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Measuring and explaining the EU's effect on national climate performance

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ABSTRACT

To what extent has the European Union (EU) had a benign or retarding effect on what its member states would have undertaken in the absence of EU climate policies during 2008–2012? A measurement tool for the EU policy's effect is developed and shows a benign average EU effect with considerable variation across countries. The EU's policy effectiveness vis-à-vis its member states is explained by the EU's non-compliance mechanism, the degree of usage of the Kyoto flexible mechanisms, and national pre-Kyoto emission reduction goals. Time-series cross-sectional analyses show that the EU's non-compliance mechanism has no effect, while the *ex-ante* plans for using Kyoto flexible mechanisms and/or the ambitious pre-Kyoto emission reduction targets allow member states to escape constraints imposed by EU climate policy.

KEYWORDS Climate change; policy effectiveness; EU; kyoto protocol; non-compliance; Kyoto (flexible) mechanisms

Introduction

After the conclusion of the 2015 Paris Agreement on climate change, it remains unclear whether its flurry of national commitments will materialize. President Trump's rhetoric raises concern about the global climate regime's effectiveness (Bomberg 2017). While the European Union (EU) has perceived itself as a climate leader, scholars have questioned the EU's leadership role in international negotiations (Wurzel and Connelly 2011, Luterbacher and Sprinz forthcoming). The EU complied with its obligations during the first compliance period for the Kyoto Protocol, but it remains unclear whether the EU's legislation and its institutions had a positive or negative effect *beyond* what member states would have undertaken in the absence of EU policies. We investigate whether and, if so, to which degree the EU had an effect in curbing carbon emissions of 14 member states[1] that committed themselves to reducing their greenhouse gas (GHG)

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emissions during the Kyoto Protocol I compliance period (2008–2012) and which factors explain variation in the EU's effectiveness.

Research on Europeanization has adopted a 'top-down' approach by focusing on *how the EU matters*, rather than answering the question *to what extent* it matters (Haverland 2007, p. 67). While the European Commission notes that 'the environmental objectives will be realized only through the proper implementation of the acquis' (European Commission 2007, p. 16), the literature analyzing the explanation of poor compliance records with EU environmental legislation does not pay attention to whether and, if so, to what extent *compliance with EU law* leads to advanced domestic policy outcomes (Pridham 1996, Börzel 2000, Falkner *et al.* 2004, Knill and Lenschow 2005). Consequently, 'many studies carry the danger of being biased towards the causal importance of the EU policies and underappreciate the effect of domestic factors on the policy performance of member states' (Haverland 2007, p. 67). The comparative environmental policy literature provides firmer evidence regarding the effect of domestic factors on domestic policy performance (Crepaz 1995, Jahn 1998, Scruggs 1999, Jacob and Volkery 2006, Liefferink *et al.* 2009). These studies, however, neglect the effects of EU policies and the related compliance record of member states on domestic policy performance.

We combine aspects of the Europeanization literature with the comparative environmental policy approach, focusing on the extent to which the EU matters to its member states. In particular, we elucidate which domestic climate change policy outcomes would have occurred in the absence of EU policies and which were achieved by way of the EU's effects on its member states. More specifically, we seek to answer two questions: to what extent is the performance of the member states attributable to EU climate policy, and which factors explain variation in the degree to which the EU impacts the emissions changes of its member states?

Our analysis makes three contributions. First, we introduce and adapt a measurement procedure from the international regimes literature to the EU level to capture the degree to which the EU governance system *adds to or subtracts from* the domestic policy performance of member countries in terms of emissions. Second, to the best of our knowledge, we are the first scholars to simultaneously compute year- and country-specific policy effectiveness scores. Third, we provide a three-pronged explanation of the variance in the effect of the EU by focusing on the EU's non-compliance procedure, the use of the Kyoto flexible mechanisms, as well as pre-Kyoto emission targets.

We check the robustness of our findings by controlling for a range of political economy variables. We illustrate our contributions by empirically focusing on the policies aimed at honoring the emission reduction goals of

the EU as part of the first compliance period under the Kyoto Protocol during 2008–2012.

In the next section, we review the pertinent literature on domestic policy performance. We follow this with an overview of our research design, the methodology to derive the policy effectiveness scores and our hypotheses, before reporting our statistical findings.

Explaining domestic policy performance

Empirical research has adopted various measurement methods for environmental performance, focusing either on environmental policy (output) or GHG emissions (outcome). The majority of studies that explain the variation in domestic policy outputs employ case studies and argue that, *inter alia*, economic development, neo-corporatism, dominant religion, green coalitions, political capacity, the presence and visibility of specific problems, and the industry structure primarily account for the pioneering behavior of countries in terms of environmental policy output (Börzel 2002, Vogel 2003, Jänicke 2005, Lenschow *et al.* 2005, Jänicke and Jörgens 2006).

By contrast, Jacob and Volkery (2006), Liefferink *et al.* (2009), and a survey by the European Bank for Reconstruction and Development (EBRD 2011) provide quantitative evidence. Only Liefferink *et al.* (2009) include EU membership among the explanatory variables for policy output that serves as a proxy of the EU's impact on domestic policies. This survey emphasizes that EU membership turns out to be the most important explanatory factor. The European Bank for Reconstruction and Development highlighted the positive impact of EU membership on domestic environmental policies: Northern EU countries with high income received high scores on the Climate Laws, Institutions and Measures (CLIM) Index (EBRD 2011, p. 61).

Empirical studies that investigate the link between specific domestic factors and environmental policy outcomes mainly adopt quantitative methods. These studies demonstrate that energy consumption, share of manufacturing sector *per* gross domestic product (GDP), and geographic size of a country are associated with increasing emissions, while income *per capita*, population density, and degree of neo-corporatism are strong predictors of emissions reductions (Crepaz 1995, Jahn 1998, Scruggs 1999).

Problem pressure and demand for ambitious environmental policies

Scholars have widely considered a strong domestic green coalition, encompassing green NGOs, public awareness of the environment, and the green business sector, to increase domestic demand for the adoption of ambitious environmental measures and to create favorable conditions for the proper implementation of policies (Scruggs 1999, Jacob and Volkery 2006).

Scholars consider neo-corporatism to be an important domestic characteristic, which translates cooperative interest group representation and public demand into the design of environmental policies (Crepaz 1995). As Liefferink *et al.* (2009, p. 692) note, 'collective action problems inherent in environmental policy can be solved more easily in neo-corporatist "closed shops"' based on trust and long-term reciprocity'. Some authors, however, argue that the privileged position of economic interest groups in neo-corporatist systems may impede the adoption of innovative environmental measures (Crepaz 1995, p. 394). The effect of neo-corporatism remains contested.

Moreover, scholars assume that structural factors such as population density, geographical size of a country, and climatic conditions change demand for emissions reductions and have important effects on environmental performance. More specifically, some authors argue that the exposure of the population to pollution is higher in densely populated countries and, thus, leads to increased pressure on policymakers to enforce pollution-control policies (Jahn 1998, Scruggs 1999, Liefferink *et al.* 2009). The geographic size of a country, controlling for population size, increases transport emissions, while harsher climates lead to higher energy demand (Jahn 1998, pp. 116–117). Empirical findings point to a negative correlation between the size of a country and emission reductions, while scholars find no statistically significant correlation between pollution and population density (Jahn 1998, pp. 116–117).

