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National climate policies in international comparison: The Climate Change Cooperation Index

Thomas Bernauer, Tobias Böhmelt *

ETH Zurich Center for Comparative and International Studies (CIS), Institute for Environmental Decisions (IED), Haldeneggsteig 4, CH-8092 Zurich, Switzerland

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ABSTRACT

Valid and reliable measurement of countries' climate policy performance is important both for policy-making and analytical purposes. The authors contribute to this end by introducing a new dataset that offers such information for up to 172 countries for the time period 1996–2008. Their *Climate Change Cooperation Index* (C3-I) captures overall performance as well as performance in terms of political behavior (output) and emissions (outcome). The C3-I, thus, allows for a systematic global comparison of countries' climate policies. The paper also compares the C3-I with its most relevant alternative, the *Climate Change Performance Index* (CCPI) by Germanwatch.

1. Introduction

Since the early 1990s, the international community has made some, albeit far from sufficient progress toward reducing greenhouse gas emissions and mitigating their impact on humankind and ecosystems. Meanwhile, it has become increasingly apparent that policies to that end differ strongly across countries and over time, both in terms of form and the de facto contribution to the global public good of "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (United Nations Framework Convention on Climate Change (UNFCCC), Art. 2).

A large body of literature describes and assesses the climate policy efforts of individual states or small groups of countries (e.g., Reiche, 2010; Victor, 2006; Yamin and Depledge, 2004). Although these studies provide important insights, broader international comparisons focusing on a large set of countries over a relatively long period of time might allow for even more systematic and far-reaching conclusions (e.g., Bättig and Bernauer, 2009; Bättig et al., 2008; Böhmelt, 2012; Burck and Bals, 2011). More specifically, it appears crucial to know – both from the perspective of policy-makers and scholars – which countries, in descriptive terms, are "leading the effort" and which ones are "lagging behind." Furthermore, in analytical terms, comparing a large number of states and their policies over time has the potential to produce more generalizable inferences with respect to the factors that are conducive to more ambitious mitigation efforts.

One major obstacle to large-scale comparisons of states' climate policies is insufficient data. Most of the existing analytical work simply uses greenhouse gas emission levels and/or rates of change to compare states. This approach does

* Corresponding author.
E-mail addresses: thbe0520@ethz.ch (T. Bernauer), tobias.boehmelt@ir.gess.ethz.ch (T. Böhmelt).
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not fully capture a country's overall climate policy performance; focusing on emissions does not automatically tell us how strict or ambitious the climate policy of a given country is, since emissions are also affected by factors other than policy (e.g., economic developments or the weather). Moreover, other scholars have measured climate policy performance by examining how fast countries ratified the UNFCCC and/or the Kyoto Protocol (e.g., Fredriksson and Gaston, 2000; Neumayer, 2002a,b; Bernauer et al., 2010). This approach ignores the emissions component and, hence, it cannot capture the overall climate policy efforts of a country either.

Thus far, we are aware of only two datasets that offer information both on emissions *and* on policy efforts for a large number of countries: the Climate Change Performance Index (CCPI) by the non-governmental organization and think-tank Germanwatch (Burck and Bals, 2011), and the Cooperation Index (CI) by Bättig et al. (2008). As we will outline in greater depth below, the CCPI is based on data for emission trends, emission levels, and climate policy. The CI has a cross-section format, is available for 198 countries, and is based on aggregated data for the time period 1990–2005.

In light of this, we have developed a new dataset that adds to these existing efforts. This *Climate Change Cooperation Index* (C3-I) builds on the measurement concept of the CI and seeks to address countries' overall climate policy performance as well as performance in terms of political behavior (output) and emissions (outcome). In its current form, it covers up to 172 countries for the time period 1996–2008, but can also easily be extended. The C3-I, thus, allows for the systematic global comparison of states' climate policy performance. In order to demonstrate the potential and usefulness of this new index, we also compare the C3-I with its most relevant alternative, the CCPI (Burck and Bals, 2011).

The paper proceeds as follows. The next sections describe the main conceptual differences between the CCPI, the CI, and, against this background, introduce the C3-I. We then compare and contrast those countries and years that are simultaneously covered by the CCPI and C3-I. To illustrate how one or the other index can affect the findings of empirical research, we also discuss the results of a simple analysis on the effect of democracy on countries' climate policy performance. We finish the article by highlighting the differing advantages and disadvantages of the two indices and by discussing policy recommendations as well as avenues for further research.

2. Conceptual differences between the CCPI and the CI

The CCPI offers times-series cross-section data for up to 58 countries over the time period between 2005 and 2011, with an increasing country coverage over time. For example, the first CCPI for the year 2005 comprises data for 53 countries; the subsequent index for 2006 already covers 56 states. The latest version of the CCPI offers data for 58 countries "that together are responsible for more than 90% of annual worldwide carbon dioxide emissions" (Burck and Bals, 2011, p. 4), i.e., the main criterion for case selection is a country's level of carbon dioxide emissions. In total, this index relies on 13 indicators, 11 of which measure emission levels and trends, and two of which assess national and international climate policies (Burck and Bals, 2011). These indicators are then aggregated into the overall CCPI measure. In this aggregation process, the weights given to the three categories of indicators are 50%, 30%, and 20%, respectively. The rationale behind those weights is to avoid an overly generous treatment of countries that make (substantial) improvements, but actually start(ed) from a comparatively low or poor performance level in the first place (Burck and Bals, 2011, p. 5). Fig. 1 illustrates the composition of the CCPI. While the emission level and trend indicators used for the CCPI are taken from third-party sources (primarily the International Energy Agency), the policy components of the CCPI are based on expert assessments solicited by Germanwatch. The overall index places countries within the interval [0; 100], where higher values indicate more "climate friendly" behavior. As Burck and Bals (2011, p. 6) note, any individual score "indicates climate performance relative to that of other countries."

