Observations considered as outliers are indicated by the shaded areas.

Table 3.A: Standardized residuals, studentized residuals, and Cook's distance for the Low income group (LIC)

GDP/capita

obs:	stand. resid.	stud. resid.	Cook´s dist.
10.	-1.671794	-1.741228	.0707688
20.	-1.353018	-1.373665	.0316385
11.	-1.307258	-1.33166	.0391779
5.	-1.206794	-1.24715	.0637879
28.	-1.045245	-1.066044	.0395955
13.	1.295225	1.31399	.0323187
32.	1.681824	1.804215	.1605497
6.	1.867634	1.997851	.1365347
19.	1.930584	2.028091	.0617443
24.	2.280263	2.484996	.1228779

Trade (% of GDP)

obs:	stand. resid.	stud. resid.	Cook´s dist.
29.	-1.287067	-1.328119	.0631427
7.	-1.117094	-1.142739	.0465685
27.	-1.07131	-1.087542	.0354976
30.	-.9059739	-.9232255	.0348041
3.	-.8940217	-.9218231	.0457378
24.	1.127744	1.139334	.029527
36.	1.545102	1.676497	.1917869
6.	1.602066	1.688924	.1065318
19.	2.066933	2.203771	.0743868
10.	2.663106	3.061926	.1945212

FDI, net inflows (% of GDP)

obs:	stand. resid.	stud. resid.	Cook´s dist.
32.	-.7795329	-.797173	.0296924
14.	-.6781642	-.6732803	.0082387
23.	-.6765121	-.6726434	.0089433
15.	-.659853	-.6541976	.0073501
27.	-.6587484	-.660137	.0123906
25.	.65245	.6506623	.0099363
28.	1.453375	1.503637	.067029
10.	1.954187	2.072806	.0966003
8.	2.199874	2.393972	.1506261
20.	3.698024	4.867408	.2224298

GDP/unit energy use

obs:	stand. resid.	stud. resid.	Cook´s dist.
32.	-.7795329	2.193209	.4605396
14.	-.6781642	.	.
23.	-.6765121	.	.
15.	-.659853	.	.
27.	-.6587484	.0284243	.0000639
25.	.65245	-.8258549	.0413478
28.	1.453375	.	.
10.	1.954187	-2.164621	.2176318
8.	2.199874	.	.
20.	3.698024	.	.

S&E degrees/million people, annual

obs:	stand. resid.	stud. resid.	Cook´s dist.
5.	-.7251837	-.7501748	.0738564
13.	-.5764732	-.5524202	.0174754
25.	-.5122679	-.5195195	.035788
11.	-.4581992	-.43933	.0129434
17.	-.4176663	-.3964875	.0090831
12.	-.2729599	-.2585844	.0041965
21.	-.1664231	-.1596819	.0021035
6.	-.1287954	-.12729	.0019872
2.	.7921903	.8701769	.1470075
19.	2.76726	6.946067	.4637352

Natural disasters/million people

obs:	stand. resid.	stud. resid.	Cook´s dist.
10.	-1.17882	-1.197336	.0344195
12.	-.9297474	-.9328235	.0175603
26.	-.899551	-.9035046	.0181062
2.	-.8945916	-.9263696	.046737
4.	-.8256994	-.8457769	.032174
24.	1.382955	1.407862	.0355191
32.	1.559011	1.636322	.1029818
15.	1.675154	1.725253	.0448925
16.	2.002548	2.101647	.0607579
13.	3.399487	4.144825	.2146215

Alternative & nuclear energy use (of total energy use)

obs:	stand. resid.	stud. resid.	Cook´s dist.
34.	-.9896509	-1.056264	.1139226
33.	-.9031453	-.9486992	.0837573
36.	-.8207027	-.883591	.1009184
27.	-.6040184	-.5997697	.0185265
26.	-.542041	-.5346572	.0134591
2.	.0243898	.0256891	.0000947
17.	.0717588	.0692964	.0001682
25.	.2481282	.2419472	.002564
19.	1.57804	1.665506	.0775572
32.	3.160915	6.123931	.9069756

High-tech exports (% of manufactured exports)

obs:	stand. resid.	stud. resid.	Cook´s dist.
3.	-1.363863	-1.51627	.2324721
6.	-1.35736	-1.465719	.1585323
26.	-.672449	-.6683015	.017428
19.	-.6696909	-.6581825	.0117945
13.	-.5845712	-.5789148	.0130379
4.	.5503454	.574535	.033403
5.	.7630221	.7968202	.0566959
29.	.9569446	.9768759	.0491678
28.	1.080425	1.105938	.0558483
7.	3.041368	4.608209	.7038247

Patent applications/million people, annual

obs:	stand. resid.	stud. resid.	Cook´s dist.
32.	-.5505765	-.7016003	.3201989
21.	-.4571629	-.4212591	.0233151
17.	-.4094932	-.3674311	.0137327
4.	-.3079944	-.3222263	.0379693
2.	-.2875122	-.3229754	.0536743
19.	-.2420492	-.2163415	.0053327
18.	2.254788	27.86567	.4330401

Table 3.B: Standardized residuals, studentized residuals, and Cook's distance for the Lower Middle Income group (LMC)

Trade (% of GDP)				FDI, net inflows (% of GDP)				S&E degrees/million people, annual				Natural disasters/million people			
obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.
33.	-1.800557	-1.851591	.0405426	53.	-.9353081	-.9622036	.0378194	44.	-1.081283	-1.205133	.2002448	11.	-.6297505	-.632789	.0088692
43.	-1.659428	-1.713263	.0621841	34.	-.8699359	-.8693504	.0091678	25.	-.9241016	-.9209569	.027997	19.	-.6156224	-.6133037	.0050493
20.	-1.289064	-1.302079	.0227393	4.	-.7767605	-.791773	.0215942	24.	-.9121032	-.9071394	.0260991	9.	-.6139702	-.6186391	.009677
11.	-1.282135	-1.30775	.0396343	36.	-.7762744	-.7755688	.0081582	16.	-.7343946	-.7246305	.0178792	21.	-.6083292	-.6052253	.0044472
19.	-1.264884	-1.27765	.0230862	37.	-.7670518	-.7668648	.0084683	18.	-.6569141	-.6443848	.013175	32.	-.5951461	-.5914707	.0039202
28.	1.101871	1.104358	.0134986	17.	1.111486	1.11897	.0180019	17.	.3095932	.3007726	.0030339	26.	1.528612	1.550635	.0240582
44.	1.183462	1.203648	.0338694	40.	2.196511	2.307261	.0846627	2.	.6654573	.6929632	.0473584	47.	1.635064	1.692833	.0735162
8.	1.877091	1.97007	.1043984	8.	2.213856	2.349949	.1329055	52.	.6975891	.8335391	.1935378	50.	1.829637	1.920094	.1129009
25.	2.469688	2.630656	.0694498	38.	3.450718	3.950792	.1827146	14.	1.252203	1.28415	.0585131	3.	2.387855	2.589964	.2197787
51.	2.702709	3.013579	.2847338	29.	3.798028	4.474754	.1464954	29.	3.11608	4.933546	.4119164	27.	4.614682	6.11987	.2174358

Gross fixed capital formation (% of GDP)				Alternative & nuclear energy use (of total energy use)				High-tech exports (% of manufactured exports)				Patent applications/million people, annual			
obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.
44.	-1.421541	-1.464827	.0602735	9.	-.6095048	-.615244	.014158	53.	-.6552321	-.6790404	.0300909	16.	-1.011441	-1.043915	.070143
12.	-1.392726	-1.426903	.048274	11.	-.5835524	-.5861526	.0112337	47.	-.6399909	-.6507846	.0189008	20.	-.8738016	-.8791389	.0378009
9.	-1.376106	-1.416527	.0580875	5.	-.5748749	-.586031	.0168278	54.	-.6183519	-.6426136	.0287007	33.	-.7956071	-.7846032	.0204221
41.	-1.323989	-1.352044	.0424425	23.	-.569036	-.5629194	.0053379	37.	-.5643656	-.5617718	.0074033	11.	-.6995358	-.7274715	.0521613
16.	-1.162761	-1.175056	.0257942	29.	-.5626675	-.5562952	.0050639	42.	-.5365828	-.5382517	.0093469	36.	-.6967809	-.6862008	.0176558
47.	1.008871	1.031245	.0374536	14.	.8054731	.8087394	.0173267	5.	.2334471	.2361727	.00258	14.	1.087364	1.140903	.0964281
29.	1.128056	1.132164	.0166639	1.	.959766	1.001765	.0624373	20.	.2376893	.2344602	.0010201	2.	1.143736	1.335712	.3242858
7.	1.479497	1.53587	.0772412	2.	1.172115	1.229128	.0867388	38.	.4302282	.4279015	.0045848	28.	1.194687	1.211792	.045707
51.	1.768814	1.884105	.151764	12.	1.234347	1.262657	.0467978	22.	2.61005	2.908864	.1139285	29.	1.254458	1.278557	.0494502
4.	3.090832	3.653778	.4152375	35.	4.672592	8.568728	.445852	40.	4.598234	8.313251	.5981078	48.	2.330689	3.031301	.4967995

Table 3.C: Standardized residuals, studentized residuals, and Cook's distance for the Upper Middle Income group (UMC)