Creating and/or securing competitive advantage for domestic industries

The introduction of strict environmental standards and regulations increases production costs, especially for energy-intensive sectors. In turn, this may erode their economic competiveness (Börzel 2002, p. 204). This is the main argument behind the well-known 'pollution haven – race to the bottom' hypothesis. According to this hypothesis, countries that are open to international trade tend to adopt less strict environmental regulations because of their desire to enhance or to secure their international competitiveness (De Santis 2012, p. 800).

Researchers, however, have widely challenged this pessimistic hypothesis, arguing that environmental policies do not necessarily pose a competitive disadvantage for domestic industries. Temporary import barriers imposed on products not complying with domestic environmental standards may not only secure the competitiveness of domestic products but may also induce further international harmonization of environmental standards (Vogel 2003, p. 565, Porter and Linde 1995). Empirical findings about the causal relationship between trade and environmental performance remain ambiguous (Van Beers and Van Den Bergh 1999, pp. 29–46, Liefferink *et al.* 2009, p. 693). However, scholars commonly accept

that high-income countries can offset the adaptation costs for domestic industries and provide a business environment for exploiting new opportunities (Scruggs 1999, Börzel 2002).

Influencing the contents of EU environmental legislation

The possibility that domestic policy is initiated to influence European and international regulations – and thereby lower long-term domestic compliance costs – features prominently in the literature (Genovese 2014). Scholarly research offers firm evidence about the strategies followed by green pioneers, especially in the EU (Liefferink and Andersen 1998, Börzel 2002, Liefferink *et al.* 2009). More specifically, those EU member countries that traditionally act as leaders in environmental policy tend to adopt stringent environmental policies and, sometimes, unilateral actions as 'first movers' or 'pushers by example' to promote their own regulatory frameworks at European level. This strategy serves a dual goal. First, harmonization of regulation among EU countries maximizes the competitive advantage for domestic industries among first movers, and, second, it reduces transboundary flows of pollution, thereby enabling the achievement of domestic environmental targets (Héritier 1996, pp. 151–154, Liefferink and Andersen 1998, pp. 255–257).

Börzel (2002, p. 196) notes, EU members 'differ in their capacity to engage successfully in the European policy contest'. Thus, policy preferences, effectiveness of governance and the level of economic development dictate country strategies. In line with this approach, Jacob and Volkery (2006) find a positive correlation between national governmental effectiveness and environmental policy performance.

Explaining non-compliance with EU legislation

The literature on non-compliance with EU environmental legislation focuses mainly on explaining non-compliance with EU law (Pridham 1996, Börzel 2000, Falkner *et al.* 2004, Knill and Lenschow 2005). More specifically, scholars attribute the poor compliance records of Southern member states – Greece, Italy, Portugal, and Spain – to the inherent characteristics of their political, social, and administrative institutions. Many scholars provide evidence for the so-called 'Mediterranean Syndrome', which refers to factors that seem to undermine compliance with EU environmental legislation: poor administrative capacity, absence of 'civic culture', clientelism, corruption, as well as fragmented, reactive, and party-dominated legislative processes (Börzel 2000, Koutalakis 2003). Many authors, however, criticize this approach, arguing that poor compliance is 'not part of a homogenous phenomenon or a disease called the Mediterranean syndrome' (Börzel 2000, p.143). Other authors attribute domestic resistance to change to the high degree of misfit between

European legislation and the fundamental reforms of existing domestic policy required under European law (Falkner *et al.* 2004).

Scholars widely accept that EU policy affects domestic politics by prescribing concrete institutional requirements with which member states must comply (Knill and Lehmkuhl 1999). Nevertheless, this literature does not attend to whether and, if so, to what extent *compliance with EU law* leads to ambitious domestic policy outcomes. As Mitchell (2008) reminds us, scholars may consider compliance with legal obligations a prerequisite to achieve ambitious policy outcomes, yet they should not confuse compliance and effectiveness (environmental impact). In effect, compliance is neither a necessary nor a sufficient condition for policy effectiveness as unambitious goals may require little policy change.

Research design and hypotheses

Building on these findings, we elucidate to which degree the EU governance system impacts the carbon dioxide (CO_2) trajectory of 14 EU member countries during the first compliance period of the Kyoto Protocol 2008–2012. Subsequently, we explain the variation in this institutional effect, focusing on three core explanatory variables: the non-compliance mechanism of the EU, the planned use of the Kyoto (flexible) mechanisms,[2] and pre-Kyoto national emission reduction goals. In order to assess the effect of these three variables, we control for a wide range of domestic factors proposed in the literature.

Dependent variable

Our central aim is to explain variation in the degree to which the EU governance system has an impact on domestic emissions during the first Kyoto Protocol compliance period as compared to the absence of the EU. To this effect, we adjust a concept originally developed by Helm and Sprinz (2000) to measure the effect of international environmental regimes.

Helm and Sprinz conceive of international treaty effects as the increment in improvement of actual policies (AP) beyond those that would occur in the absence of such treaties, i.e. the no-regime (NR) counterfactual, which serves as the lower bound. To allow for standardized comparisons, they delimited the space for improvements by an upper bound, the so-called 'collective optimum' (CO), which is the counterfactually best policy performance under an ideal treaty or EU regime. The resulting effectiveness score, $E = (AP - NR)/(CO - NR)$, relates the distance travelled by AP-NR to the theoretically possible improvement (CO-NR) on a common dimension of assessment – e.g. emissions reductions (see Figure 1). They computed the degree of effectiveness at the level of each country as well as an aggregate

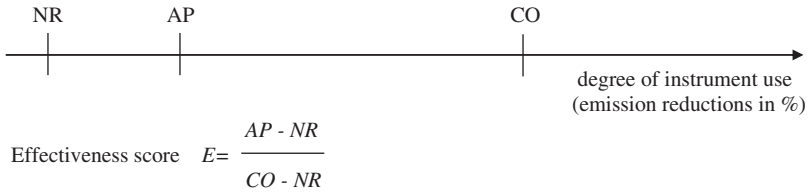

Figure 1. Effectiveness score.

Source: Adapted from Helm & Sprinz (2000, p. 637).

score for all countries. The ensuing debate of the effectiveness measure also resulted in a range of extensions (Young 2001, 2003, Grundig 2006, Rieckermann *et al.* 2006, Bernauer and Siegfried 2008).

In the context of our research, we adapt the effectiveness score to the EU governance system.[3] In contrast to Helm and Sprinz (2000), we introduce two major changes: we allow for negative values *and* positive effectiveness scores, as well as scores beyond |1|. We thereby incorporate two refinements: first, the effect of the EU on each member state and in aggregate does not have to be zero or positive by design. Second, E do not have to fall into the interval of $-1 \leq E \leq +1$. Helm and Sprinz assumed that countries would not lower their policy ambitions even if this was economically efficient, and by scoring some countries as '1*', they pointed to scores exceeding the upper bound of '+ 1'. In our refinement, we retain the central aim of standardized effectiveness scores with the above mentioned enhancements (see Table 1).