Like the CCPI, the original CI (Bättig et al., 2008, p. 480ff) is composed of indicators on emissions and states' policy behavior. It uses aggregated average data for 1990–2005 and differs conceptually from the CCPI in important ways. On the policy side, it relies on rather easily and objectively observable phenomena, rather than expert assessments. These policy phenomena are summarized in Table 1. Higher values on each of these indicators indicate more cooperative political behavior in terms of contributing to the global environmental public good.[1]

On the emissions side, the CI compares emissions against an emissions trajectory, i.e., a fitted environmental Kuznets curve (Seleden and Song, 1994; Grossman and Krueger, 1995) that serves as a benchmark. Here, the CI's emissions part uses two components: 1990 levels of CO_2 emissions per capita in relation to GDP per capita; and the trend of CO_2 emissions per capita in relation to GDP per capita between 1990 and 2002. The rationale behind this approach is that per capita CO_2 emissions should be allowed to develop differently depending on the economic situation of a country. As Bättig et al. (2008, p. 480ff) emphasize:

> "*A developing country should have the possibility to increase its per capita emissions during economic growth. In contrast, a developed country should have the responsibility to invest in cleaner, more efficient technology and renewable energies, and, thus, stabilize and reduce its per capita emissions. To assess countries in this sense, per capita CO_2 emission levels and trends were evaluated with respect to an environmental Kuznets curve, which describes the relationship between economic development and emissions, and is assumed to first increase and then decrease as a function of income.*"

[1] Note already here that the policy component of the C3-I that we will be presenting below differs from the CI as discussed here. Bättig et al. (2008) categorize membership in the UNFCCC and the Kyoto Protocol as "commitment to common goals" and all other indicators as "implementation of measures." However, we will treat two of the four "implementation of measures" components of the CI as policy indicators (reporting and financial contributions under the UNFCCC).

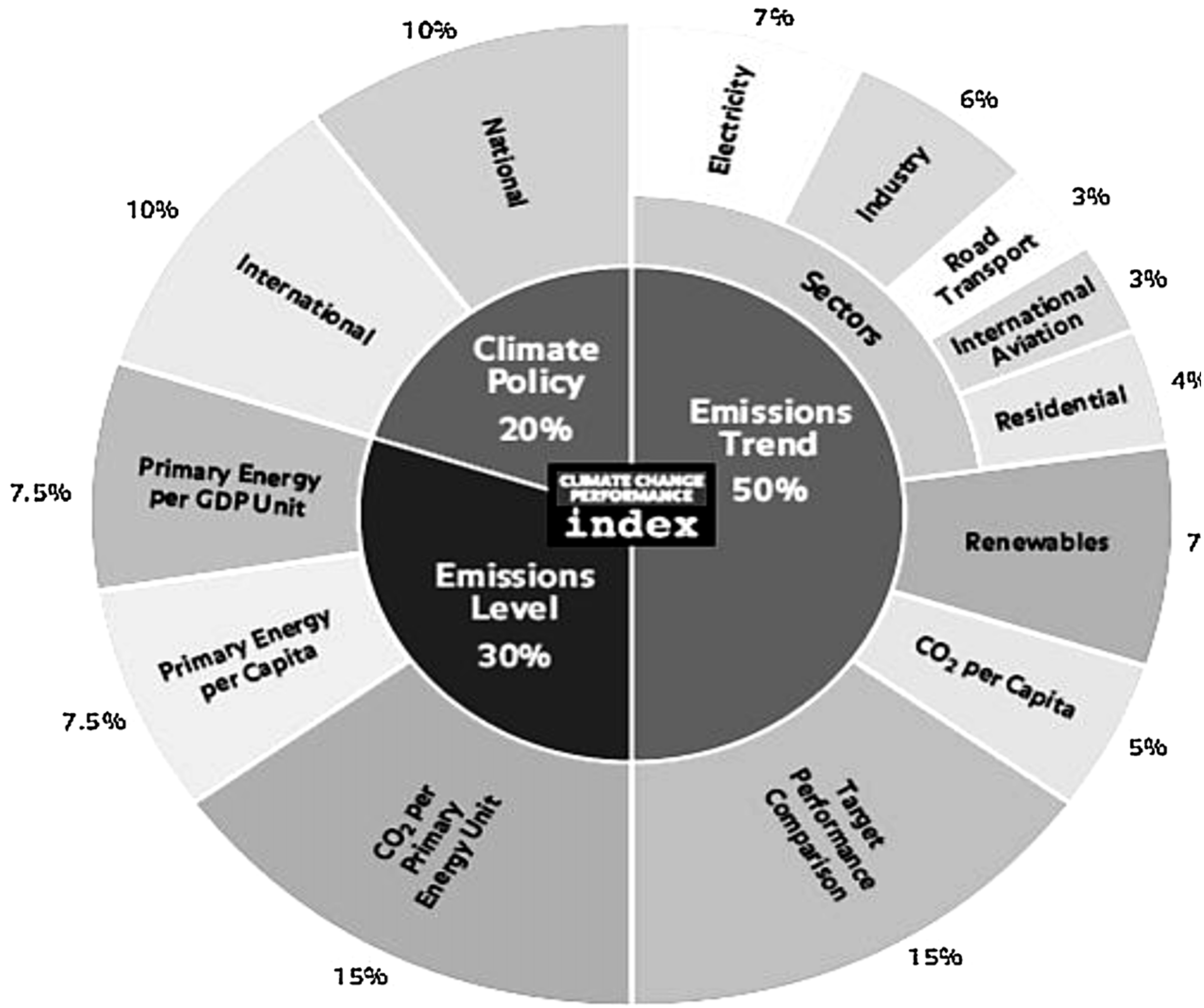

Fig. 1 – Components of the CCPI.
***Source*: Burck and Bals (2011, p. 5).**

Therefore, relating emission trends and levels to income offers an indication of how effectively countries deal with the challenge of growing economically without excessively damaging the natural environment (Mendelsohn et al., 2006; Schelling, 1992). Ultimately, higher values on the emissions component of the CI indicate more cooperative behavior. Note that the CCPI from Germanwatch apparently also seeks to incorporate the economic status of a country. As Burck and Bals (2011, p. 6) note, their index "ensures that the current status of economic development within each country is taken into account." Presented like this, however, it remains unclear to us how exactly this is achieved with the current conceptualization of the CCPI, given that the CCPI combines a rather large number of different types of emission indicators.

Table 1 – Policy components of the CI (C3-I).

(1)	Two equally weighted indicators capturing whether a country ratified the UNFCCC (yes/no) and how fast it did so (declining scale from 1992 on)
(2)	Two equally weighted indicators capturing whether a country ratified the Kyoto Protocol (yes/no) and how fast it did so (declining scale from 1998 on)
(3)	Two equally weighted indicators capturing whether a country submitted the latest national climate report (yes/no) and whether it did so in time (declining scale until a delay of 6 month (AI countries) or three years (non-AI countries)
(4)	One indicator measuring how often a country made its financial contributions to the UNFCCC secretariat on time between 1996 and 2005 (linear scale according to the number of contributions)

The aggregation of policy and emissions factors into the overall CI differs from the CCPI as well. More specifically, the CI combines its components as follows: the four policy parts are weighed equally, since there is no a priori reason why one or any other component should be more important (Bättig et al., 2008, p. 486). The emissions component is multiplied by a factor of two, though, before being added to the four policy-related scores. Bättig et al. (2008, p. 483) argue that the emission component is "the most important of all as it requires larger efforts to change or implement a climate policy than to write a report, pay financial contributions, or ratify an agreement." Climate policy, thus, receives a much greater weight in the CI than in the CCPI, relative to emissions-related performance (2:1 in the CI vs. 1:4 in the CCPI). The scale for the aggregate CI ranges from 0 (least cooperative) to 6 (most cooperative) and is available for 198 countries.