GDP/capita				FDI, net inflows (% of GDP)				Literacy rate (% of population aged 15+)				S&E degrees/million people, annual			
obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.	obs:	stand. resid.	stud. resid.	Cook´s dist.
24.	-1.616474	-1.648118	.0308698	47.	-2.489722	-2.684382	.1622004	3.	-3.463502	-4.792603	.9425009	36.	-1.253047	-1.282054	.051089
36.	-1.527234	-1.554808	.0317743	3.	-1.548568	-1.617911	.0987291	9.	-1.164589	-1.205498	.0649414	54.	-1.155378	-1.27286	.184932
3.	-1.500476	-1.571848	.1032129	54.	-1.308412	-1.357251	.0719837	23.	-1.142622	-1.149447	.0226389	53.	-.9861371	-1.067288	.1239439
47.	-1.227949	-1.25548	.0428464	44.	-1.14712	-1.163007	.0279646	36.	-1.097473	-1.109475	.0293111	16.	-.6376309	-.6356601	.01488
51.	-1.187344	-1.222432	.0530333	50.	-1.030682	-1.052355	.0341658	33.	-1.064244	-1.069963	.0224736	14.	-.5502419	-.549952	.0129002
12.	1.151031	1.17008	.0324165	27.	1.503022	1.523355	.0232177	25.	1.040855	1.042047	.0177276	26.	.5755318	.5655905	.0075381
29.	1.571721	1.598282	.0268746	46.	2.06245	2.168363	.1038479	8.	1.149505	1.193253	.0687756	24.	.7332416	.7247591	.0126814
4.	2.030771	2.173006	.1766703	51.	2.243851	2.404355	.1733022	5.	1.208868	1.273087	.0975009	11.	.865126	.8829791	.0405288
41.	2.053024	2.149059	.0785033	43.	2.262937	2.392687	.1015775	16.	1.285442	1.313069	.0444576	29.	1.269849	1.288995	.0374363
43.	2.98652	3.337747	.1908734	35.	2.909921	3.179206	.102737	4.	1.429977	1.529893	.1480815	40.	3.494001	5.498357	.5345113

obs:	Natural disasters/million people stand. resid.	stud. resid.	Cook´s dist.
7.	-.6034636	-.6093022	.0102498
10.	-.5958062	-.5986343	.0080834
13.	-.5948161	-.5952743	.0065275
6.	-.5837352	-.5902877	.0102871
1.	-.5695715	-.5818919	.0137951
21.	2.239078	2.343955	.057595
17.	2.304331	2.4276	.0752994
45.	2.325408	2.484683	.1450835
46.	3.101173	3.504765	.2768395
2.	3.661589	4.426902	.5330148

obs:	Gross fixed capital formation (% of GDP) stand. resid.	stud. resid.	Cook´s dist.
16.	-1.70185	-1.752632	.0517983
3.	-1.27757	-1.327069	.0734416
29.	-.9923847	-.9921172	.0113619
18.	-.8941687	-.8955593	.0125649
54.	-.8002121	-.8269575	.0347538
27.	1.335684	1.347966	.0202645
4.	1.734837	1.829941	.1263045
7.	2.107025	2.248919	.150661
13.	2.889856	3.220163	.1840151
51.	3.588952	4.416812	.5689322

obs:	Alternative & nuclear energy use (of total energy use) stand. resid.	stud. resid.	Cook´s dist.
51.	-.8648282	-.8914811	.0378528
49.	-.8402417	-.8609653	.0310339
28.	-.8203583	-.8168152	.0083059
48.	-.8086925	-.8259794	.0267697
16.	-.7865298	-.7869978	.0112805
10.	1.029765	1.045496	.0295
53.	1.359385	1.431518	.1074414
11.	2.349857	2.535136	.1428526
35.	2.905813	3.245552	.1385875
15.	3.549242	4.27489	.2455806

obs:	Access to electricity (% of population) stand. resid.	stud. resid.	Cook´s dist.
36.	-2.535838	-2.900759	.1876771
3.	-2.532395	-3.022968	.4419654
20.	-2.240514	-2.450226	.1045257
9.	-1.727427	-1.843663	.1291242
44.	-.7648607	-.7815557	.0312432
15.	.6496021	.6473065	.0117224
10.	.658361	.6632843	.0173683
5.	.6625891	.6779949	.0259101
13.	.6757578	.6763799	.0146118
1.	.8009791	.8364739	.0515934

obs:	High-tech exports (% of manufactured exports) stand. resid.	stud. resid.	Cook´s dist.
46.	-.8756279	-.8947063	.0322186
38.	-.7732807	-.7754979	.0141117
33.	-.7625898	-.7600748	.0100221
17.	-.7519953	-.7503121	.0105238
36.	-.7308761	-.7302802	.0110192
34.	.7963317	.7950634	.0115593
48.	1.411404	1.478356	.09671
13.	1.913469	2.013475	.0885429
15.	3.103195	3.624022	.2032656
31.	3.465313	4.222233	.1878225

obs:	Patent applications/million people, annual stand. resid.	stud. resid.	Cook´s dist.
1.	-.7769389	-.8167682	.0549218
19.	-.7467167	-.7429445	.0129237
15.	-.7366018	-.7374134	.0164219
14.	-.7210205	-.7229865	.0169486
39.	-.6616484	-.6636358	.0152334
26.	.5766867	.5687442	.0061504
25.	.9686102	.9668257	.0174496
7.	2.249115	2.556425	.285947
41.	2.632473	3.09303	.2817627
13.	2.822745	3.392902	.2803172

Table 3.D: Standardized residuals, studentized residuals, and Cook's distance for the High Income group (HIC)

obs:	GDP/capita stand. resid.	stud. resid.	cook´s dist.
61.	-1.527678	-1.577898	.0673165
50.	-1.236031	-1.249435	.0242437
14.	-1.138429	-1.158859	.0339281
30.	-1.081694	-1.084838	.0139226
20.	-1.074144	-1.084232	.0217021
48.	1.367465	1.385708	.0269265
56.	1.382553	1.41175	.0417859
41.	1.885621	1.942192	.0397651
53.	2.768886	3.026131	.1422807
40.	3.359841	3.825945	.1237309

obs:	Trade (% of GDP) stand. resid.	stud. resid.	cook´s dist.
69.	-1.171776	-1.214337	.063017
36.	-1.09446	-1.096667	.0130184
3.	-.8881465	-.9152352	.0376037
60.	-.8093663	-.8190926	.0184681
46.	-.7910362	-.7895843	.0085088
42.	.6817282	.6780658	.0054811
32.	.8354481	.8328452	.0079706
40.	2.425673	2.573045	.0661968
56.	3.301045	3.802817	.2461759
29.	3.941232	4.825494	.1934258

obs:	FDI, net inflows (% of GDP) stand. resid.	stud. resid.	cook´s dist.
40.	-6.538458	-19.6218	.4591494
30.	-.7150996	-.7118095	.0056223
4.	-.3824195	-.3888424	.0057267
18.	-.2397629	-.2392079	.0010643
44.	-.0985092	-.0976472	.0001177
8.	.6405631	.6491099	.0130179
32.	.6748576	.6710486	.004791
61.	.7827747	.7927809	.0175029
56.	.8929008	.9006258	.0173763
29.	1.38381	1.398728	.0216625

obs:	GDP/unit energy use stand. resid.	stud. resid.	cook´s dist.
40.	-6.538458	.4900971	.0029097
30.	-.7150996	-.042582	.0000246
4.	-.3824195	.4649146	.010713
18.	-.2397629	.8953264	.0188301
44.	-.0985092	.0155256	3.24e-06
8.	.6405631	-.3879292	.0061084
32.	.6748576	1.154626	.0164621
61.	.7827747	.	.
56.	.8929008	.1849119	.0008102
29.	1.38381	5.252993	.2314651

Functioning of government

obs:	stand. resid.	stud. resid.	cook´s dist.
19.	-3.013135	-3.407692	.2102245
55.	-2.013759	-2.115946	.0908079
53.	-1.849586	-1.922547	.0685049
6.	-1.707419	-1.809415	.1408907
49.	-1.681877	-1.728224	.0458962
18.	1.167541	1.18693	.0334137
22.	1.169917	1.183961	.0267994
31.	1.175263	1.181966	.0178694
48.	1.185361	1.195411	.0217243
63.	1.194271	1.226986	.0504418

Literacy rate (% of population aged 15+)

obs:	stand. resid.	stud. resid.	cook´s dist.
55.	-2.793613	-3.754551	.4227946
52.	-1.68011	-1.810588	.1282506
6.	-1.357486	-1.492952	.2035787
19.	-.7371076	-.7412942	.0267676
10.	-.3886271	-.3971396	.0129405
30.	.7753391	.7672989	.0174574
65.	.7903216	.8285358	.0631104
50.	.9646266	.9741254	.0378316
20.	.9676992	.9824237	.0435321
59.	1.037193	1.077653	.0744655

S&E degrees/million people, annual

obs:	stand. resid.	stud. resid.	cook´s dist.
10.	-1.693489	-1.781836	.1121385
53.	-1.581971	-1.630203	.0564029
40.	-1.529697	-1.558309	.030992
67.	-1.392966	-1.458067	.095111
6.	-1.324122	-1.381874	.0854743
36.	1.295326	1.306917	.0215087
51.	1.475787	1.510435	.0441425
34.	1.517728	1.544971	.0299867
50.	1.795791	1.863917	.0620935
22.	2.817575	3.151829	.1600686

Awareness of climate change (share)

obs:	stand. resid.	stud. resid.	cook´s dist.
55.	-4.169227	-6.756773	.627124
65.	-1.558808	-1.676626	.1672468
35.	-.6804437	-.673785	.0078196
17.	-.6050341	-.6113052	.0151534
8.	-.5135666	-.5312054	.0195093
48.	.8959084	.8981252	.0189153
36.	.946181	.9439331	.0149616
63.	.9943562	1.032379	.0598609
68.	1.170541	1.245784	.1141219
69.	1.184273	1.26619	.1244268

Natural disasters/million people

obs:	stand. resid.	stud. resid.	cook´s dist.
22.	-.3954472	-.3936953	.0025728
11.	-.3856999	-.3884911	.0043853
18.	-.3821689	-.3817557	.0029527
25.	-.3797045	-.3772054	.0020606
8.	-.370067	-.3743442	.0047405
5.	.5465794	.5567062	.0121126
28.	.554101	.5506126	.0038906
47.	1.048331	1.052711	.0156486
66.	4.124788	5.380675	.6516936
12.	4.854758	7.188612	.6582629

Gross fixed capital formation (% of GDP)

obs:	stand. resid.	stud. resid.	cook´s dist.
52.	-1.579881	-1.621041	.0485249
32.	-1.235276	-1.243109	.0175993
31.	-1.123842	-1.127772	.0148959
41.	-1.118271	-1.122194	.0149492
7.	-.9408939	-.9634827	.034484
56.	.6596118	.6632584	.0105602
3.	.9479476	.9784581	.0434487
37.	1.189778	1.195322	.0157896
61.	2.618475	2.881002	.2203381
19.	4.822542	7.063728	.4640875