Absent consistent *ex post* inputs for the Helm and Sprinz measure, we reconceptualize the effectiveness measurement procedure by drawing on

Table 1. Effectiveness scores in 2010 for 14 EU member states and the EU-14.

Country	Projected Emissions [mt CO_2]	Actual Emissions [mt CO_2]	Adjusted Emissions [mt CO_2]	Optimal Allocation of Emissions [mt CO_2]	Effectiveness score (adjusted emissions)
Austria	54.8	64.2	66.6	48.9	−2.0
Belgium	124.0	99.9	107.9	114.1	1.6
Denmark	54.9	48.7	57.5	46.4	−0.3
Finland	73.6	57.5	60.9	62.9	1.2
France	389.7	343.2	374.8	352.4	0.4
Germany	827.5	757.4	873.2	741.3	−0.5
Greece	109.4	82.7	109.6	91.7	0.0
Ireland	42.8	38.3	45.5	37.5	−0.5
Italy	429.9	379.4	449.2	379.1	−0.4
Netherlands	205.6	174.2	188.7	184.7	0.8
Portugal	66.5	45.6	69.7	59.4	−0.5
Spain	274.1	248.8	255.8	239.7	0.5
Sweden	64.0	46.2	43.4	55.4	2.4
UK	572.3	483.4	486.0	509.2	1.4
EU-14	3289.10	2869.50	3188.80	2922.70	0.29

inputs from *ex ante* simulations of policy measures that the European Commission commissioned and the National Technical University of Athens (NTUA) conducted (European Commission 1999). Wherever empirically possible, we use *ex ante* measurements for consistency (Sprinz et al. 1997).

First, NTUA (European Commission 1999) provides projections for emissions under a business-as-usual scenario from 1990 until 2010, thereby offering *ex ante* (NR) inputs. Second, the Kyoto Protocol obligations for the period 2008–2012 stipulate emission reductions of 8% from 1990 levels for the EU-15 at large. Under an optimal carbon tax regime, NTUA provides country-level emissions projections for the minimum EU-15-wide tax that is needed to comply with the average 8% EU-wide emission reductions during 2008–2012 (CO), with the year 2010 serving as the mid-point.[4] Third, we derive actual carbon emissions (AP) from the European Environment Agency (2012).[5] Unforeseen changes in GDP partially drive the differences between AP and NR – not least because of the monetary, economic, fiscal, and governance crisis of the EU beginning in 2007. According to the European Environment Agency (EEA) (2014b, 16), the EU-15 decreased its GHG emissions by 9.2% during 2008–2012; almost 30–50% of observed emission reductions are attributable to the economic recession.

To correct for differential effects of GDP changes across the EU-15, we adjust the EEA carbon emissions for each member state:

Adjusted CO_2 emissions$_t$ = actual CO_2 emissions$_t$ *($GDP_{t,\ projected}$/ $GDP_{t,\ actual}$)

with the subscript t indicating year.

To accomplish the adjustment of CO_2 emissions as if the NTUA had, in 1999, foreseen the economic turbulence of the second half of the first decade of the 21st century, we multiply actual CO_2 emissions by (GDP projected/GDP actual), i.e. if the actual GDP went below values originally projected, then we will correct the adjusted emissions upward to afford consistency with the (pre-crisis) *ex ante* perspective.[6]

As 1990 serves as the universal point of departure for all computations and in order to avoid level effects, we corrected actual carbon emissions and GDP developments to start at the respective levels foreseen by NTUA for 1990 (European Commission 1999) and employ first differences (yearly % changes) from the original European Environment Agency and Organization for Economic Co-operation and Development sources to compute our yearly, adjusted CO_2 emissions (EEA 2012, OECD 2014). Figure 2 illustrates the effect of the adjustment procedure for the group of all EU-15 countries.

Projected CO_2 emissions (Figure 2, dotted grey line) serve as our NR counterfactual for EU policies (NR), the trajectory of (unadjusted) actual

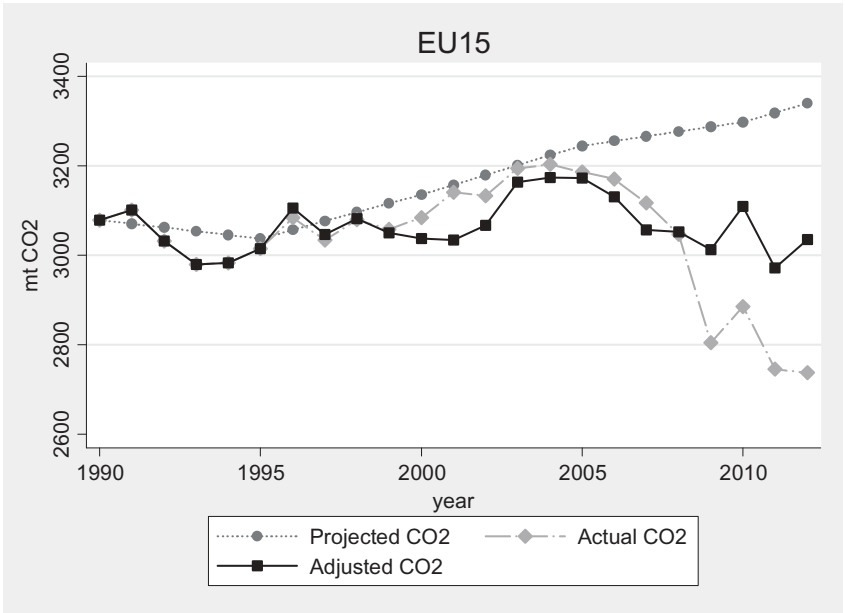

Figure 2. Projected CO_2 emissions, actual CO_2 emissions, and CO_2 emissions adjusted to projected GDP (EU-15).

Source: Authors' estimations. Data from European Commission, (1999), Capros *et al*. (2001), EEA (2012).

emissions (dashed grey line) shows substantially lower emissions since 2000, with particularly large deviations beginning in 2007. Once we adjust the emissions data (solid black line, AP), we arrive at a more modest deviation from the projected NR emissions because we adjust for deviations of actual GDP developments from projected GDP trajectories. The differences between actual and adjusted emissions vary considerably across member states. The EU policy in terms of emission reductions 'held back' (i.e. negative values) some states, such as Austria, Denmark, and Germany, while the EU regime propelled Belgium and Sweden (positive values) to do more than would have been achieved nationally in the absence of the EU policy regime.