3. The Climate Change Cooperation Index (C3-I)

In the following, we rely on the CI rather than the CCPI as a foundation for creating the new C3-I. This choice is based on the following reasons. First, and as noted above, climate change policies as well as emissions can and do change quite dramatically over time. Measuring such changes is important both from an academic and policy perspective. The policy component of the CCPI relies on expert assessments, which cannot be extended backwards in time in a reliable manner, however. In fact, the CCPI starts in 2005, long after global climate policy started in earnest. Hence, backward extension or replication of the CCPI is excluded ex ante, while this is in principle possible for the CI, despite its main disadvantage of a cross-sectional nature. In order to address this latter issue, we compiled time-series cross-section data instead.

Second, and related to the first point, we believe that the CI's concept of policy measurement, while arguably being narrower than that of the CCPI, rests on objectively observable, i.e., transparent characteristics. The factors pertaining to the policy measurement of the CI are states' ratification behavior, financial contributions, and countries' reporting behavior under the UNFCCC. Arguably, these variables are publicly observable, easy to detect, and comparable. In other words, transparency and reliability of measurement are likely to be higher in the case of the CI, as compared to the CCPI, which relies on expert assessments. Having said that, expert assessments clearly form an important part of many international data projects in the social sciences (e.g., democracy scores; see Marshall and Jaggers, 2004). However, they are sometimes hard to replicate, unreliable, and in either case less transparent than those directly observable factors the CI builds on.

Third, the CCPI uses a rather large number of subcategories for its emission level and trend components, with different weights assigned to each component when aggregating them into the overall index. While each of these weights may well be justified, this approach introduces great complexity, much room for contestation, and, perhaps most importantly, increases noise in the data. We prefer the parsimonious approach of the CI, which relates overall national emissions to the economic output.

By and large, we employ the same coding rules that were used for the six individual parts of the CI (Bättig et al., 2008, p. 480ff) for our components of the C3-I, albeit in a times-series cross-section format. That is, for our purposes, the CI coding rules were used for every country-year separately. This ensures that our components and, as a result, the C3-I varies over time. We then aggregate the first four components (see Table 1) into a "climate policy index," whereas the emission level and emission trend components are combined into an "emissions index" (see also Bättig and Bernauer, 2009; Böhmelt, 2012).

We deviate from the CI's original emissions component in some respects. Due to its cross-sectional nature, the CI was weighed by a fitted environmental Kuznets curve for 13 countries of the EU. Since the C3-I follows a panel data format, this less flexible approach is no longer necessary and we use a ratio that weighs emission levels and emission trends by the corresponding GDP per capita (i.e., income) level. We also deviate from the original CI concept in terms of its overall aggregation (see also Böhmelt, 2012). Whereas, in our view, the CCPI leans too much toward one extreme in weighing the policy component by (only) 20% in the overall index, the CI leans toward the other extreme in weighing policy by a factor of 2:1, relative to the emissions component. Therefore, for the C3-I, the policy and emissions components are aggregated with equal weight (50%/50%).[2] This means that we do not prioritize climate policy behavior over emissions behavior. To facilitate comparison with the CCPI in this paper, we re-scaled the C3-I to the interval [0; 100], where higher values indicate more cooperative climate change behavior. The resulting panel dataset covers up to 172 countries for the time period 1996–2008 (mean value: 67.31; standard deviation: 3.26). Note that the C3-I is available up to 2008 only, whereas the CCPI is available up to 2011. The reason for this is that at the time of conducting this research, reliable emissions data for the most recent years were not available. However, the climate policy part of the C3-I is available until the year 2010.

Fig. 2 visualizes the distribution of the C3-I's country coverage by year. Starting with 99 countries in 1996 due to data constraints, we reach the maximum of 172 countries in 2007. The final year covered by our dataset (2008) offers information for 171 states. Note that even with its minimum of 99 countries in the first year of observation, the C3-I covers more countries and more years than the CCPI.

In addition, Fig. 3 shows the median band of our index and also identifies the three best and worst performing countries in each year based on the yearly C3-I score. It is demonstrated that the yearly average level of the C3-I as a whole is fairly stable and quite well above the "theoretical mean" of 50 over time. The visual inspection of the best and worst performing countries in Fig. 3 suggests that poor performers include the "usual suspects," whereas some of the best performers may appear more surprising (e.g., Turkmenistan, Moldova).

4. Empirical comparison of the CCPI and the C3-I

4.1. *Descriptive comparison*

The C3-I offers times-series cross-section data for up to 172 countries in 13 years (1996–2008), whereas the CCPI is comprised of times-series cross-section data for up to 58 countries between 2005 and 2011. Any systematic empirical comparison of the two indices must, therefore, remain limited to four years and 55 countries (52 in 2005) for which data are available in both datasets ($N = 217$; time period: 2005–2008).

In comparing the first two rows in Table 2, we observe two important differences between the two indices. First, although we re-coded the C3-I to the interval [0; 100] to facilitate

[2] Depending on the researcher's needs, however, one can adjust these weights.

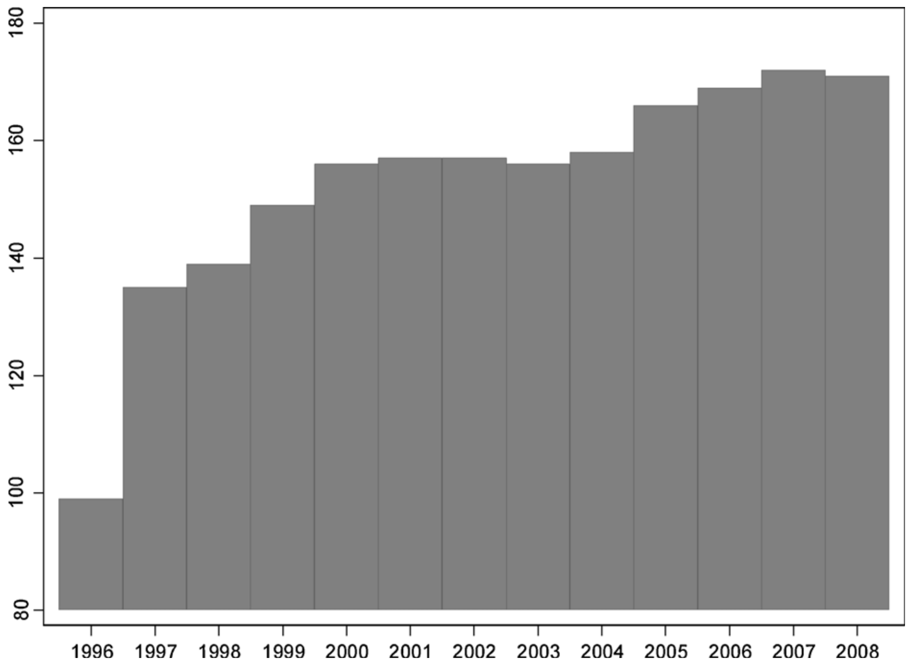

Fig. 2 – C3-I country coverage, 1996–2008 (frequencies).