Alternative & nuclear energy use (of total energy use)

obs:	stand. resid.	stud. resid.	cook´s dist.
67.	-.8836251	-.906859	.034248
65.	-.8763025	-.8957583	.0301642
56.	-.8433508	-.8497393	.0168282
55.	-.8396895	-.8449892	.0157735
53.	-.8323669	-.8356892	.0138799
46.	1.162895	1.170558	.0192081
64.	1.510111	1.571326	.0847295
63.	1.622278	1.692844	.0924646
23.	2.004903	2.096684	.0730622
31.	4.24297	5.554514	.2308375

High-tech exports (% of manufactured exports)

obs:	stand. resid.	stud. resid.	cook´s dist.
65.	-1.258893	-1.300741	.0623085
41.	-1.198102	-1.204983	.0170453
55.	-1.174129	-1.192456	.0314066
49.	-1.171407	-1.182637	.0227139
61.	-1.141677	-1.167844	.0412908
23.	1.049601	1.054925	.0166713
37.	1.40999	1.425892	.021809
16.	2.125699	2.240733	.0983699
42.	2.947621	3.249071	.1064068
56.	3.15626	3.591959	.2397735

Patent applications/million people, annual

obs:	stand. resid.	stud. resid.	cook´s dist.
55.	-.5628918	-.5648147	.0089037
41.	-.5286044	-.5233991	.0039668
58.	-.5116587	-.5155355	.0088359
42.	-.4920382	-.4871184	.003531
51.	-.4846359	-.4831345	.0052044
46.	.109385	.1081909	.0002037
25.	.5591859	.556839	.0061776
69.	.8129571	.8452716	.0432086
36.	3.648071	4.528347	.18025
37.	4.363591	6.263836	.2571225

Appendix 4: Data sets per income group and proxy

For all tables in Appendix 4, observations detected as outliers are indicated by shaded areas and asterisks.

Table 4.A: Data for the Low Income group (LIC), by economy and by proxy.

	GDP/capita	Trade (% of GDP)	FDI, net inflows (% of GDP)	GDP/unit of energy use	Functioning of government	Strength of legal rights	CPIA prop.rights & rule-based governance	Literacy rate (% of people ages 15+)	S&E-degrees/million people, annual	Awareness of climate change (% of population)	Climate related natural disasters/million people	Poverty headcount ratio (% of population)	Gross fixed capital formation (% of GDP)	Alternative & nuclear energy (% of total energy use)	Access to electricity (% of population)	High-technology exports (% of manufactured exports)	Patent applications/million people, annual
Afghanistan	1082.32	87.22	1.34		0.79	6.00	1.50			25	0.17		26.52		15.60		
Bangladesh	1648.63	43.42	0.91	7.89	5.43	7.00	3.00	56.78	503.35	33	0.05	76.54	24.41	0.46	41.00		0.44
Benin	1572.76	39.76	0.82	3.81	6.43	3.00	3.00	42.36		21	0.07		20.50	0.00	24.80	0.48	
Burkina Faso	1259.05	41.93	0.38		3.57	3.00	3.50			36	0.06		19.86		14.60	7.80	0.12
Burundi	579.99	42.65	0.04		3.29	3.00	2.50	67.16	24.69	22	0.32		18.00			8.50	
Cambodia	2180.17	113.60	6.96	6.13	6.07	8.00	2.50		208.30	58	0.10		16.19	0.05	24.00	0.09	
Central African Republic	781.60	35.18	4.62		1.07	3.00	2.00	55.99		56	0.25		14.27			*17.11	
Chad	1481.03	69.38	22.71		0.00	3.00	2.00	34.47		45	0.11		31.81				
Comoros	1089.79	66.08	0.72		2.21	3.00	2.50	74.94			0.27						
Congo, Dem. Rep.	350.57	*146.28	20.82	0.97	1.07	3.00	2.00	66.80		53	0.01		23.55	2.84	11.10		
Eritrea	542.46		2.63	3.83	2.14	2.00	2.50	67.77	95.36		0.08			0.02	32.00		
Ethiopia	1032.67	46.61	1.08	2.58	3.93	4.00	3.00		150.96	80	0.04		24.68	1.32	17.00	2.74	
Gambia, The	1899.82	65.60	3.90		4.29	5.00	3.00	49.96	54.39		*0.64		21.42			2.14	
Guinea	1083.82	64.88	0.00		0.43	3.00	2.00	41.05		55	0.09		10.57				
Guinea-Bissau	1200.47		0.18		0.00	3.00	2.50	54.18			0.40						
Haiti	1099.35	74.53	2.26	4.80	1.86	3.00	2.00			46	0.44			0.67	38.50		
Kenya	1645.52	67.85	0.55	3.41	4.29	10.00	2.50	87.38	95.53	56	0.09		20.32	7.90	16.10	5.70	1.90
Korea, Dem. Rep.					2.50						0.06			6.22	26.00		*329.33
Kyrgyz Republic	2244.68	133.23	9.13	4.19	1.14	10.00	2.50		*1082.99	52	0.20	22.90	28.11	30.44		0.98	24.60
Liberia	540.69	101.27	*34.99		0.79	4.00	2.50	60.78		15	0.13		26.37				
Madagascar	962.54	60.75	9.74		2.14	2.00	3.00		165.45	49	0.15	92.62			19.00	1.04	0.43
Malawi	864.44	74.32	1.80		5.71	7.00	3.50	74.77			0.13		24.16		9.00	1.29	
Mali	1071.03	65.88	0.29		6.43	3.00	3.50	31.10		53	0.11	78.66	21.13			2.40	
Mauritania	2438.64	108.34	3.54		4.29	3.00	3.00	58.02		44	0.35		24.00				
Mozambique	911.34	71.28	10.92	2.09	4.64	3.00	3.00	56.11	49.46	54	0.14		22.00	14.04	11.70	1.27	
Myanmar					1.79			92.29			0.03			3.14	13.00	0.00	
Nepal	1199.77	45.95	0.55	3.52	4.29	7.00	2.50	60.31		37	0.08	57.25	22.19	2.70	43.60	0.62	

Niger	720.20		17.38		0.43	3.00	3.00			24	0.08					6.56	
Rwanda	1193.04	40.63	0.75		4.64	7.00	3.50	71.05		30	0.11		20.97			5.94	
Sierra Leone	1066.35	52.16	9.41		1.86	7.00	2.50	42.12		36	0.10		24.48				
Somalia											0.28						
Tajikistan	2147.21	76.26	-0.26	6.40	0.79	2.00	2.50	99.69		43	0.36		18.79	*59.04			1.02
Tanzania	1432.39	66.40	4.46	3.10	4.29	7.00	3.50	73.21		53	0.04		31.52	1.10	13.90	3.48	
Togo	999.43	96.87	3.91	2.24	0.79	3.00	2.50			29	0.10		18.81	0.31	20.00	0.06	
Uganda	1273.00	57.68	3.16		3.21	7.00	3.50	73.21	94.33	35	0.07		23.26		9.00	2.37	
Zimbabwe		126.12	2.23		1.29	7.00	1.50	92.24		52	0.09		14.00	3.64	41.50		
Number of obs incl. outliers	**32**	**30**	**33**	**14**	**35**	**33**	**33**	**25**	**11**	**28**	**36**	**5**	**27**	**17**	**20**	**20**	**7**
Number of outliers	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**
Average, outliers included	**1237.34**	**72.74**	**5.51**	**3.93**	**2.80**	**4.67**	**2.67**	**63.35**	**229.53**	**43**	**0.16**	**65.59**	**21.92**	**7.88**	**22.07**	**3.53**	**51.12**
Average, outliers excluded	**1237.34**	**70.20**	**4.59**	**3.93**	**2.80**	**4.67**	**2.67**	**63.35**	**144.18**	**43**	**0.15**	**65.59**	**21.92**	**4.68**	**22.07**	**2.81**	**4.75**

Data source: The World Bank World Development Indicators, EM-DAT, The Economist Intelligence Unit, Gallup World, National Science Board.

Table 4.B: Data for the Lower Middle Income group (LMC), by economy and by proxy

	GDP/capita	**Trade (% of GDP)**	**FDI, net inflows (% of GDP)**	**GDP/unit of energy use**	**Functioning of government**	**Strength of legal rights**	**CPIA prop.rights & rule-based governance rating**	**Literacy rate (% of people ages 15+)**	**S&E-degrees/million people, annual**	**Awareness of climate change (% of population)**	**Climate related natural disasters/million people**	**Poverty headcount ratio (% of population)**	**Gross fixed capital formation (% of GDP)**	**Alternative & nuclear energy (% of total energy use)**	**Access to electricity (% of population)**	**High-technology exports (% of manufactured exports)**	**Patent applications/million people, annual**
Albania	8630.99	86.30	9.19	13.31	5.07	9.00			246.54		0.31		25.79	31.70		0.89	
Armenia	5428.43	65.36	6.08	6.86	3.21	6.00	3.50	99.55	897.78	78	0.06	19.91	33.07	35.55		1.85	43.98
Belize	6623.95	116.27	6.90			7.00				53	2.61						
Bhutan	5508.27	98.26	1.20		5.36	3.00	3.50				0.41		*51.56			0.14	
Bolivia	4818.15	75.51	3.17	6.53	5.00	1.00	2.50		515.11	55	0.27		16.57	2.57	77.50	8.40	
Cameroon	2263.11	54.51	2.40	6.24	4.29	3.00	2.50		554.98	49	0.05		16.12	5.15	48.70	4.87	
Cape Verde	3848.21	105.67	7.00		7.86	3.00	4.00	84.29			0.40		37.80				
Congo, Rep.	4222.72	139.82	18.40	11.62	2.86	3.00	2.50			41			20.27	2.52	37.10	3.74	
Cote d'Ivoire	1875.87	76.73	1.56	3.87	2.86	3.00	2.00	56.17			0.03		13.77	1.45	47.30	2.17	
Djibouti					1.43	1.00	2.50			43	0.68						
Egypt, Arab Rep.	6140.78	47.48	2.92	6.80	3.21	3.00		72.05		25	0.01		18.60	1.71	99.60	0.88	7.46
El Salvador	6621.56	69.12	1.22	9.78	6.07	5.00		84.49	365.25	55	0.32		13.31	35.55	86.40	5.79	
Fiji	4602.32	117.06	6.18		2.86	7.00					1.86						
Georgia	5035.66	87.72	7.47	7.19	2.14	7.00	3.50	99.73	1462.90	62	0.13	35.60	19.33	27.30		1.78	40.20
Ghana	1637.77	70.63	7.86	4.29	5.00	8.00	3.50	67.27		26	0.04		23.02	6.45	60.50	2.00	
Guatemala	4759.46	62.07	2.23	6.68	6.43	8.00		75.18	103.00	57	0.21		14.81	5.03	80.50	5.68	0.49