In some cases – with Austria the most prominent example – EU climate policy might not only have affected national performance through the 'restrictions' set by EU regulations, but also by the 'opportunities' created at EU level, i.e. alternative policy measures that are more economically efficient. In the case of Austria, the adoption of stringent environmental policy lacked wide societal acceptability since the early 1990s. At the same time, social partners strongly opposed tradable permits. The attitude to Kyoto (flexible) mechanisms changed remarkably after the announcement of EU proposals for the EU trading scheme (Wurzel *et al*. 2003). Austria

officially reported before 2005 its intention to make extensive use of the Kyoto (flexible) mechanisms for achieving national objectives. Austria recorded the largest deviations from the national emission reduction target among the 15 European countries, purchasing international credits representing more than 10% of base-year emissions. We therefore argue that the market-based options that the EU climate regime offered acted as a disincentive to the implementation of regulatory measures and, therefore, negatively affect the national performance of certain countries.[7]

Moreover, the extremely low carbon prices of European Trading Scheme did not mobilize private investments in green technology and low carbon production processes (Brohé and Burniaux 2016).

Independent variables and hypotheses

Building on the literature review in the previous section, we derive our hypotheses. We define EU non-compliance records as infringements cases of EU climate change regulations (detected and active) during the period 2008–2012. For the *non-compliance* records, we identified all legislative measures adopted by the EU – directives, regulations and decisions – with a transposition deadline starting in 2002 (i.e. after the ratification of Kyoto Protocol) until 2012 and reported in the European Commission annual report *Progress towards achieving the Kyoto Objectives* (European Commission 2011a, pp. 11–16).

Based on this catalog of approximately 100 policy measures, we developed a database of the infringement proceedings that the European Commission launches against member countries. This database draws on annual reports of the European Commission on the implementation of EU law and includes all reasoned opinions sent to each member-country for non-communication of national measures as well as for non-conformity and incorrect national application of EU law (European Commission 2009, 2010, 2011b, 2012, 2013). In our analysis, we include the number of open infringement cases during the period 2008–2012 by country and year.

This newly developed non-compliance database encompasses five policy sectors relevant to climate policy (horizontal issues, energy production and consumption, industry and waste, transport, and agricultural development) and cuts across EU Commission Directorates. The infringement cases that the Commission reports constitute the most widely used measure of non-compliance, even though these data do not necessarily include all cases of non-compliance in member states, either because of insufficient information provided by member governments or because of the Commission's political discretion (Börzel and Knoll 2012, pp. 5–11). The Commission monitors the cases of late or non-transposition of EU law, based mainly on national reports and direct communication with national authorities.

However, monitoring of incorrect transposition or improper implementation of EU legislation remains a more challenging task. The Commission's own investigations are not always sufficient to detect all cases of improper implementation of EU legislation at national level. Complaints from EU citizens and organizations, petitions from the European Parliament, and questions from members of European Parliament contribute significantly to monitoring (European Commission 2012). Thus, the number of reported infringement cases indicates the overall member states' non-compliance behavior, but fails to fully capture the national reality in terms of proper implementation of EU law as well as the seriousness of different non-compliance cases.

For the effect of EU non-compliance procedures, we hypothesize that

H1: The higher the number of non-compliance cases with EU climate change legislation (measured as open infringement cases), the lower is the impact of EU policies on member state performance.

To achieve compliance with its emission-reduction goals, the Kyoto Protocol allows signatories to use a range of market-based instruments, the so-called Kyoto (flexible) mechanisms, such as emissions trading, creation of emission bubbles,[8] or joint emission reduction projects. We interpret the embarking on plans for their use, especially in early periods, as the inability or unwillingness to use domestic mitigation measures to achieve domestic emission reduction goals or as a measure to avoid non-compliance.

We use the decisions of member states from 2005 (i.e. well before the 2008 start of the Kyoto Protocol compliance period) to use flexible mechanisms during 2008–2012 (EEA 2005, p. 25, 2006, pp. 30–31, 2007, p. 86). We hypothesize that

H2: The higher the share of emission reductions to be accomplished by the Kyoto (flexible) mechanisms, the lower the impact of the EU climate policies on member states' performance.

In order to capture the effect of domestic policy output and national predispositions, we rely on national, unilateral pre-Kyoto ambitions announced during 1990–1994 (OECD 1994). Even though some EU member states merely announced reduction goals that are not legally binding, these targets declare the political willingness of national governments to reduce emissions and are likely to induce accountability by naming and shaming. We hypothesize that

H3: The more ambitious the unilateral national emission reductions targets adopted prior to the Kyoto Protocol, the lower the impact of the EU climate policy on member states' performance.

Table A1 indicates all of the sources for our variables.

Control variables

The literature suggests a range of variables to include in the assessment of the effect of EU policies. In order to more clearly assess the effect of the three core variables, we introduce the following control variables.

First, scholars argue that neo-corporatist political systems take domestic industry interests and the implementation costs of environmental policy into account at an early stage of decision-making (Crepaz 1995, p. 395, Lenschow *et al.* 2005, pp. 809–810). These systems base policy decisions on negotiations and consensus among domestic actors. Therefore, decisions can be more easily implemented (Jahn 1998, pp. 119–120, Scruggs 1999, p. 30). We base our country ranking on Siaroff's (1999) corporatism scores and the more recent literature (Liefferink *et al.* 2009)[9] (see Table A2). We expect that countries with a neo-corporatist political system have higher environmental effectiveness scores compared with statist systems, as they have the capacity to exploit the new opportunities that the EU policy regime creates and adopt less costly decisions for their own domestic industry. We suggest that higher scores on neo-corporatism lead to higher EU policy effect.

Second, countries with high general governance effectiveness have the capacity to properly implement EU policies domestically and to exploit the new opportunities offered by the EU policy regime as compared to low performers. To this end, we use the World Bank indicator for governance effectiveness, which ranges from −2.5 (weak) to + 2.5 (strong governance performance) (World Bank 2014)[10] (see Table A3). High governance effectiveness could impact EU effectiveness in two directions: governments might be better able to implement EU policies, but high national governance scores also enable successful resistance to EU measures. Given both arguments, theory does not provide us with clear guidance as to which effect will dominate and which sign of the coefficient to expect in our empirical analysis.

Third, the literature that expects countries with high public spending on environmental research and development (R&D), measured as percentage of total public spending, to offer higher incentives for their domestic industry to implement environmental policies and have important competitive advantages in environmental technology (Porter and Linde 1995). High R&D spenders support the development of a strong domestic green industry

which encourages the adoption and implementation of more advanced environmental measures (Scruggs 1999, pp. 18–21, Jacob and Volkery 2006, p. 80). Consequently, we suggest that increases in national environmental R&D expenditures co-vary positively with institutional effectiveness.

Fourth, GHG-intensive sectors may lobby their national governments and the EU to abstain from initiating ambitious emission reduction goals (Jacob and Volkery 2006, p. 86). Since the EU Emissions Trading System has generated very low prices for carbon offsets, it is unclear which directional impact to expect. As energy-intensive industries form an important part of the policies needed for emissions reductions, we control for the projected (business-as-usual) carbon intensity as provided by NTUA (projected CO_2/projected GDP).

Fifth, economic wealth, traditionally measured as GDP, is both a driver of high emissions as well as a harbinger of potential solutions that lead to lower emissions (Grossman and Krueger 1991). We include the projected level of GDP and its rate of projected changes.