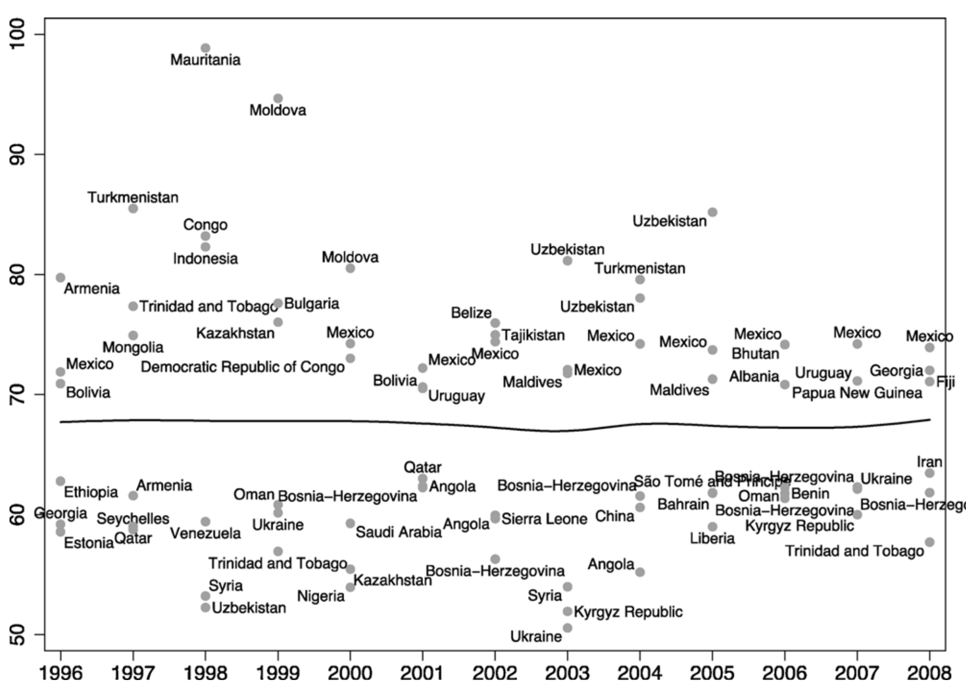

Fig. 3 – C3-I median band with three best and worst performing countries, 1996–2008. Solid line shows median band.

comparison with the CCPI, both measures remain different in terms of their scaling and overall distribution. A bivariate OLS regression for the two indices shows that a one-unit increase in our index is associated with a 2.43-point increase in the CCPI ($p < 0.01$). Hence, the latter appears to be more "generous" in locating countries within its scale. Second, variation on the CCPI is stronger than variation on the C3-I. This may indicate that the former index is more susceptible to outlier problems.

Table 2 – Descriptive statistics for the CCPI and the C3-I.

	N	Mean	SD	Min	Max
CCPI	217	26.08	26.34	−1.16	66.70
C3-I	217	67.78	1.98	61.99	74.23
CCPI – outliers dropped	101	52.10	6.89	35.58	66.70
C3-I – outliers dropped	101	68.13	1.83	62.12	74.22

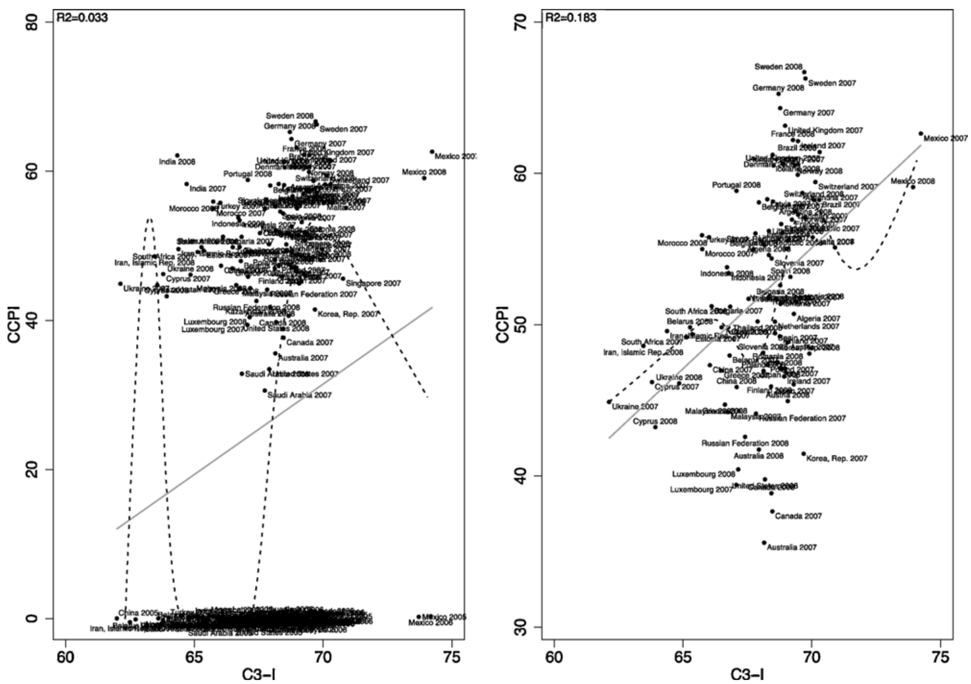

Fig. 4 – Relationship between the CCPI and the C3-I. Solid line shows linear fit of OLS regression. Dashed line shows median spline.