Guyana	3438.12		11.93		5.36	4.00	3.00		844.28	67	0.66		25.40			0.50	
Honduras	3897.78	108.48	5.16	6.49	5.71	6.00	3.00	84.76	183.01	62	0.36		23.41	5.58	70.30		
India	3404.30	48.24	1.55	6.02	8.57	8.00	3.50		378.23	35	0.01	68.72	31.74	2.70	66.30	7.18	7.23
Indonesia	4303.66	47.56	1.94	4.97	7.50	3.00				39	0.04	46.12	32.08	8.47	64.50	9.78	2.15
Iraq	3539.16		1.72	3.00	0.79	3.00		78.17	363.06	55	0.02			1.08	86.00		
Kiribati	2280.16		2.59			5.00	3.50				1.00					42.72	
Kosovo		78.71	8.70			8.00	3.00						30.28	0.58			
Lao PDR	2561.71	73.45	3.88		3.21	4.00	3.00		82.89	80	0.10		24.32		55.00		
Lesotho	1603.83	157.69	5.22		6.07	6.00	3.50	89.65	87.50		0.23		28.50		16.00		
Marshall Islands			5.31			9.00					1.85						
Micronesia, Fed. Sts.	3284.54		3.42			7.00					*4.50						
Moldova	3094.33	117.77	3.47	4.24	5.71	8.00	3.50	98.52		83	0.22	4.35	22.62	0.26		8.26	39.02
Mongolia	4010.28	117.05	*27.28	3.37	5.71	6.00	3.00	97.41	*2957.91	75	0.40		32.54	0.00	67.00		39.91
Morocco	4682.13	75.92	1.37	9.21	4.64	3.00			387.43	30	0.05		30.67	2.15	97.00	7.69	4.76
Nicaragua	3599.40	90.85	6.03	6.64	4.36	3.00	2.50			53	0.43		23.10	10.10	72.10	4.81	
Nigeria	2367.04	65.10	2.65	3.32	3.21	9.00	2.50	61.34		28	0.02	84.49		0.48	50.60	1.09	
Pakistan	2655.27	33.01	1.14	5.45	5.71	6.00	3.00			34	0.04		13.96	4.29	62.40	1.69	0.66
Papua New Guinea	2456.21	108.93	0.30		6.43	5.00	2.00	60.61			0.19		16.66				
Paraguay	5124.57	109.71	2.59	6.91	6.07	3.00		93.87			0.20	13.22	17.34	*97.10	96.70	6.61	2.79
Philippines	3944.09	71.42	0.82	9.09	5.00	4.00			929.54	47	0.16		20.52	22.76	89.70		1.82
Samoa	4310.63	90.69	0.86			7.00	4.00	98.79			1.64					0.20	
Sao Tome and Principe	1972.61	76.41	*25.17			2.00	2.50	89.19								14.03	
Senegal	1925.25	67.80	2.14	7.08	4.29	3.00	3.50			36	0.09		29.00	0.64	42.00	1.19	
Solomon Islands	2691.90	92.64	17.91			9.00	3.00				1.30					*71.77	
South Sudan		94.18											10.82				
Sri Lanka	5096.55	53.06	0.96	10.66	6.07	4.00	3.50	91.18		73	0.11	23.85	25.91	4.93	76.60	1.03	10.89
Sudan	2226.15	37.46	3.19	6.00	1.43	4.00	2.00	71.06		47	0.05		20.17	2.05	35.90		
Swaziland	5912.64	120.66	3.49		2.86	6.00		87.44	224.54		0.66	60.40	9.68				
Syrian Arab Republic	5251.61	71.08	2.48	4.94	2.50	1.00		83.44		56	0.03		18.82	1.03	92.70	1.34	
Timor-Leste	1436.09		3.26		6.79	2.00	2.00	58.31			0.61				22.00		
Tonga	4574.52	71.20	2.31			7.00	4.00				1.92		29.64			0.04	
Ukraine	6678.40	104.31	4.73	2.35	5.00	9.00		99.71		79	0.03	0.08	19.24	18.79		4.34	*55.72
Uzbekistan	3050.22	61.84	4.14	1.99	0.79	2.00	2.50	99.39		53	0.01		26.22	2.13			12.95
Vanuatu	4327.99	103.89	6.12			9.00	3.50	82.57			2.09						
Vietnam	3184.65	*165.34	7.52	4.67	4.29	8.00	3.50	93.18		73	0.10		35.56	4.00	97.60	8.61	3.52
West Bank and Gaza					2.86	1.00		94.93	1569.36	67	0.05						
Yemen, Rep.	2628.64	65.07	-0.30	8.82	1.79	2.00	2.50	63.91			0.08		11.70	0.00	39.60	0.36	0.83
Zambia	1552.25	81.67	10.68	2.47	5.36	9.00	3.00	71.21		27	0.11		21.07	11.95	18.80	0.96	
Number of obs incl. outliers	**49**	**46**	**51**	**32**	**43**	**53**	**36**	**30**	**18**	**33**	**50**	**10**	**40**	**33**	**29**	**33**	**17**
Number of outliers	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**
Average, outliers included	**3858.86**	**85.52**	**5.40**	**6.28**	**4.46**	**5.13**	**3.01**	**82.91**	**675.18**	**53**	**0.54**	**35.67**	**23.38**	**10.79**	**64.01**	**7.04**	**16.14**
Average, outliers excluded	**3858.86**	**83.74**	**4.55**	**6.28**	**4.46**	**5.13**	**3.01**	**82.91**	**540.91**	**53**	**0.45**	**35.67**	**22.65**	**8.09**	**64.01**	**5.02**	**13.67**

Data source: The World Bank World Development Indicators, EM-DAT, The Economist Intelligence Unit, Gallup World, National Science Board.

Table 4.C: Data for the Upper Middle Income group (UMC), by economy and by proxy

	GDP/capita	Trade (% of GDP)	FDI. net inflows (% of GDP)	GDP/unit of energy use	Functioning of government	Strength of legal rights	CPIA prop.rights & rule-based governance rating	Literacy rate (% of people ages 15+)	S&E-degrees/million people. annual	Awareness of climate change (% of population)	Climate related natural disasters/million people	Poverty headcount ratio (% of population)	Gross fixed capital formation (% of GDP)	Alternative & nuclear energy (% of total energy use)	Access to electricity (% of population)	High-technology exports (% of manufactured exports)	Patent applications/million people. annual
Algeria	8379.35	52.33	1.44	7.36	2.21	3.00			958.32		0.09			0.04	99.30	0.50462	2.14
American Samoa											*4.38						
Angola	5728.89	105.36	-3.99	8.00	3.21	3.00	2.00	*70.14		43	0.14		12.67	2.22	*26.20		
Antigua and Barbuda	19243.45	104.35	8.38			8.00		98.95			2.25		36.29			0	
Argentina		40.11	1.91		5.71	4.00		97.80	533.50	76	0.09	1.87	22.00	6.38	97.20	7.50	
Azerbaijan	9872.55	73.91	6.34	7.55	1.79	6.00	3.00			58	0.06		16.67	2.50		1.08	28.05
Belarus	13852.02	122.16	2.52	4.74	2.86	3.00				80	0.03	0.09	39.34	0.01		3.04	185.35
Bosnia and Herzegovina	8635.35	92.29	1.98	5.07	3.29	5.00	3.00	97.88			0.43		17.03	10.78		2.58	14.89
Botswana	13805.29	72.95	1.78	12.24	7.14	7.00		84.47		38	0.30		27.11	0.01	45.40	0.40	
Brazil	11180.29	22.77	2.49	8.21	7.50	3.00			622.84	79	0.03		19.46	14.69	98.30	11.21	13.88
Bulgaria	13892.18	116.72	3.91	5.86	5.71	8.00			2237.64		0.33		22.80	25.39		7.91	32.25
Chile	16084.48	69.97	7.11	8.90	8.57	4.00			902.26	73	0.13		21.46	6.13	98.50	5.48	19.17
China	7554.01	57.31	4.11	4.18	5.00	6.00		94.27	854.70	62	0.02		*45.73	4.03	99.40	27.51	*219.08
Colombia	9392.88	33.92	2.35	13.49	7.14	5.00		93.37	640.61	68	0.10	15.82	21.73	10.79	93.60	5.06	2.87
Costa Rica	11578.69	78.39	4.05	11.60	8.21	3.00		96.16		75	0.43		19.86	*35.16	99.30	*39.97	1.72
Cuba		38.58			4.64			99.83	565.64		0.20		9.93	0.09	97.00		
Dominica	13019.83	91.57	5.16			9.00	4.00				2.95		21.63			0.01	
Dominican Republic	9290.50	57.25	4.06	11.06	5.00	3.00		89.54		50	0.25	9.88	16.34	1.85	95.90	2.35	
Ecuador	7976.80	71.57	0.27	9.54	4.64	3.00		91.85		70	0.10	10.59	25.16	6.14	92.20	8.43	0.28
Gabon	15076.91	96.53	4.02	10.64	2.21	3.00		88.38			0.13		27.20	3.26	36.70		
Grenada	10538.80	69.72	7.68			8.00	3.50				2.87		21.17				
Iran. Islamic Rep.					3.21	4.00			1258.89	55	0.04			0.40	98.40	4.46	
Jamaica		80.86	1.38		6.79	8.00		86.62			0.59		19.89	0.58	92.00	0.57	5.18
Jordan	5815.06	116.82	6.25	4.88	4.64	2.00		92.55	2254.51	62	0.07	1.59	22.99	1.80	99.90	2.86	7.44
Kazakhstan	12091.67	73.17	4.48	2.63	2.14	3.00		99.69		60	0.05		24.33	0.92			103.59
Latvia	15943.46	109.05	1.80	8.09	5.36	10.00		99.78	2098.25	91	0.22		19.53	6.95		7.64	79.50
Lebanon	13978.23	72.39	11.53	9.16	3.93	3.00			2089.60	64	0.07		34.19	1.35	99.90	12.80	
Libya					2.14			89.21						0.00	99.80		
Lithuania	18119.97	138.19	1.93	8.60	5.71	5.00		99.70	2939.92	91	0.18		16.06	1.01		10.61	32.86
Macedonia. FYR	11327.24	111.84	3.22	8.08	4.64	7.00		97.27	1312.75		0.58	6.88	19.11	7.64			13.10
Malaysia	15182.51	170.33	3.71	5.94	6.79	10.00		93.12	1540.58	71	0.10		22.25	0.77	99.40	*44.52	43.34