Sixth, scholars often see trade openness as a representation of international competitiveness, yet it may also undermine the implementation of strict environmental standards (De Santis 2012, p. 800). In order to capture the effect of trade openness, we control for the sum of exports and imports as a percentage of GDP. We expect countries with high trade openness to receive low EU policy effectiveness scores.

Seventh, the growing size of the renewable energy sector is likely to influence the effect of the EU on its member states. We control for renewable energy supply as the percentage of total primary energy supply. The sign of the coefficient may go both ways as higher proportions of renewables may reinforce the EU's institutional effects or allow for some degree of freedom from it.

We did not include other structural factors, such as population density, geographical size of a country, and climate conditions that increase or decrease the demand for stricter environmental policy, in the empirical analysis, as they are time-invariant variables. Table 2 lists all of the descriptive statistics.

Data analysis and findings

The central aim of our analysis is to assess the effects of three core political variables on the degree to which the EU climate regime impacts national CO_2 emissions during the first Kyoto Protocol period. Diagnostic tests point to the violation of the homoscedasticity assumption and, in some cases, cross-sectional correlation and/or serial correlation. We employ regression with panel-corrected standard errors (Beck and Katz 1995),

Table 2. Descriptive statistics.

Variable	N	Mean	Std. Dev.	Min	Max
effectiveness score	70	.3066666	1.052277	−2.0	2.4
EU non-compliance case	70	5.871429	4.488056	0	16
Kyoto flexible mechanisms	70	1.840659	3.563457	0	13
pre-Kyoto emission reduction goals	70	−1.456044	9.271577	−25	25
neo-corporatism	70	1.142857	.9213367	0	2
governance effectiveness	70	1.446286	.5342018	.29	2.26
public spending on environmental R&D	70	2.255857	1.049259	.05	5.52
projected CO_2 intensity	70	460.3057	173.0495	247.3	954.9
projected GDP per capita	70	21,791	5,996	9,116	31,066
projected GDP growth	70	2.314286	.516478	1.6	3.6
trade openness	70	46.808	20.19228	22.17	96.21
renewable energy supply	70	13.63284	9.945943	2.622	36.92

permitting heteroscedasticity, cross-sectionally correlated panels, as well as autocorrelation (AR) of errors as we explain further below.

We proceed with a modular approach to the inclusion of relevant variables. Model 1 includes the core variables of interest. Model 2 adds other relevant political control variables, whereas model 3 tests the core model in the presence of all control variables. Our diagnostic tests suggest using a common AR1 specification for model 3, while model 4 uses a panel-specific AR 1. All our models use the *ex ante* EU effectiveness score as the dependent variable and projected explanatory variables.

Our core political variables include the EU non-compliance mechanism and two climate policy-specific political variables: the degree of use of Kyoto (flexible) mechanisms and the pre-Kyoto ambitions of member countries (Table 3, Model 1). Our analysis of 14 EU countries for the period 2008–2012 shows that the higher the number of infringement cases with EU climate change legislation, the lower the institutional effect of the EU climate regime. The same holds for the expected use of the Kyoto flexible mechanisms. In addition, the higher the emission reduction goals, the lower the effect of the EU climate regime.

The coefficient estimates of these three core political variables change somewhat once we add additional political control variables. If we include the type of governance system (statist, liberal-pluralist, neo-corporatist), general government effectiveness, and public spending on environmental R&D expenditures, a more nuanced perspective arises. First, the EU non-compliance procedure ceases to have any substantive effect on the dependent variable (Table 3, Model 2). The higher the planned use of the Kyoto flexible mechanisms, the lower is the effect of the EU climate regime. Furthermore, the more ambitious the pre-Kyoto national emission reduction goals were, the lower the EU's institutional effect on member countries. This pattern among the core variables of interest holds in all subsequent specifications.[11]

Table 3. Drivers of Institutional Effectiveness.

Variables	Model 1	Model 2	Model 3	Model 4
EU non-compliance	−0.0949***	0.0173	0.0178	0.00412
cases	(0.0249)	(0.0400)	(0.0302)	(0.0266)
Kyoto (flexible) mechanisms	−0.134***	−0.157***	−0.125***	−0.198***
	(0.00909)	(0.0118)	(0.0160)	(0.0212)
pre-Kyoto emission	−0.0239***	−0.0388***	−0.0530***	−0.0475***
reduction goals	(0.00398)	(0.00496)	(0.00814)	(0.00675)
1.liberal (*vis-à-vis* statist)		0.0599	0.378	0.763**
		(0.152)	(0.437)	(0.388)
2.neo-corporatist (*vis-à-vis*		1.464***	1.787**	3.240***
statist)		(0.230)	(0.710)	(0.667)
government effectiveness		0.447	0.400	−0.777*
		(0.281)	(0.419)	(0.411)
public spending on		0.0821**	−0.00431	−0.0286
environmental R&D		(0.0390)	(0.117)	(0.106)
projected CO_2 intensity			1.801	3.272***
			(1.140)	(0.984)
projected GDP growth			−1.414***	−1.278***
			(0.308)	(0.217)
projected GDP *per capita*			−4.95e-05	−6.21e-05**
			(4.32e-05)	(3.11e-05)
trade openness			−0.0123	−0.0213**
			(0.0119)	(0.0101)
renewable energy supply			−0.00534	−0.0172
			(0.0147)	(0.0154)
Constant	1.836***	−0.229	3.943**	5.646***
	(0.187)	(0.618)	(1.562)	(1.287)
Observations	70	70	70	70
R-squared	0.288	0.541	0.557	0.746
Panels	14	14	14	14

Standard errors in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1

Notes: Regressions coefficients with panel-corrected standard errors. Models 1 & 2: disturbances are heteroskedastic and contemporaneously correlated. Model 3: in addition to Models 1 & 2: AR1. Model 4: in addition to Models 1 & 2: panel-specific AR1.

Neo-corporatist rather than liberal countries enjoy a positive and statistically significant effect if compared to statist political systems. General governance effectiveness is unrelated to the dependent variable, while public spending on environmental R&D enhances the effect the EU climate regime exerts on national emissions.

We add a range of economic control variables to embark on a broader explanation of the effect of the EU climate regime on national performance (Table 3, Model 3). Compared to Model 2, Model 3 adds projected carbon intensity, projected economic growth, projected per capita income, trade openness, and renewable energy supply.[12] This augmented specification maintains the findings from Model 2 for the political variables – except for public spending on environmental R&D, while only projected GDP growth reduces the institutional effect of the EU.

As we are dealing with a period (2008–2012) of monetary, fiscal, economic, and governance crisis for the EU, we probed the results for panel-specific AR1 processes rather than a common AR1 as the crisis did not

equally affect countries (Table 3, Model 4). The results are largely congruent with Model 3, except that some effects are now magnified and some control variables become substantively and statistically more significant. In particular, not only neo-corporatist but also liberal states enhance the effect of the EU climate regime, while projected GDP and its growth rate as well as trade openness both retard such an effect.