The left panel in Fig. 4 illustrates this issue more thoroughly. It depicts the scatter plot of the C3-I and the CCPI and also indicates the linear fit of a simple OLS regression and a median spline to facilitate the interpretation of the directional relationship between the two indices. This panel, in combination with additional test statistics, suggests that the CCPI may underestimate the climate policy performance of countries located below a value of 35 on the scale [0; 100]. However, it should be noted that those observations below the threshold of 35 mostly pertain to the year 2005 for which the CCPI used a somewhat different measurement concept than for all other following years (Burck and Bals, 2011). We, therefore, dropped those observations and re-calculated the mentioned statistics. The last two rows in Table 2 and the right panel in Fig. 4 summarize our results.[3]

Dropping outliers from the data decreases the variance of the CCPI considerably and, hence, reduces the impact of influential observations on the relationship between the two indices. It also leads to a greater approximation between the scales of the two indices. However, the variance of the C3-I still remains much smaller than the variance of the CCPI. In fact, the C3-I's variance remains virtually unchanged compared to the full sample. We conclude that the C3-I and its underlying coding rules are less likely to be affected by outliers than the CCPI – even after dropping those cases that appear as influential observations in the CCPI.

These differences notwithstanding, Table 2 and Fig. 4 suggest that both indices still measure the same underlying concept and do not seem to be too far away from each other – conceptually and empirically. After discarding the outliers, the right panel in Fig. 4 shows that most cases (i.e., country-year observations) are similarly classified by each measure: countries that contribute little to global climate change mitigation in a given year receive low values on either index; countries that contribute, relatively, more in a given year are ranked high on both measures. That being said, it is evident that important differences remain – most importantly, the higher variance of the CCPI.

4.2. *Are democracies more "climate friendly?" A simple model comparison*

To examine possible analytical implications of such differences, we revisit a rather well-studied issue, i.e., the impact of democratic regime type on climate change policy. Several scholars argue that democracies, relative to non-democracies, are more likely to provide environmental public goods in the form of environmental quality at the national level (e.g., Payne, 1995; McGuire and Olson, 1996; Lake and Baum, 2001; Fredriksson et al., 2005; Bernauer and Koubi, 2009), and are more inclined to cooperate in international environmental problem solving efforts as well (e.g., Congleton, 1992; Neumayer, 2002a,b; Ward, 2006, 2008; Bernauer et al., 2010, 2013). The fundamental reasoning is that democratic governments need to provide more benefits via public goods, including environmental ones, to a relatively large (compared to non-democracies) part of the electorate in order to survive politically (Bueno de Mesquita et al., 2003; Downs, 1957). In democratic states, citizens also benefit from greater civil liberties, e.g., freedom of speech, press and association, which enable them to

[3] Note that we drop outliers exclusively with reference to the CCPI. This approach is more conservative because it increases the fit of the CCPI by definition, but not necessarily the fit of the C3-I.

Table 3 – Effect of democracy on climate policy performance – the CCPI and C3-I in comparison. Robust standard errors clustered on country in parentheses.

	Model 1 (CCPI – full)	Model 2 (C3-I – full)	Model 3 (CCPI – constrained)	Model 4 (C3-I – constrained)
Democracy	0.195	0.133	0.193	0.162
	(0.108)	(0.035)***	(0.132)	(0.035)***
Constant	24.73	66.86	50.64	66.91
	(0.904)***	(0.335)***	(0.986)***	(0.336)***
N	217	217	101	101
F	3.24	14.33***	2.13	21.92***
R^2	0.002	0.136	0.017	0.164
RMSE	26.38	1.847	6.865	1.690

*$p < 0.05$ (two-tailed).
**$p < 0.01$ (two-tailed).
*** $p < 0.001$ (two-tailed).

voice concerns over environmental problems more effectively – both at national and international levels. Therefore, at any given level of environmental risk and socio-economic development, popular demand for more environmental protection is likely to be stronger in democracies, and policy-makers are likely to experience stronger incentives to meet this demand. Empirically, Neumayer (2002a), for example, finds that democracies are more likely than autocracies to participate in international environmental treaties. He concludes that ''a spread of democracy around the world will lead to enhanced environmental commitment worldwide'' (Neumayer, 2002a, p. 158; see also Congleton, 1992; Beron et al., 2003; Bättig and Bernauer, 2009).

To evaluate this hypothesis, we use the Polity IV data to measure democracy (Marshall and Jaggers, 2004) and the CCPI and C3-I, respectively, to evaluate the behavior of countries vis-à-vis global climate change. The combined *polity*2 item from the Polity IV data ranges between −10 (full autocracy) and +10 (full democracy). The overall CCPI and C3-I indices are used as dependent variables in separate regression models. Again, we compare results for the full sample, i.e., that sample for which both the C3-I and the CCPI offer comparable data, and for the constrained sample without outliers. We deliberately do not consider any further explanatory variables that may affect climate policy and emissions additionally. Including more covariates would only reduce parsimony and degrees of freedom in this simple comparison. Moreover, while other factors may also influence countries' climate policy, existing research shows that democracy is a key determinant in this respect (Bättig and Bernauer, 2009). In other words, we are, in this comparison of the CCPI and C3-I, not interested in exhaustively explaining climate policy performance, but mainly in comparing the effect of democracy on climate policy performance as measured by the two different indices. Note, however, that our results and key findings remain unchanged when departing from this narrow comparison and estimating the effect of democracy on either index using their full sample data, i.e., 2005–2011 for the CCPI and 1996–2008 for the C3-I. Table 3 and Fig. 5 summarize our findings.

In all regression models shown here, democracy has a positive effect on climate policy performance. However, the observed democracy effect is statistically significant only in those models using the C3-I data. A one-unit increase on the democracy variable is associated with a 0.133-unit increase on the C3-I in Model 2 (0.162 in Model 4). As a corollary, the models using the CCPI exhibit a weaker statistical model fit than the models employing our index. On average, the democracy variable explains 15% of the variance on the C3-I, but only 0.95% on the CCPI. Furthermore, and as expected, those models that discard the outliers perform better.

The reasons for differences in statistical model fit and significance of the democracy effect can be derived from Fig. 5, which shows a graphical presentation of Model 3 (left panel) and Model 4 (right panel). Although we dropped the most influential, i.e., outlier observations for those calculations, the CCPI still includes more outliers than the C3-I. An important indication for this is the downward slope of the median spline toward the value of 5 on the democracy variable, as shown in the left panel. While the panel on the right depicts a similar downward slope at this exact value of the democracy variable, it is less influential. Note as well that the observations in that section of either graph are virtually the same. A systematic pattern beyond that could not be identified for these cases, though. The most noteworthy differences are observed for those cases that score the maximum on the democracy variable (+10), i.e., full democracies. While the C3-I varies a lot in terms of states' climate policy performance, the CCPI varies even more. This strong variation of the CCPI implicates that democracy has next to no explanatory power when using this index for climate policy performance.