Maldives	8182.43	178.28	10.43			4.00	3.50				0.32						
Mauritius	13606.56	116.36	4.43		8.21	6.00		88.51			0.16		24.90		99.40	0.69	
Mexico	15160.51	61.86	2.02	9.65	7.14	5.00		93.07	1030.08	67	0.06	4.54	20.66	5.97		16.94	8.38
Montenegro	12976.65	97.82	*18.50	9.96	5.00	10.00		98.38			0.63	0	21.11	*30.27			36.42
Namibia	6458.39	102.18	6.19	9.19	5.36	8.00		88.75	114.75	46	0.53		22.84	6.78	34.00	1.17	
Palau	12805.11	184.20	1.50			1.00											
Panama	14000.40	146.45	8.20	13.05	6.79	5.00		94.09	1043.56	67	0.57	13.80	27.50	9.56	88.10	0.83	
Peru	9477.05	48.27	5.50	14.21	5.00	7.00				62	0.11	12.74	25.09	8.91	85.70	6.59	1.34
Romania	14778.26	76.18	1.95	9.05	6.43	9.00		97.68	*5654.21	81	0.23	1.30	23.96	13.60		10.95	64.46
Russian Federation	20260.99	51.62	2.91	4.11	3.21	3.00		99.58	2192.04	85	0.05		21.76	8.48		9.28	*201.72
Serbia	11421.16	86.29	3.49	5.33	4.64	7.00		97.90			0.12	0.62	22.76	6.86			39.77
Seychelles	*23877.35	141.61	16.00			4.00		91.84			1.16						
South Africa	10520.03	54.88	0.34	3.84	8.21	10.00				31	0.07		19.60	2.49	75.00	4.28	16.42
St. Lucia	11329.75	117.05	9.10			8.00	4.00				2.87		32.43				
St. Vincent and the Grenadines	10469.65	84.88	15.26			7.00	4.00				*3.66		25.47			0.16	
Suriname	7878.90		-5.67		6.43	5.00		94.68			0.38					12.14	
Thailand	8499.53	135.14	2.85	5.00	6.07	5.00				88	0.07	4.05	24.73	0.41	99.30	24.02	17.56
Tunisia	9409.77	104.98	3.01	10.31	2.86	3.00				60	0.05	4.25	24.47	0.17	99.50	4.89	
Turkey	15829.77	47.97	1.24	10.95	7.14	4.00			1254.16	74	0.05	4.71	18.91	6.76		1.93	43.71
Turkmenistan	8134.83	123.16	16.39	1.93	0.79			99.58					*52.90	0.00			
Tuvalu			4.71														
Uruguay	14003.93	52.87	5.56	11.29	8.57	4.00		98.07	644.70	73	0.45	1.18	18.82	18.03	98.30		6.85
Venezuela. RB	12155.23	46.14	0.20	4.55	3.93	1.00			462.09	63	0.06		18.68	8.58	99.00	5.05	
Number of. obs incl outliers	**47**	**49**	**50**	**37**	**44**	**49**	**8**	**32**	**23**	**31**	**50**	**17**	**45**	**42**	**28**	**37**	**28**
Number of outliers	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**2**	**0**	**2**	**2**	**1**	**2**	**2**
Average, outliers included	**12102.06**	**89.77**	**4.68**	**8.06**	**5.14**	**5.35**	**3.38**	**93.83**	**1443.72**	**67**	**0.58**	**5.52**	**23.75**	**6.61**	**87.38**	**8.25**	**44.33**
Average, outliers excluded	**11846.07**	**89.77**	**4.40**	**8.06**	**5.14**	**5.35**	**3.38**	**94.60**	**1252.34**	**67**	**0.43**	**5.52**	**22.56**	**5.31**	**89.65**	**6.31**	**31.56**

Data source: The World Bank World Development Indicators, EM-DAT, The Economist Intelligence Unit, Gallup World, National Science Board.

Table 4.D: Data for the High Income group (HIC), by economy and by proxy

	GDP/capita	Trade (% of GDP)	FDI, net inflows (% of GDP)	GDP/unit of energy use	Functioning of government	Strength of legal rights	CPIA prop.rights & rule-based governance rating	Literacy rate (% of people ages 15+)	S&E-degrees/million people, annual	Awareness of climate change (% of population)	Climate related natural disasters/million people	Poverty headcount ratio (% of population)	Gross fixed capital formation (% of GDP)	Alternative & nuclear energy (% of total energy use)	Access to electricity (% of population)	High-technology exports (% of manufactured exports)	Patent applications/million people, annual
Andorra																	
Aruba								96.82								3.29	
Australia	39124.74	39.60	3.02	6.92	8.93	9.00			2172.64		0.31		27.53	1.40		11.88	109.18
Austria	40401.19	104.01	-6.71	10.02	7.86	7.00			1161.18	95	0.20		20.52	10.89		11.91	288.92
Bahamas, The	31165.99	91.59	11.22			9.00					2.33		23.43		99.70	0.00	
Bahrain	23644.84		0.68	3.05	3.57	4.00		91.92	422.40					0.00		0.11	
Barbados		99.74	16.28								1.46		14.63			12.13	
Belgium	37834.03	157.53	18.55	6.77	8.21	6.00			1138.53	89	0.16		19.97	20.86		10.47	56.90
Bermuda			3.86								1.56						
Brunei Darussalam	50409.29	114.31	5.06	6.07		7.00		95.22	110.30				15.87	0.00	100.00		
Canada	39074.78	60.74	1.31	5.30	9.29	7.00			2023.23	95	0.10		22.07	21.72		14.05	133.33
Cayman Islands											*12.45						
Channel Islands																	
Croatia	18727.21	79.22	1.43	9.69	6.07	7.00		98.83	1287.69		0.36		20.57	8.67		9.15	58.17
Curacao																	
Cyprus	31779.69	86.67	0.31	10.45	6.43	9.00		98.28	473.88		0.54		18.42	2.86		36.90	3.62
Czech Republic	25357.78	129.77	3.08	6.05	7.14	6.00			1992.43	87	0.17		24.54	17.35		15.30	82.51
Denmark	40587.87	95.15	-3.75	11.70	9.64	9.00			1336.23	90	0.07		16.88	3.63	99.40	14.11	293.10
Equatorial Guinea	33778.56	122.97	9.44		*0.79	3.00		93.94					*53.35				
Estonia	20092.48	152.13	10.89	4.84	7.50	7.00		99.80	1941.56	88	0.15		19.08	0.47		9.27	62.68
Faeroe Islands																	
Finland	36029.72	79.28	4.83	5.31	9.64	8.00			*3929.26	98	0.02		18.91	19.45		10.94	322.75
France	34261.98	53.31	1.48	8.50	7.14	7.00			1540.62	93	0.08		19.45	45.03		24.92	
French Polynesia											0.37					4.75	
Germany	37651.59	88.45	0.62	9.41	7.86	7.00			1448.89	96	0.04		17.44	13.32	99.70	15.25	575.31
Greece	27519.65	53.76	0.18	11.28	6.43	4.00		97.19	1370.33	87	0.24		17.64	3.98		10.15	64.34
Greenland																	
Guam											2.22						
Hong Kong SAR, China	47168.54	*432.30	36.15	*24.17	5.36	10.00				93	0.11		21.77	0.00	98.00	16.10	18.82
Hungary	20733.84	166.59	-16.07	8.08	6.07	7.00		99.05	1044.70	93	0.17		17.97	16.70		24.01	64.90
Iceland	35506.00	102.58	2.05	2.10	9.64	7.00			2333.03	95			12.76	*82.47		20.86	179.22
Ireland	40883.44	183.43	18.40	12.71	7.86	9.00			1272.14	94	0.13		11.98	2.08		21.23	163.82