In substantive terms, our results show that the EU non-compliance procedure – the only policy instrument under the sole control of the European Commission – does not impact the effect of the EU. A low bivariate correlation score between both variables (−.18) corroborates this result. For example, Austria has a low effectiveness score, yet also a low level of non-compliance, whereas France has above-average levels of both effectiveness and well as non-compliance.

Conclusions

We have pursued two aims. First, we derived a measurement method for the effect of the EU climate regime on the EU-14 members during the first compliance period of the Kyoto Protocol. Second, we explained the variation therein by focusing on three core political variables, namely the EU non-compliance procedure, the use of the Kyoto (flexible) mechanisms, and national pre-Kyoto emission reduction targets. Our findings show that the EU non-compliance mechanism, on average, does not explain the variation in EU effectiveness, thereby rejecting hypothesis 1. By contrast, our analysis reveals that more ambitious positioning on the use of the Kyoto flexible mechanism and higher pre-Kyoto emission reduction targets reduce the EU's effectiveness, hence supporting hypotheses 2 and 3.

Elevated use of flexible mechanisms and early national positioning to reduce emissions allow these countries to escape pressure from the outside. In policy terms, this implies polarization: those countries that are willing to buy emission-reduction services abroad rather than undertake domestic emission reduction policies, as well as those who embark early on ambitious unilateral emission reductions, escape the pressure of the EU climate regime. The EU's non-compliance mechanism appears to be an ineffective policy instrument. We should, however, keep in mind that the reported effect is an average effect across countries and time.

The findings beg the question whether the EU is always a benign force in environmental policy. On average, the positive effectiveness score demonstrates that the EU climate regime has a benign effect across the EU-14, but the EU cannot rely on the policy lever under its sole control: the EU non-compliance mechanism.

Instead, our results demonstrate that countries that are willing to use their wealth and wish to advance their climate policies largely remain

unaffected by supranational institutions. They 'buy' freedom. Conversely, those who do not wish to lead, at least among our sample of countries within the supranational EU setting, are subject to pressures from the EU. Countries remain 'interdependent, yet sovereign' (Putnam 1988, p. 434) as the EU institutions can only exert pressure on those countries that lack the resources to buy GHG certificates abroad and/or are laggards in terms of the depth of their national commitments. As our results are broadly robust across specifications and methods used, the fine point emerges that it may partially be in member states' own hands to define whether and to what extent the EU's climate change policy accelerates or retards their national environmental policy performance.

While the EU is formally a supranational institution with uniform powers vis-a-vis its member states, our results indicate that the EU's institutions systematically affects member countries in unequal ways. Nudging the moderates and laggards to increase their environmental ambitions might work, but pushing ambitious members states might well be beyond the capacity of the EU.

Notes

1. We exclude Luxembourg from the analysis; due to its small size it is an outlier.
2. The Kyoto (or flexible) mechanisms reflect the ability to purchase pollution reductions abroad rather than to generate them at home. Following the standard (environmental) economic theory, flexible mechanisms are cost-effective tools to reach environmental targets, and several EU countries defended their use based on this argument.
3. Given that the UNFCCC-based climate regime forms part of the wider EU climate regime, the measurement of the EU policy's effect on national performance during 2008–2012 empirically incorporates the effect of the global climate regime. Conceptually, separating the effect of the EU from the global (UNFCCC) climate regime is possible, yet necessitates permutations of counterfactual assessments. It is impossible within the confines of *ex ante* calculations (see below) to retroactively undertake these permutations of counterfactuals that should have been undertaken in 1997–2000. Given the EU's leadership role during much of the existence of UNFCCC's climate regime, it would be very unlikely that the effect of the global climate regime exceeds that of the EU climate regime. As the EU did not upgrade its 2020 Kyoto Protocol goals (conditional on equivalent efforts of other countries – which were lacking), positive interaction of the EU and the global climate regime is also unlikely. We henceforth point to the effect of the EU, its measurement, and the explanation of its variation.
4. Optimal allocation of efforts according to the full flexibility scenario (i.e., potential for emission trading across member states, sectors and pollutants). The least-cost optimum scenario assumes that the EU member states achieve the 8% reduction target jointly. See Capros *et al.* (2001, p. 77) for details. For

the collective optimum, we use the 2010 simulations results uniformly for the years 2008 through 2012.

5. Emissions reported by the European Environment Agency (2012) take into account neither carbon sinks from land use, land-use change and forestry (LULUCF), nor the additional use of flexible mechanisms. See EEA (2014a, p. vi).
6. We do allow for the carbon intensities of economies to change from those projected to more credibly adjust for country-level effects during 1990–2010.
7. See also hypothesis 2 below.
8. The Kyoto Protocol contains bubble (joint) commitments for all EU members as well as individual (uniform) commitments. Under the emission 'bubble' scheme, 15 EU member-countries took on an overall target (−8%), with widely varying national obligations under EU climate policies.
9. Corporatism remains a contested variable in the literature. Siaroff (1999) summarizes and compares the corporatist rankings of 23 different analyses, resulting from different definitions of 'corporatism'. He observes limited scholarly disagreement with the classification of Switzerland, Japan, and France featuring as the more controversial cases. For example, scholars consider France, which we also include in our sample, a country with a historic legacy of statism, yet with specific areas of sectoral corporatism. Siaroff uses a 5-point scale; Liefferink *et al.* (2009) (based on Siaroff's ranking) cluster countries into the three conventional categories of neo-corporatism (liberal), pluralism, and statism. We follow the latter approach.
10. The aggregate indicator developed by the World Bank (2014) reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
11. We probed the robustness of our results by excluding the pre-Kyoto reductions variable. The findings with the omitted variable indicated that the EU non-compliance mechanism continues to have no effect, and replicated the inverse relationship between the Kyoto (flexible) mechanisms and the impact the EU's effectiveness (compare Table 3 and Table A4).
12. We derive all 'projected' metrics from business-as-usual computations.

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References

Beck, N. and Katz, J., 1995. What to do (and not to do) with time-series cross-section data. *American Political Science Review*, 89 (3), 634–647. doi:10.2307/2082979

Bernauer, T. and Siegfried, T., 2008. Compliance and performance in international water agreements: the Case of the Naryn/Syr Darya Basin. *Global Governance*, 14 (4), 479–501.

Bomberg, E., 2017. Environmental politics in the Trump era: an early assessment. *Environmental Politics*, 26 (5), 956–963. doi:10.1080/09644016.2017.1332543

Börzel, T., 2000. *Private actors on the rise? The role of non-state actors in compliance with international institutions*. Bonn: Preprints aus der Max-Planck-Projektgruppe Recht der Gemeinschaftsgüter, No. 2000/14.

Börzel, T., 2002. Pace-setting, foot-dragging, and fence-sitting: member state responses of europeanization. *Journal of Common Market Studies*, 40 (2), 193–214. doi:10.1111/1468-5965.00351

Börzel, T. and Knoll, M., 2012. *Quantifying non-compliance in the EU: a database on EU infringement proceedings*. Berlin: Freie Universität Berlin, Working Paper on European Integration No. 15.