The observation that democracy has a strong and significant effect on climate policy performance as measured by the C3-I, but no significant effect on such performance as measured by the CCPI cannot, a priori, be taken as evidence that the C3-I is more suitable for large-*N* statistical research on climate policy. Nevertheless, we tend to think that the C3-I produces more reliable results, because its (transparent) coding rules result in fewer outliers and because we were able to empirically confirm a well-established theoretical argument and corresponding empirical evidence for the democracy–environment relationship when using the C3-I for this analysis.

4.3. *Disaggregating the two indices – a comparison of outcome and output components*

As stated above, the CCPI and the C3-I differ conceptually with respect to their policy output (commitment) and outcome

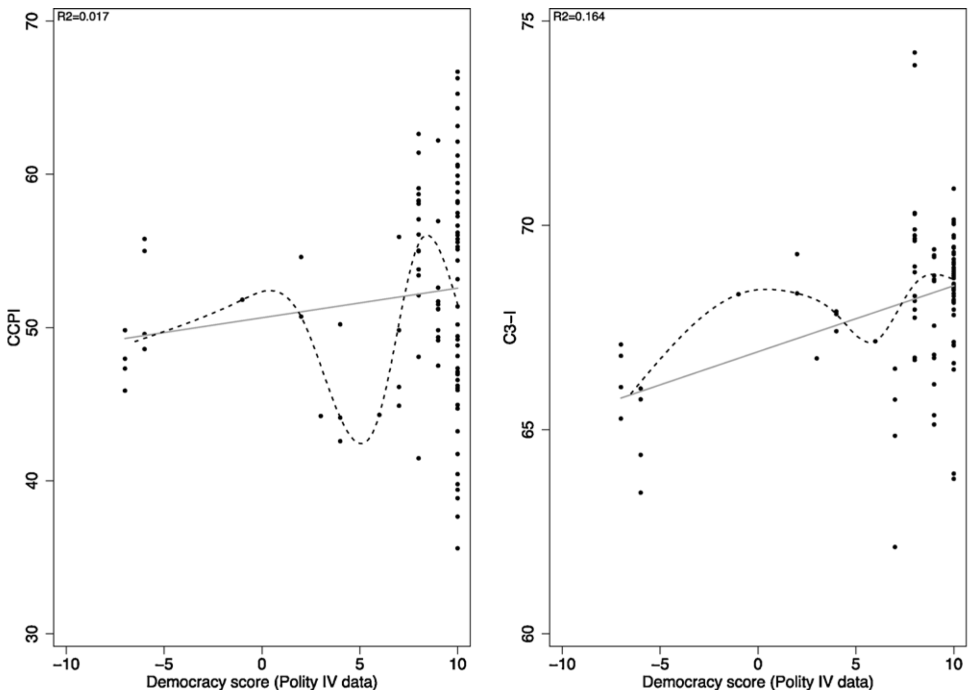

Fig. 5 – Effect of democracy on climate policy – the CCPI and C3-I in comparison. Solid line shows linear fit of OLS regression. Dashed line shows median spline.

(emissions) components. Hence, it is also useful to distinguish between these components and find out whether differences between the overall indices are driven by either component.

To start with, the CCPI distinguishes between an outcome (emissions) trend and an outcome level component. To facilitate comparison with the C3-I, we combine these two components into one outcome (emissions) component. Table 4 and Fig. 6 show basic descriptive statistics and depict the relationship between the emission components of the two indices. Table 4 indicates that multiple outliers affect the CCPI on this component; the standard deviation in the full sample of overlapping (with the C3-I) years and countries is close to 40. These influential observations can be identified via the left panel in Fig. 6.

Following the same procedure as above, we then identified and dropped those outliers in order to discard their influence on the overall result. The variance then decreases for both indices, which is also demonstrated in the right panel of Fig. 6. This panel not only indicates an improved model fit, but also that the median spline now deviates only marginally from the underlying linear OLS fit. These results suggest that the differences between the overall CCPI and C3-I (as summarized in Table 2 and Fig. 4) are *not* primarily driven by differences between the *emission components* of the two indices (Table 5).

Against this background, we now turn to the policy components of both the CCPI and the C3-I, for which we compute the same statistics as for the emission components. It turns out that the climate policy component of the CCPI is the principle source of differences between the CCPI and the C3-I. The standard deviation of the former is more than twice as large as the standard deviation of the latter. Moreover, the left panel in Fig. 7 indicates that countries below a value of 20 on the CCPI's climate policy component are influential cases that deviate strongly from the main pattern. Again, these observations mainly pertain to the year 2005, for which the CCPI used a slightly different coding rule than for all succeeding years (Burck and Bals, 2011). When dropping those observations and estimating the quantities of interest again, variance in both indices decreases only to some extent, but not substantially. This indicates that there must be another source of variation. This additional source stems from those cases that score 50 on the policy component of the C3-I, but vary

Table 4 – Descriptive statistics for the CCPI and C3-I emission components.

	N	Mean	SD	Min	Max
CCPI emiss.	217	38.34	36.75	0	100
C3-I emiss.	217	68.73	1.09	62.45	70.88
CCPI emiss. – outliers dropped	104	73.91	10.16	48.09	100
C3-I emiss. – outliers dropped	104	68.92	0.86	65.93	70.78

Table 5 – Descriptive statistics for the CCPI and the C3-I climate policy components.

	N	Mean	SD	Min	Max
CCPI policy	217	26.20	29.05	−2.12	95.45
C3-I policy	217	48.46	13.03	8.02	100
CCPI policy – outliers dropped	100	53.30	17.35	19.72	95.45
C3-I policy – outliers dropped	100	49.61	12.80	8.02	100