Isle of Man																	
Israel	27048.17	71.79	2.53	9.00	7.5	9.00			2830.68	86	0.05		17.84	4.94		14.66	190.20
Italy	32109.61	55.07	-0.26	11.41	6.79	3.00		98.93	1340.15	84	0.05		19.61	6.02		7.24	146.77
Japan	33625.29	29.18	0.02	8.63	8.21	7.00			2642.71	99	0.04		20.09	17.25		17.96	*2276.03
Korea, Rep.	28612.83	101.98	0.11	5.65	7.86	8.00			2623.78	93	0.06		28.27	15.70		29.47	*2667.58
Kuwait	50537.93	86.36	0.26	4.14	4.29	4.00							19.09	0.00			
Liechtenstein																	
Luxembourg	*84763.73	312.63	*-161.24	10.16	9.29	5.00			252.49	95	0.39		18.41	0.39		8.37	155.83
Macao SAR, China	63834.62	156.67	12.60										12.54		98.70	0.00	7.36
Malta	26672.05	172.95	13.68	13.25	8.21					95			16.59	0.11		47.08	28.85
Monaco															99.00		169.46
Netherlands	41673.18	148.28	-1.33	8.30	8.93	6.00			1352.66	96	0.05		17.33	1.72		21.29	152.09
New Caledonia								96.49			0.40				100.00	0.85	
New Zealand	30193.53	55.42	0.36	7.25	9.29	10.00			2015.89		0.25		18.96	32.52		9.00	362.88
Northern Mariana Islands											3.28						
Norway	56976.42	69.90	4.88	8.58	9.64	6.00			1205.91	97	0.08		19.78	31.39		16.15	228.46
Oman	27204.89		1.97	3.78	3.57	4.00			867.59		0.14			0.00		0.57	
Poland	20032.80	85.70	3.63	7.54	6.07	9.00		99.52	3067.91	84	0.06	0.19	19.86	0.40		6.69	83.88
Portugal	25519.20	69.21	2.72	11.53	7.5	3.00		95.18	2797.22	90	0.16		19.76	10.38		3.41	46.91
Puerto Rico		170.22				9.00		90.41			0.19		9.12				
Qatar	*77317.69		3.67	6.04	3.21	4.00		96.28	209.80					0			
San Marino																	
Saudi Arabia	22746.77	96.73	6.48	3.69	2.86	5.00		*86.55	1067.47	*49	0.03		20.57	0.00		0.73	10.49
Singapore	57790.54	*385.92	22.82	8.95	7.5	10.00		95.86	1030.98	84			24.18	0.00		*49.91	176.30
Sint Maarten (Dutch part)																	
Slovak Republic	23148.53	163.80	0.76	7.06	7.5	9.00			2495.72		0.26		22.23	24.25		6.77	43.09
Slovenia	26509.03	130.28	1.35	7.53	7.14	4.00		99.69	1217.43		0.20		21.60	26.30		5.72	215.76
Spain	31574.72	56.56	3.38	11.39	8.21	6.00		97.75	1302.45	85	0.05		22.26	19.28		6.36	77.40
St. Kitts and Nevis	16701.38	79.42	19.87			7.00							37.32		99.00	1.30	
St. Martin (French part)																	
Sweden	39250.66	92.78	0.35	7.18	9.64	8.00			1545.72	96	0.03		18.03	41.13		13.70	234.16
Switzerland	48719.64	92.20	3.92	14.55	9.29	8.00			1187.49		0.22		20.03	39.34		24.84	207.29
Trinidad and Tobago	25668.92	90.73	2.62	1.61	7.14	9.00		98.79		72	0.30			0.00	100.00	0.10	
Turks and Caicos Islands											*10.43						
United Arab Emirates	46915.90	146.70	1.85	5.67	3.57	4.00			371.42				23.81	0.00			
United Kingdom	35298.43	63.23	2.72	10.85	7.86	10.00			1834.96	97	0.05		14.91	8.63		21.02	248.78
United States	46611.98	29.13	1.88	6.51	7.86	9.00			1603.91	97	0.08		14.44	11.71		19.93	782.21
Virgin Islands (U.S.)											0.91						
Number of. obs incl. outliers	**48**	**47**	**50**	**44**	**44**	**47**	**0**	**20**	**40**	**31**	**47**	**1**	**46**	**44**	**10**	**47**	**38**
Number of outliers	**2**	**2**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**2**	**0**	**1**	**1**	**0**	**1**	**2**
Average, outliers included	**36641.49**	**117.15**	**1.48**	**8.24**	**7.14**	**6.91**	**#**	**96.32**	**1546.59**	**90**	**0.87**	**0.19**	**20.25**	**12.78**	**99.35**	**13.40**	**289.19**
Average, outliers excluded	**34711.09**	**104.17**	**4.80**	**7.87**	**7.29**	**6.91**	**#**	**96.84**	**1485.49**	**91**	**0.40**	**0.19**	**19.51**	**11.16**	**99.35**	**12.61**	**167.94**

Data source: The World Bank World Development Indicators, EM-DAT, The Economist Intelligence Unit, Gallup World, National Science Board.

Appendix 5: Definitions and sources of data

Table 5.A: Definitions of data for the proxies, data sources, and the year of data

Factor	Proxy	Definition	Source	Year
Economic				
	GDP per capita, PPP (current international $)	PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates.	World Bank[i]	2010
	Trade (% of GDP)	Sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank[ii]	2010
	Foreign direct investment, net inflows (% of GDP)	Sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. Net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors.	World Bank[iii]	2010
	GDP per unit of energy use (PPP $ per kg oil equivalent)	The PPP GDP per kilogram of oil equivalent of energy use.	World Bank[iv]	2010
Institutional				
	Functioning of government (0=low, 10=high)	Category score for cat. II, Functioning of government, in the Economic Intelligence Unit Democracy Index 2010 report.	The Economist Intelligence Unit	2010
	Strength of legal rights index (0=weak, 10=strong)	The degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 10, with higher scores indicating that these laws are better designed to expand access to credit.	World Bank[v]	2010
	CPIA property rights and rule-based governance rating (1=low, 6=high)	The extent to which private economic activity is facilitated by an effective legal system and rule-based governance structure in which property and contract rights are reliably respected and enforced.	World Bank[vi]	2010
Socio-cultural				
	Climate related natural disasters	Number of climate related natural disasters for 2000-2010. Climate related natural disasters are classified as drought, extreme temperature, flood, mass movement dry (rockfall, avalanche, landslide, subsidence), mass movement wet (rockfall, landslide, avalanche, subsidence), storm and wildfire.	EM-DAT[vii]	2000-2010
	Poverty headcount ratio at $2 a day (PPP) (% of population)	Population below $2 a day is the percentage of the population living on less than $2.00 a day at 2005 international prices. As a result of revisions in PPP exchange rates, poverty rates for individual countries cannot be compared with poverty rates reported in earlier editions.	World Bank[viii]	2010

Percentage of citizens reporting awareness of Global Warming	Percentage of citizens reporting knowledge of global warming. Poll conducted in the years of 2007 to 2008, in 127 countries worldwide.	Gallup World[ix]	2007-2008
Literacy rate, adult total (% of people ages 15 and above)	Total is the percentage of the population age 15 and above who can, with understanding, read and write a short, simple statement on their everyday life. Generally, 'literacy' also encompasses 'numeracy', the ability to make simple arithmetic calculations. This indicator is calculated by dividing the number of literates aged 15 years and over by the corresponding age group population and multiplying the result by 100.	World Bank[x]	2010
Science and engineering degrees (annual)	The total number of first university degrees in science and engineering. From the report "Science and Engineering indicators 2012", with data from 2008 or most recent.	National Science Board[xi]	2008-onward
Technological			
Access to electricity (% of population)	The percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources.	World Bank[xii]	2009
Alternative and nuclear energy (% of total energy use)	Clean energy is noncarbohydrate energy that does not produce carbon dioxide when generated. It includes hydropower and nuclear, geothermal, and solar power, among others.	World Bank[xiii]	2010
Gross fixed capital formation (% of GDP)	Includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.	World Bank[xiv]	2010
High-technology exports (% of manufactured exports)	High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.	World Bank[xv]	2010
Patent applications, residents	Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years.	World Bank[xvi]	2010

[i] World Bank, International Comparison Program database. **Catalog Sources** World Development Indicators.
[ii] World Bank national accounts data, and OECD National Accounts data files. **Catalog Sources** World Development Indicators.
[iii] International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, International Debt Statistics, and World Bank and OECD GDP estimates. **Catalog Sources** World Development Indicators.
[iv] International Energy Agency (IEA Statistics © OECD/IEA, http://www.iea.org/stats/index.asp), and World Bank PPP data. Catalog Sources World Development Indicators.
[v] World Bank, Doing Business project (http://www.doingbusiness.org/). **Catalog Sources** World Development Indicators.
[vi] World Bank Group, CPIA database (http://www.worldbank.org/ida). **Catalog Sources** World Development Indicators.

[vii] EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium).
[viii] World Bank, Development Research Group. Data are based on primary household survey data obtained from government statistical agencies and World Bank country departments. Data for high-income economies are from the Luxembourg Income Study database. For more information and methodology, please see PovcalNet (http://iresearch.worldbank.org/PovcalNet/index.htm). **Catalog Sources** World Development Indicators.
[ix] Gallup Poll, http://www.gallup.com/poll/117772/Awareness-Opinions-Global-Warming-Vary-Worldwide.aspx#1 (April, 2009).
[x] UNESCO Institute for Statistics. **Catalog Sources** World Development Indicators.
[xi] National Science Board. 2012. Science and Engineering Indicators 2012. Arlington VA: National Science Foundation (NSB 12-01).
[xii] International Energy Agency, World Energy Outlook 2010. **Catalog Sources** World Development Indicators.
[xiii] International Energy Agency (IEA Statistics © OECD/IEA, http://www.iea.org/stats/index.asp). **Catalog Sources** World Development Indicators.
[xiv] World Bank national accounts data, and OECD National Accounts data files
[xv] United Nations, Comtrade database. **Catalog Sources** World Development Indicators.
[xvi] World Intellectual Property Organization (WIPO), World Intellectual Property Indicators and www.wipo.int/econ_stat. The International Bureau of WIPO assumes no responsibility with respect to the transformation of these data. **Catalog Sources** World Development Indicators.