Brohé, A. and Burniaux, S., 2016. The impact of the EU ETS on firms' investment decisions: evidence from a survey. *Carbon Management*, 6 (5–6), 221–231. doi:10.1080/17583004.2015.1131384

Capros, P., Kouvaritakis, N., and Mantzos, L., 2001. *Top-down analysis of GHG emission reduction possibilities in the EU*. Athens: NTUA

Crepaz, M., 1995. Explaining national variations of air pollution levels: political institutions and their impact on environmental policy-making. *Environmental Politics*, 4 (3), 391–414. doi:10.1080/09644019508414213

De Santis, R., 2012. Impact of environmental regulations on trade in the main EU countries: conflict or synergy?. *The World Economy*, 35 (7), 799–815. doi:10.1111/twec.2012.35.issue-7

EBRD, 2011. *Special report on climate change: a low carbon transition*. London: EBRD.

EEA, 2005. *Greenhouse gases trends and projections in Europe*. Luxembourg: Office for Official Publications of the European Communities.

EEA, 2006. *Greenhouse gases trends and projections in Europe*. Luxembourg: Office for Official Publications of the European Communities.

EEA, 2007. *Greenhouse gases trends and projections in Europe*. Luxembourg: Office for Official Publications of the European Communities.

EEA, 2012. *GHG viewer*. [Online] Available from: http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer [Accessed 2 October 2014]

EEA, 2014a. *Greenhouse gas inventory 2014*. Copenhagen: European Environment Agency, Technical report No. 09/2014.

EEA, 2014b. *Progress towards 2008–2012 Kyoto targets in Europe*. Copenhagen: European Environment Agency, Technical Report No. 18/2014.

European Commission, 1999. *European Union energy outlook to 2020: the shared analysis project*. Luxembourg: Official Publications of the European Communities.

European Commission. 2007. Mid-term review of the sixth community environment action programme. *Brussels: COM*, (2007), 225.

European Commission. 2009. *26th report on monitoring the application of community law 2008*. Brussels: COM(2009) 675.
European Commission. 2010. *27th report on monitoring the application of EU law 2009*. Brussels: COM(2010) 538.
European Commission, 2011a. *Progress towards achieving the Kyoto objectives*. Brussels: SEC(2011) 1151 final.
European Commission. 2011b. *28th annual report on monitoring the application of EU law 2010*. Brussels: COM(2011) 588.
European Commission. 2012. *29th annual report on monitoring the application of EU law 2011*. Brussels: COM(2012) 714.
European Commission. 2013. 30th annual report on monitoring the application of EU law 2012. Brussels: COM(2013) 726.
Falkner, G., *et al*., 2004. Non-compliance with EU directives in the member. states: opposition through the backdoor? *West European Politics*, 27 (3), 452–473. doi:10.1080/0140238042000228095
Genovese, F., 2014. States' interests at international climate negotiations: new measures of bargaining positions. *Environmental Politics*, 23 (4), 610–631. doi:10.1080/09644016.2014.904068
Grossman, G.M. and Krueger, A.B., 1991. *Environmental impacts of a North American free trade agreement*. Cambridge, MA: National Bureau of Economic Research, Working Paper Series 3914.
Grundig, F., 2006. Patterns of international cooperation and the explanatory power of relative gains: an analysis of cooperation on global climate change, ozone depletion, and international trade. *International Studies Quarterly*, 50 (4), 781–801. doi:10.1111/isqu.2006.50.issue-4
Haverland, M., 2007. Methodology. *In*: P. Graziano and P. Vink, eds. *Europeanization: new research agendas*. New York: Palgrave Macmillan, 59–70.
Helm, C. and Sprinz, D.F., 2000. Measuring the effectiveness of international environmental regimes. *Journal of Conflict Resolution*, 45 (5), 630–652. doi:10.1177/0022002700044005004
Héritier, A., 1996. The accommodation of diversity in European policy-making and its outcomes: regulatory policy as a patchwork. *Journal of European Public Policy*, 3 (2), 149–167. doi:10.1080/13501769608407026
Jacob, K. and Volkery, A., 2006. Modelling capacities for environmental policy-making in global environmental politics. *In*: M. Jänicke and K. Jacob, eds. *Environmental governance in global perspective: new approaches to ecological modernisation*. Berlin: Freie Universität Berlin, 167–209.
Jahn, D., 1998. Environmental performance and policy regimes: explaining variations in 18 OECD countries. *Policy Sciences*, 31 (2), 107–131. doi:10.1023/A:1004385005999
Jänicke, M., 2005. Trend-setters in environmental policy: the character and role of pioneer countries. *European Environment*, 15 (2), 129–142. doi:10.1002/eet.v15:2
Jänicke, M. and Jörgens, H., 2006. New approaches to environmental governance. *In*: M. Jänicke and K. Jacob, eds. *Environmental governance in global perspective. new approaches to ecological modernisation*. Berlin: Freie Universität, 167–209.
Knill, C. and Lehmkuhl, D., 1999. How Europe matters: different mechanisms of europeanization. *European Integration Online Papers*, 3 (7), 1–33.
Knill, C. and Lenschow, A., 2005. Compliance, communication and competition: patterns of EU environmental policy making and their impact on policy convergence. *European Environment*, 15 (2), 114–128. doi:10.1002/(ISSN)1099-0976

Koutalakis, C., 2003. *From the 'mediterranean' to the 'iron curtain syndrome': lessons from the southern enlargement for central eastern European accession countries*. Paper prepared for the ECPR workshop Explaining Environmental Policy in Central Europe, Edinburgh, March 28-April 2.

Lenschow, A., Liefferink, D., and Veenman, S., 2005. When the birds sing: a framework for analysing domestic factors behind policy convergence. *Journal of European Public Policy*, 12 (5), 797–816. doi:10.1080/13501760500161373

Liefferink, D., *et al*., 2009. Leaders and laggards in environmental policy: a quantitative analysis of domestic policy outputs. *Journal of European Public Policy*, 16 (5), 677–700. doi:10.1080/13501760902983283

Liefferink, D. and Andersen, M., 1998. Strategies of the "green" member states in EU environmental policy-making. *Journal of European Public Policy*, 5 (2), 254–270. doi:10.1080/135017698343974

Liefferink, D., Arts, B., Kamstra, J., and Ooijevaar, J., 2009. Leaders and laggards in environmental policy: a quantitative analysis of domestic policy outputs. *Journal Of European Public Policy*, 16 (5), 677-700.

Luterbacher, U. and Sprinz, D.F., eds, forthcoming. *Global climate policy: actors, concepts, and enduring challenges*. Cambridge, MA: MIT Press.

Mitchell, R., 2008. Evaluating the performance of environmental institutions: what to evaluate and how to evaluate it? *In*: O. Young, L. King, and H. Schroeder, eds. *Institutions and environmental change: principal findings, applications, and research frontiers*. Cambridge: MIT Press, 79–114.

OECD, 1994. *Climate change policy initiatives, 1994 update, OECD countries, vol. 1*. Paris: OECD.

OECD, 2014. *GDP annual growth rates in percentage*. [Online] Available from: https://stats.oecd.org/[Assecced 5 December 2014].