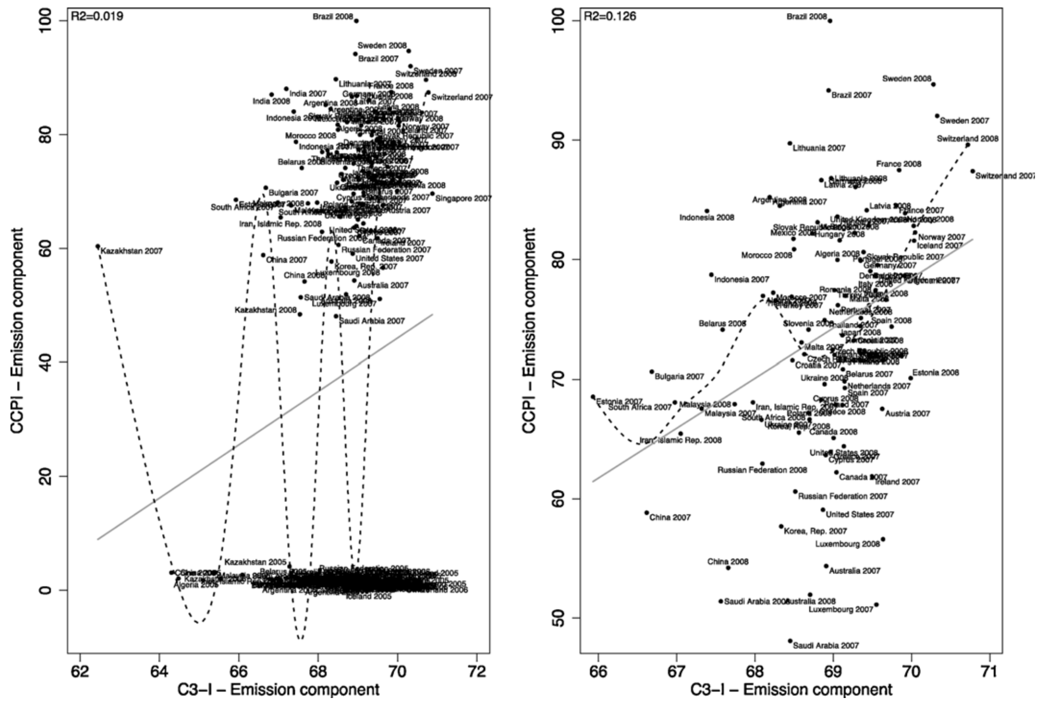

Fig. 6 – Emission components of the CCPI and C3-I in comparison. Solid line shows linear fit of OLS regression. Dashed line shows median spline.

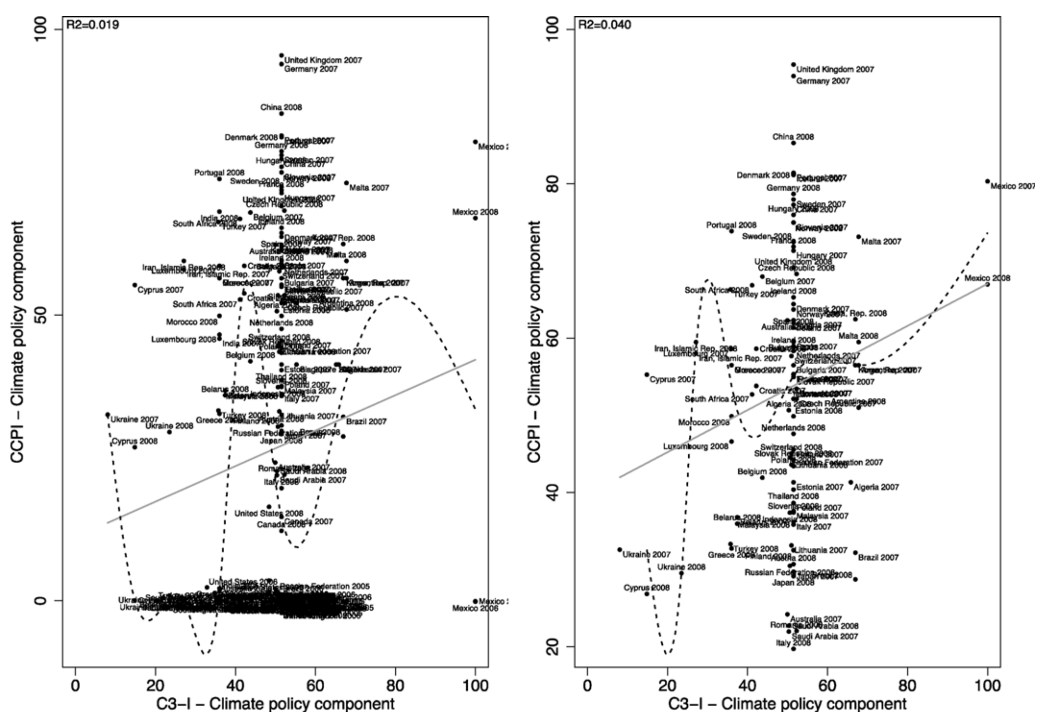

Fig. 7 – Policy components of the CCPI and C3-I in comparison. Solid line shows linear fit of OLS regression. Dashed line shows median spline.

along the continuum of the policy component of the CCPI. The right panel in Fig. 7 shows that cases like the UK in 2007 are overrated by the CCPI (or underrated by the C3-I), whereas cases like Italy in 2008 are underrated by the CCPI (or overrated by the C3-I).

5. Conclusion

Valid and reliable measurement of countries' climate policy performance is important for policy-making and analytical

Table 6 – Summary comparison of CCPI and C3-I (latest version of each index).

	CCPI	C3-I
Country coverage	≤58	≤172
Time period	2005–2011	1996–2008[a]
Emissions component	Trends, levels	Trends, levels, relative to income
Policy component	Expert assessments	Observed behavior
Weighing of emissions relative to policy	80%/20%	50%/50%
Forward extension possible	Yes	Yes
Backward extension possible	No	Yes
Outlier problems	Yes	No
Results in ''democracy analysis''	Insignificant	Significant

[a] Policy component of the C3-I is available for 1996–2010.

purposes. In this paper, we have presented a new dataset that builds on one of the two existing indices that cover a large number of countries and measure country performance toward climate policies both in terms of political behavior and emissions. To recap, first, while the CCPI uses a more complex construct for its emissions component, the C3-I, which builds on the CI of Bättig et al. (2008), is more transparent, more parsimonious, yet also more strongly associated with the concept of sustainable development. Second, the CCPI uses presumably more encompassing expert assessments for its climate policy component and the C3-I relies on simpler types of objectively observable behavior of countries. From our perspective, the latter approach has the advantage that it allows for extending the C3-I data backwards in time – this is arguably not possible for the CCPI. Moreover, the C3-I is available for more countries and a longer time period than the CCPI. This is useful for obtaining more statistical power and, thus, more robust inferences in studying the determinants of cross-national and temporal variation in national climate policies.

The comparison in this paper demonstrates, nevertheless, that the CCPI and C3-I are positively correlated and measure useful empirical expressions of the underlying theoretical concept of interest here, i.e., countries' efforts to address the global problem of climatic change. In light of the differing advantages and shortcomings of the two indices discussed in our research, it would be premature to claim that one or the other index is superior. Instead, we summarize the key differences between the CCPI and C3-I in Table 6.