Appendix 6: Descriptive statistics per income group and proxy

Table 6.A: Descriptive Statistics: Low Income Group (LIC)

	N	Minimum	Maximum	Mean	Std. Dev.	Variance
GDP per capita, PPP (current international $)	32	350.57	2,438.64	1,237.34	520.30	270,714.03
Trade (% of GDP)	29	35.18	133.23	70.20	26.46	700.12
Foreign direct investment, net inflows (% of GDP)	32	-.26	22.71	4.59	6.04	36.51
GDP per unit of energy use (PPP $ per kg oil equivalent)	14	.97	7.89	3.93	1.87	3.50
Functioning of government (0=low, 10=high)	35	.00	6.43	2.80	1.96	3.85
Strength of legal rights index (0=weak, 10=strong)	33	2.00	10.00	4.67	2.35	5.54
CPIA property rights and rule-based governance rating (1=low, 6=high)	33	1.50	3.50	2.67	.57	.32
Literacy rate, adult total (% of people ages 15 and above)	25	31.10	99.69	63.35	18.09	327.28
Science and engineering degrees (per million people)	10	24.69	503.35	144.18	138.31	19,128.70
Percentage of citizens reporting awareness of global warming	28	15.00	80.00	42.57	14.61	2.10
Climate related natural disasters (average, per million people)	35	.01	.44	.15	.11	.01
Poverty headcount ratio at $2 a day (PPP) (% of population)	5	22.90	92.62	65.59	26.99	728.34
Gross fixed capital formation (% of GDP)	27	10.57	31.81	21.92	4.93	24.29
Alternative and nuclear energy (% of total energy use)	16	.00	30.44	4.68	7.82	61.13
Access to electricity (% of population)	20	9.00	43.60	22.07	11.44	130.83
High-technology exports (% of manufactured exports)	19	.00	8.50	2.81	2.74	7.50
Patent applications (residents, per million people)	6	.12	24.60	4.75	9.74	94.91

The table comprises values adjusted for outliers

Table 6.B: Descriptive Statistics: Lower Middle Income Group (LMC)

	N	Minimum	Maximum	Mean	Std. Dev	Variance
GDP per capita, PPP (current international $)	49	1,436.09	8,630.99	3,858.86	1,608.87	2,588,475.13
Trade (% of GDP)	45	33.01	157.69	83.74	26.98	727.72
Foreign direct investment. net inflows (% of GDP)	49	-.30	18.40	4.55	3.98	15.82
GDP per unit of energy use (PPP $ per kg of oil equivalent)	32	1.99	13.31	6.28	2.74	7.502
Functioning of government (0=low, 10=high)	43	.79	8.57	4.46	1.90	3.63
Strength of legal rights index (0=weak, 10=strong)	53	1.00	9.00	5.13	2.59	6.69
CPIA property rights and rule-based governance rating (1=low, 6=high)	36	2.00	4.00	3.01	.59	.35
Literacy rate. adult total (% of people ages 15 and above)	30	56.17	99.73	82.91	14.07	197.85
Science and engineering degrees (per million people)	17	82.89	1,569.36	540.91	455.08	207,095.80
Percentage of citizens reporting awareness of global warming	33	25.00	83.00	52.82	17.37	3.00
Climate related natural disasters (average, per million people)	49	.01	2.61	.45	.65	.42
Poverty headcount ratio at $2 a day (PPP) (% of population)	10	.08	84.49	35.67	28.55	815.13
Gross fixed capital formation (% of GDP)	39	9.68	37.80	22.65	7.28	52.96
Alternative and nuclear energy (% of total energy use)	32	.00	35.55	8.09	10.77	115.98
Access to electricity (% of population)	29	16.00	99.60	64.01	24.82	616.06
High-technology exports (% of manufactured exports)	32	.04	42.72	5.02	7.73	59.70
Patent applications (residents, per million people)	16	.49	43.98	13.67	16.58	274.95

The table comprises values adjusted for outliers

Table 6.C: Descriptive Statistics: Upper Middle Income Group (UMC)

	N	Minimum	Maximum	Mean	Std. Dev	Variance
GDP per capita, PPP (current international $)	46	5,728.89	20,260.99	11,846.07	3,453.34	11,925,584.97
Trade (% of GDP)	49	22.77	184.20	89.77	38.05	1,447.91
Foreign direct investment. net inflows (% of GDP)	49	-5.67	16.39	4.40	4.31	18.57
GDP per unit of energy use (PPP $ per kg of oil equivalent)	37	1.93	14.21	8.06	3.16	9.98
Functioning of government (0=low, 10=high)	44	.79	8.57	5.14	2.05	4.22
Strength of legal rights index (0=weak to 10=strong)	49	1.00	10.00	5.35	2.50	6.23
CPIA property rights and rule-based governance rating (1=low, 6=high)	8	2.00	4.00	3.38	.69	.48
Literacy rate, adult total (% of people ages 15 and above)	31	84.47	99.83	94.60	4.50	20.29
Science and engineering degrees (per million people)	22	114.75	2,939.92	1,252.34	746.94	557,912.79
Percentage of citizens reporting awareness of global warming	31	31.00	91.00	66.55	14.81	2.20
Climate related natural disasters (average, per million people)	48	.02	2.95	.43	.74	.55
Poverty headcount ratio at $2 a day (PPP) (% of population)	17	.00	15.82	5.52	5.17	26.76
Gross fixed capital formation (% of GDP)	43	9.93	39.34	22.56	5.61	31.47
Alternative and nuclear energy (% of total energy use)	40	.00	25.39	5.31	5.65	31.93
Access to electricity (% of population)	27	34.00	99.90	89.65	19.25	370.60
High-technology exports (% of manufactured exports)	35	.00	27.51	6.31	6.54	42.77
Patent applications (residents, per million people)	26	.28	185.35	31.56	40.51	1,640.79

The table comprises values adjusted for outliers

Table 6.D: Descriptive Statistics: High Income Group (HIC)

	N	Minimum	Maximum	Mean	Std. Dev	Variance
GDP per capita. PPP (current international $)	46	16,701.38	63,834.62	34,711.09	11,058.36	122,287,414.83
Trade (% of GDP)	45	29.13	312.63	104.17	51.83	2,686.17
Foreign direct investment. net inflows (% of GDP)	49	-16.07	36.15	4.80	8.28	68.63
GDP per unit of energy use (PPP $ per kg of oil equivalent)	43	1.61	14.55	7.87	3.04	9.24
Functioning of government (0=low, 10=high)	43	2.86	9.64	7.29	1.90	3.60
Strength of legal rights index (0=weak to 10=strong)	47	3.00	10.00	6.91	2.12	4.51
Literacy rate, adult total (% of people ages 15 and above)	19	90.41	99.80	96.84	2.63	6.93
Science and engineering degrees (per million people)	39	110.30	3,067.91	1,485.49	762.74	581,777.63
Percentage of citizens reporting awareness of global warming	30	72.00	99.00	91.43	5.91	.30
Climate related natural disasters (average, per million people)	45	.02	3.28	.40	.69	.48
Gross fixed capital formation (% of GDP)	45	9.12	37.32	19.51	4.66	21.74
Alternative and nuclear energy (% of total energy use)	43	.00	45.03	11.16	12.74	162.22
Access to electricity (% of population)	10	98.00	100.00	99.35	.67	.45
High-technology exports (% of manufactured exports)	46	.00	47.08	12.61	10.09	101.83
Patent applications (residents, per million)	36	3.62	782.21	167.94	159.37	25,398.31

The table comprises values adjusted for outliers. Due to missing data for CPIA property rights and rule-based governance rating, and Poverty headcount ratio, descriptive statistics for these proxies are missing in the table.

Appendix 7: Table of average factor scores for the four income groups

Table 7.A: Rescaled average factor scores for LIC, LMC, UMC, and HIC

	LIC		LMC		UMC		HIC	
Factor, rescaled	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**
Economic	1.25	12	1.28	29	1.57	36	1.85	38
Institutional*	1.00	33	1.31	43	1.56	41	2.24	42
Socio-cultural**	0.00	5	1.26	7	1.80	12	2.55	7
Technological	0.87	1	1.17	9	1.52	9	3.03	3

Average, rescaled factor scores for the four different income groups LIC, LMC, UMC, and HIC; and number of observations in the computation of the average scores (N). The scores have been added with the absolute value of the lowest average factors score (1.555834) in the sample, in the rescaling.

Table 7.B: Non-rescaled average factor scores for Lower Income, Lower Middle Income, Upper Middle Income, and High Income.

	LIC		LMC		UMC		HIC	
Factor, non-rescaled	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**
Economic	-0.30	12	-0.27	29	0.01	36	0.29	38
Institutional*	-0.56	33	-0.25	43	0.01	41	0.68	42
Socio-cultural**	-1.56	5	-0.30	7	0.24	12	0.99	7
Technological	-0.68	1	-0.38	9	-0.03	9	1.48	3

Average, non-rescaled factor scores for the four different income groups LIC, LMC, UMC, and HIC; and number of observations in the computation of the average scores (N). These scores are original average factor scores, not rescaled.

Appendix 8: Factor analysis, output and comments

Tables 8.A-E: Factor analysis output for the Economic Factor

Table 8.A

KMO and Bartlett's Test: Economic		
a. Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.472
b.Bartlett's Test of Sphericity	Approx. Chi-Square	25.064
	df	6
	Sig.	.000

Table 8.B

Communalities		
	Initial	Extraction
GDP per capita, PPP (current international $)	.112	.032
Trade (% of GDP)	.134	.923
Foreign direct investment, net inflows (% of GDP)	.116	.069
GDP per unit of energy use (PPP $ per kg oil equivalent), inversed	.069	.000

Table 8.C

Total Variance Explained						
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.322	33.059	33.059	1.024	25.596	25.596
2	1.307	32.668	65.726			
3	.771	19.278	85.005			
4	.600	14.995	100.000			

Extraction Method: Principal Axis Factoring.

Table 8.D

Factor Matrix[a]	
	Factor
	1. Economic
GDP per capita, PPP (current international $)	.179
Trade (% of GDP)	.961
Foreign direct investment, net inflows (% of GDP)	.262
GDP per unit of energy use (PPP $ per kg oil equivalent), inversed	-.020

Extraction Method: Principal Axis Factoring.[a]

Table 8.E

Factor Score Coefficient Matrix	
	Factor
	1. Economic
GDP per capita, PPP (current international $)	-.024
Trade (% of GDP)	.968
Foreign direct investment, net inflows (% of GDP)	-.011
GDP per unit of energy use (PPP $ per kg oil equivalent), inversed	-.009

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

Factor Scores Method: Regression.

Comment, factor analysis Economic Factor: there is a rather unsatisfying Kaiser-Meyer-Olkin Measure of sampling adequacy (KMO) of 0.472, as the minimum requirement is considered to be 0.6 (IDRE, n.d.). However the significance level of the Bartlett's test of sphericity enables us to reject the null hypothesis. Although we can reject the null hypothesis, the minimum requirements are still not fully satisfied due to the low KMO measure. This implies that the results are not fully reliable. From the commonalities table we can see that the factor best represented in the common factor space is the one for trade as a percentage of GDP. Also, the economic factor explains 33.06% of the total variance. The factor matrix reveals that correlations between the variables and the factor exhibits positive correlations between GDP per capita, trade and FDI, but a negative correlation with efficiency (GDP per unit of energy use).