We conclude the article by outlining some policy implications and avenues for further research. First, our data contribute to efforts by governments, international institutions, and non-governmental organizations to identify ''leaders'' and ''laggards'' in global climate policy. In the words of Bättig et al. (2008, p. 486f), ''indices hold a high potential to convey simple messages and are appreciated by their users.'' We strongly believe that the C3-I will prove useful to that end.

Second, more systematic identification of leaders and laggards also facilitates capacity building initiatives. As Chayes and Chayes (1993) note, non-compliance with international norms is the exception rather than the rule because most countries have an interest not to violate agreements to which they have committed themselves. If non-compliance occurs, however, it often happens unintentionally due to rule ambiguity or capacity limitations. For example, ''annual financial contributions [to the UNFCCC secretariat] are paid more frequently by developed countries than by developing countries'' (Bättig et al., 2008, p. 487). Compliance can, therefore, be increased through transparency, clear rule interpretation, and – first and foremost – capacity building. A prerequisite for efficient and effective capacity building is, though, that those states most in need are recognized in the first place.

Finally, our data also support academic research that focuses on the factors that influence countries' national climate policies and, hence, national contributions to the global public good of avoiding major climatic changes induced by anthropogenic factors. This research area is currently moving from empirical models that emphasize the effects of state characteristics (e.g., income levels or democratic institutions) on climate policy performance to models that connect state characteristics and other domestic-level factors with international network effects and dynamic processes of policy diffusion (e.g., Bernauer et al., 2010, 2013; Hafner-Burton et al., 2008; Spilker, 2012; von Stein, 2008; see also Cao and Prakash, 2012). Such research requires high-quality panel data (cross-sectional times-series data) for large number of countries and many years.

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REFERENCES

Bättig, M., Bernauer, T., 2009. National institutions and global public goods: are democracies more cooperative in climate change policy? International Organization 63 (2), 281–308.

Bättig, M., Brander, S., Imboden, D., 2008. Measuring countries' cooperation within the international climate change regime. Environmental Science and Policy 11 (6), 478–489.

Bernauer, T., Koubi, V., 2009. Effects of Political Institutions on Air Quality. Ecological Economics 68 (5), 1355–1365.

Bernauer, T., Kalbhenn, A., Koubi, V., Spilker, G., 2010. A comparison of international and domestic sources of global governance dynamics. British Journal of Political Science 40 (3), 509–538.

Bernauer, T., Böhmelt, T., Koubi, V., 2013. Is there a democracy-civil society paradox in global environmental governance? Global Environmental Politics 13 (1), in press.

Beron, K.J., Murdoch, J., Vijverberg, W.P., 2003. Why cooperate? Public goods, economic power, and the montreal protocol. The Review of Economics and Statistics 85 (2), 286–297.

Böhmelt, T., 2012. The Influence of Civil Society Lobbying on Countries' Cooperation in Climate Change Policy – A Matching Approach. Typescript, ETH Zurich.

Bueno de Mesquita, B., Smith, A., Siverson, R.M., Morrow, J.D., 2003. The Logic of Political Survival. MIT Press, Cambridge.

Burck, J., Bals, C., 2011. The Climate Change Performance Index – Background and Methodology. Germanwatch and CAN Europe, Berlin/Brussels.

Cao, X., Prakash, A., 2012. Trade competition and environmental regulations: domestic political constraints and issue visibility. Journal of Politics 74 (1), 66–82.

Chayes, A., Chayes, A.H., 1993. On compliance. International Organization 47 (2), 175–205.

Congleton, R.D., 1992. Political institutions and pollution control. Review of Economics and Statistics 74 (3), 412–421.

Downs, A., 1957. An Economic Theory of Democracy. Harper, New York.

Fredriksson, P.G., Gaston, N., 2000. Ratification of the 1992 climate change convention: what determines legislative delay? Public Choice 104 (3/4), 345–368.

Fredriksson, P.G., Neumayer, E., Damania, R., Gates, S., 2005. Environmentalism, democracy, and pollution control. Journal of Environmental Economics and Management 49 (2), 343–365.

Grossman, G.M., Krueger, A.B., 1995. Economic growth and the environment. Quarterly Journal of Economics 110 (2), 353–377.

Hafner-Burton, E., von Stein, J., Gartzke, E., 2008. International organizations count. Journal of Conflict Resolution 52 (2), 175–188.

Lake, D., Baum, M., 2001. The invisible hand of democracy: political control and the provision of public service. Comparative Political Studies 34 (6), 587–621.

Marshall, M.G., Jaggers, K., 2004. Polity IV Project: Political Regime Characteristics and Transitions 1800–2004, Dataset Users' Manual. Center for Global Policy School of Public Policy, Colorado State University.

McGuire, M., Olson, M., 1996. The economics of autocracy and majority rule: the invisible hand and the use of force. Journal of Economic Literature 34 (2), 72–96.

Mendelsohn, R., Dinar, A., Williams, L., 2006. The distributional impact of climate change on rich and poor countries. Environment and Development Economics 11 (2), 159–178.

Neumayer, E., 2002a. Do democracies exhibit stronger international environmental commitment? A cross-country analysis. Journal of Peace Research 39 (2), 139–164.

Neumayer, E., 2002b. Does trade openness promote multilateral environmental cooperation? World Economy 25 (6), 815–832.

Payne, R.A., 1995. Freedom and the environment. Journal of Democracy 6 (3), 41–55.

Reiche, D., 2010. Energy policies of Gulf Cooperation Council (GCC) countries – possibilities and limitations of ecological modernization in Rentier states. Energy Policy 38 (5), 2395–2403.

Schelling, T.C., 1992. Some economics of global warming. American Economic Review 82 (1), 1–14.

Seleden, T., Song, D., 1994. Environmental quality and development: is there a Kuznets curve for air pollution emissions? Journal of Environmental Economics and Management 27 (2), 147–162.

Spilker, G., 2012. Helpful organizations: membership in inter-governmental organizations and environmental quality in developing countries. British Journal of Political Science 42 (2), 345–370.

Victor, D., 2006. Toward effective international cooperation on climate change: numbers, interests, and institutions. Global Environmental Politics 6 (3), 90–103.

von Stein, J., 2008. The international law and politics of climate change. Journal of Conflict Resolution 52 (2), 243–268.

Ward, H., 2006. International linkages and environmental sustainability: the effectiveness of the regime network. Journal of Peace Research 43 (2), 149–166.

Ward, H., 2008. Liberal democracy and sustainability. Environmental Politics 17 (3), 386–409.

Yamin, F., Depledge, J., 2004. The International Climate Change Regime – A Guide to Rules, Institutions and Procedures. Cambridge University Press, Cambridge.