Tables 8.F-J: Factor analysis output for the Institutional Factor

Table 8.F

KMO and Bartlett's Test: Institutional		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	36.595
	df	1
	Sig.	.000

Table 8.G

Communalities	Initial	Extraction
Functioning of government (0=low, 10=high)	.209	.456
Strength of legal rights index (0=weak to 10=strong)	.209	.456

Extraction Method: Principal Axis Factoring

Table 8.H

Total Variance Explained						
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.457	72.831	72.831	.911	45.565	45.565
2	.543	27.169	100.000			

Extraction Method: Principal Axis Factoring.

Table 8.I

Factor Matrixa	Factor
	1. Institutional
Functioning of government (0=low, 10=high)	.675
Strength of legal rights index (0=weak to 10=strong)	.675

Extraction Method: Principal Axis Factoring.[a]

a. 1 factors extracted. 8 iterations required.

Table 8.J

Factor Score Coefficient Matrix	Factor
	1. Institutional
Functioning of government (0=low, 10=high)	.463
Strength of legal rights index (0=weak to 10=strong)	.463

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

Factor Scores Method: Regression.

Comments, factor analysis Institutional Factor: the measure of the KMO-measure of sampling adequacy is 0.500, still below the minimum requirement of 0.6, but slightly better than the KMO-statistic for the economic factor. Still, according to Bartlett's test we can reject the null hypothesis. All in all we may state that the minimum requirements are quite satisfying. The communalities table shows that both variables are quite well represented in the common space (values for both variables are 0.456). The retained factor accounts for around 72.8% of total variance, which can be considered as a rather large fraction. As can be seen in the factor matrix both variables exhibit strong positive correlations with the extracted factor.

Tables 8.K-O: Factor analysis output for the Socio-cultural Factor

Table 8.K

KMO and Bartlett's Test: Socio-cultural		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.695
Bartlett's Test of Sphericity	Approx. Chi-Square	49.597
	df	6
	Sig.	.000

Table 8.L

Communalities		
	Initial	Extraction
Literacy rate, adult total (% of people ages 15 and above)	.656	.703
Science and engineering degrees (per million people)	.513	.543
Percentage of citizens reporting awareness of global warming	.726	.929
Natural disasters (average, per million people), inversed	.014	.003

Extraction Method: Principal Axis Factoring.

Table 8.M

Total Variance Explained						
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.432	60.802	60.802	2.178	54.459	54.459
2	.999	24.971	85.773			
3	.393	9.816	95.588			
4	.176	4.412	100.000			

Extraction Method: Principal Axis Factoring.

Table 8.N

Factor Matrix[a]	
	Factor
	1. Socio-cultural
Literacy rate, adult total (% of people ages 15 and above)	.839
Science and engineering degrees (per million people)	.737
Percentage of citizens reporting awareness of global warming	.964
Natural disasters (average, per million people), inversed	-.058

Extraction Method: Principal Axis Factoring.[a]

a. 1 factors extracted. 14 iterations required.

Table 8.O

Factor Score Coefficient Matrix	
	Factor
	1. Socio-cultural
Literacy rate, adult total (% of people ages 15 and above)	.162
Science and engineering degrees (per million people)	.089
Percentage of citizens reporting awareness of global warming	.772
Natural disasters (average, per million people), inversed	.016

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

Factor Scores Method: Regression.

Comment, factor analysis Socio-cultural Factor: the KMO-statistic shows a satisfying value (0.695) and also the null hypothesis in Bartlett's test can be rejected. The minimum requirements for the created factor are thus well satisfied. The communalities table shows that all factors except climate related natural disasters seem to be well represented in the common space, with the variable for the percentage of citizens reporting global warming having the highest representation. The factor extracted also accounts for the quite high percentage of about 60.80% of total variance. The factor matrix clearly envisages that all variables except from the variable for average climate related natural disasters per million people have a positive correlation with the retained factor.

Tables 8.P-T: Factor analysis output for the Technological Factor

Table 8.P

KMO and Bartlett's Test: Technological		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.483
Bartlett's Test of Sphericity	Approx. Chi-Square	13.208
	df	10
	Sig.	.212

Table 8.Q

Communalities	Initial	Extraction
Gross fixed capital formation (% of GDP)	.210	.000
Alternative and nuclear energy (% of total energy use)	.148	.109
Access to electricity (% of population)	.175	.172
High-technology exports (% of manufactured exports)	.302	.398
Patent applications (residents, per million people)	.392	.480

Extraction Method: Principal Axis Factoring.

Table 8.R

Total Variance Explained						
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.803	36.066	36.066	1.158	23.162	23.162
2	1.302	26.047	62.113			
3	.895	17.905	80.018			
4	.629	12.571	92.589			
5	.371	7.411	100.000			

Extraction Method: Principal Axis Factoring.

Table 8.S

Factor Matrix[a]	Factor
	1. Technological
Gross fixed capital formation (% of GDP)	.022
Alternative and nuclear energy (% of total energy use)	.329
Access to electricity (% of population)	.414
High-technology exports (% of manufactured exports)	.631
Patent applications (residents, per million people)	.693

Extraction Method: Principal Axis Factoring.[a]

a. 1 factors extracted. 9 iterations required.

Table 8.T

Factor Score Coefficient Matrix	
	Factor
	1. Technological
Gross fixed capital formation (% of GDP)	.045
Alternative and nuclear energy (% of total energy use)	.102
Access to electricity (% of population)	.157
High-technology exports (% of manufactured exports)	.355
Patent applications (residents, per million people)	.485

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
Factor Scores Method: Regression.

Comment, factor analysis Technological Factor: there is a rather unsatisfying KMO statistic of 0.483. Also, it is here rather doubtful whether we can actually reject the null hypothesis as the significance level is 0.212, which is higher than the general cut-off 0.15. In sum, as the minimum requirements are not completely fulfilled for either of the tests, the factor scores are not as reliable as one could wish. The commonalities table tells us that the variables for patent applications and for high-technology exports are best represented in the common factor, while the variable for gross fixed capital formation is not represented at all (a value of 0.000). The retained factor accounts for the rather low fraction of the total variance, 36.07%. The factor matrix makes it clear that the two factors of patent applications and high-technology exports have the highest correlation with the extracted factor, while gross fixed capital formation has the lowest correlation. However, one can still see that all the variables are related to the extracted technological factor in a positive way, as they have positive correlations.

Appendix 9: Classification of the five different cooperation organizations

ASEAN	AU	EU	MERCOSUR	OECD
Brunei Darussalam	Algeria	Austria	Argentina	Australia
Cambodia	Angola	Belgium	Brazil	Austria
Indonesia	Benin	Bulgaria	Paraguay	Belgium
Lao PDR	Botswana	Cyprus	Uruguay	Canada
Malaysia	Bukina Faso	Czech Republic	Venezuela	Chile
Myanmar	Burundi	Denmark	Bolivia	Czech Republic
Philippines	Cameroun	Estonia	Chile	Denmark
Singapore	Cap Verde	Finland	Colombia	Estonia
Thailand	Central African Republic	France	Ecuador	Finland
Viet Nam	Chad (Tchad)	Germany	Peru	France
	Comoros (Comores)	Greece		Germany
	Congo	Hungary		Greece
	Republique deocratique du Congo	Ireland		Hungary
	Cote d'Ivoire	Italy		Iceland
	Djibouti	Latvia		Ireland
	Egypt	Lithuania		Israel
	Equatoriale Guinea	Luxembourg		Italy
	Eritrea	Malta		Japan
	Ethiopa	Netherlands		Korea
	Gabon	Poland		Luxembourg
	Gambia	Portugal		Mexico
	Ghana	Romania		Netherlands
	Guinea Bissau	Slovakia		New Zealand
	Guinea	Slovenia		Norway
	Kenya	Spain		Poland
	Lesotho	Sweden		Portugal
	Liberia	United Kingdom		Slovak Republic
	Libya			Slovenia
	Madagascar			Spain
	Malawi			Sweden
	Mali			Switzerland
	Mauritania			Turkey
	Mauritius			United Kingdom
	Mozambique			United States
	Namibia			
	Niger			
	Nigeria			
	Rwanda			
	Sao Tome and Principe			
	Senegal			
	Seychelles			
	Sierra Leone			
	Somalia			
	South Africa			
	Sudan			
	Swaziland			
	Tanzania			
	Togo			
	Tunisie			
	Uganda			
	Zambia			
	Zimbabwe			

Data source: ASEAN, AU, EU, European Union External Action, OECD .

Appendix 10: Table of average factor scores for the five cooperation organizations

Table 10.A: Rescaled average factor scores for the ASEAN, the AU, the EU, the MERCOSUR, and the OECD

	ASEAN		AU		EU		MERCOSUR		OECD	
Factor, rescaled	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**
Economic	2.04	6	1.09	22	2.02	26	0.69	9	1.50	33
Institutional*	1.71	8	0.92	47	2.11	26	1.24	10	2.20	34
Socio-cultural**	1.58	1	0.00	5	2.42	9	1.59	3	2.24	8
Technological	1.71	3	0.83	3	3.39	2	1.41	5	2.69	3

Average, rescaled factor scores for the five different cooperation organizations the ASEAN, the AU, the EU, the MERCOSUR, and the OECD; and the number of observations in the computation of the average scores (N). The scores have been added with the absolute value of the lowest average factors score (1.37556) in the sample, in the rescaling.

Table 10.B: Non-rescaled average factor scores for the ASEAN, the AU, the EU, the MERCOSUR, and the OECD

	ASEAN		AU		EU		MERCOSUR		OECD	
Factor, non-rescaled	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**	**score**	**N**
Economic	0.67	6	-0.29	22	0.65	26	-0.69	9	0.12	33
Institutional*	0.34	8	-0.45	47	0.73	26	-0.14	10	0.83	34
Socio-cultural**	0.21	1	-1.38	5	1.04	9	0.21	3	0.87	8
Technological	0.34	3	-0.55	3	2.01	2	0.04	5	1.31	3

Average, non-rescaled factor scores for the five different cooperation organizations the ASEAN, the AU, the EU, the MERCOSUR, and the OECD; and the number of observations in the computation of the average scores (N). These scores are original average factor scores, not rescaled.