OECD, 2015. *Green growth indicators*. [Online] Available from: http://stats.oecd.org/Index.aspx?DataSetCode=GREEN_GROWTH [Accessed 2 April 2015]

Porter, M.E. and Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9 (4), 97–118. doi:10.1257/jep.9.4.97

Pridham, G., 1996. Environmental policies and problems of European legislation in southern europe. *South European Society and Politics*, 1 (1), 47–73. doi:10.1080/13608749608454716

Putnam, R.D., 1988. Diplomacy and domestic politics: the logic of two-level games. *International Organization*, 42 (3), 427–460. doi:10.1017/S0020818300027697

Rieckermann, J., *et al*., 2006. Assessing the performance of international water management at Lake Titicaca. *Aquatic Sciences-Research across Boundaries*, 68 (4), 502–516. doi:10.1007/s00027-006-0863-0

Scruggs, L.A., 1999. Institutions and environmental performance in seventeen western democracies. *British Journal of Political Science*, 29 (1), 1–31. doi:10.1017/S0007123499000010

Siaroff, A., 1999. Corporatism in 24 industrial democracies: meaning and measurement. *European Journal Of Political Research*, 36 (2), 175-205.

Sprinz, D., *et al*., 1997. *International governmental organizations and national participation in environmental regimes: the organizational components of the acidification regime*. Rotterdam: Erasmus University Rotterdam.

UNCTAD, 2014. *Trade indicators - goods and services trade openness indicators, 1980-2013*. [Online] Available from: http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx [Accessed 7 March 2014].

Van Beers, C. and Van Den Bergh, J.C.J.M., 1999. An empirical multi-country analysis of the impact of environmental regulations on foreign trade flows. *Kyklos*, 50 (1), 29–46. doi:10.1111/1467-6435.00002

Vogel, D., 2003. The hare and the tortoise revisited: the new politics of consumer and environmental regulation in europe. *British Journal of Political Science*, 33 (4), 557–580. doi:10.1017/S0007123403000255

World Bank. 2014.*Worldwide governance indicators: governance effectiveness*. [Online] Available from: http://info.worldbank.org/governance/wgi/index.aspx#reports [Accessed 7 March 2014].

Wurzel, K.W., *et al*., 2003. Struggling to Leave Behind a Highly Regulatory Past? 'New' Environmental Policy Instruments in Austria. *Environmental Politics*, 12 (1), 51–72. doi:10.1080/714000663

Wurzel, R. and Connelly, J., 2011. The European Union's leadership role in international climate change politics reassessed. *In*: R. Wurzel and J. Connelly, eds. *The European Union as a leader in international climate.change politics*. London: Routledge, 271–290.

Young, O.R., 2001. Inferences and indices: evaluating the effectiveness of international environmental regimes. *Global Environmental Politics*, 1 (1), 99–121. doi:10.1162/152638001570651

Young, O.R., 2003. Determining regime effectiveness: a commentary on the Oslo-Potsdam solution. *Global Environmental Politics*, 3 (3), 97–104. doi:10.1162/152638003322469295

Appendix

Table A1: Data measurement & Sources

Variable	Measurement	Sources
effectiveness score	effectiveness score (own computations)	European Commission 1999, Capros *et al*. 2001, EEA 2012
EU non-compliance cases	number of infringement cases	European Commission 2009, 2010, 2011b, 2012, 2013
Kyoto (flexible) mechanisms	ambitious, moderate or no intention to use the Kyoto mechanisms based on the national plans released before 2005	EEA 2005, EEA 2006, EEA 2007
pre-Kyoto emission reduction goals	ambitious, moderate or no unilateral national targets adopted prior to Kyoto Protocol (1997)	OECD 1994
neo-corporatism	neo-corporatist, liberal or statist	Siaroff 1999, Liefferink *et al*. 2009
governance effectiveness	range from -2.5 (weak) to 2.5 (strong) governance performance	World Bank 2014
public spending on environmental R&D	% of total public spending	OECD 2015
projected CO_2 intensity	projected CO_2 *per* projected GDP (t CO_2/ million euro)	Capros *et al*. 2001
projected GDP growth	% annual change	Capros *et al*. 2001
projected GDP *per capita*	hundreds euro *per capita*	Capros *et al*. 2001
trade openness	sum of exports and imports as a percentage of GDP	UNCTAD 2014
renewable energy supply	renewable energy supply as % of total primary energy sources	OECD 2015

Table A2: Neo-corporatism, liberalism, statism - Country rankings

Country	Type of Governance System
Austria	Neo-corporatist
Belgium	Neo-corporatist
Denmark	Neo-corporatist
Finland	Neo-corporatist
France	Statist
Germany	Neo-corporatist
Greece	Statist
Ireland	Liberal-pluralist
Italy	Statist
Netherlands	Neo-corporatist
Portugal	Statist
Spain	Statist
Sweden	Neo-corporatist
UK	Liberal-pluralist

Source: Liefferink et al. (2009)

Table A3: Governance effectiveness – Country ranking

Country	2008	2009	2010	2011	2012
Austria	1.77	1.67	1.84	1.61	1.56
Belgium	1.38	1.59	1.58	1.66	1.59
Denmark	2.24	2.23	2.09	2.11	1.97
Finland	2.04	2.24	2.25	2.26	2.21
France	1.58	1.49	1.45	1.37	1.33
Germany	1.52	1.59	1.57	1.55	1.57
Greece	0.59	0.61	0.55	0.50	0.31
Ireland	1.49	1.34	1.34	1.45	1.53
Italy	0.29	0.42	0.45	0.38	0.41
Netherlands	1.69	1.74	1.73	1.79	1.80
Portugal	1.08	1.16	1.02	0.96	1.03
Spain	0.92	0.93	0.99	1.03	1.11
Sweden	1.94	2.05	2.01	1.97	1.94
UK	1.64	1.50	1.56	1.55	1.53

Source: World Bank (2014)

Table A4: Drivers of Institutional Effectiveness (pre-Kyoto Emission Reductions Goals omitted)

Variables	Model 1	Model 2	Model 3	Model 4
EU non-compliance	-0.0210	-0.00735	0.0120	0.0100
cases	(0.0202)	(0.0335)	(0.0201)	(0.0169)
Kyoto (flexible) mechanisms	-0.0981***	-0.0978***	-0.171***	-0.178***
	(0.00664)	(0.00733)	(0.0225)	(0.0349)
1.liberal (vis-à-vis statist)		-0.735***	-0.591*	-0.774
		(0.244)	(0.355)	(0.564)
2.neo-corporatist (vis-à-vis		-0.442*	-0.290	-0.227
statist)		(0.253)	(0.398)	(0.503)
government effectiveness		0.416***	1.091***	1.424**
		(0.101)	(0.404)	(0.586)
public spending on		-0.189***	-0.0184	0.0170
environmental R&D		(0.0452)	(0.0813)	(0.0927)
projected CO_2 intensity			-0.00205	0.00133
			(0.00483)	(0.00717)
projected GDP growth			-0.0669***	-0.0621***
			(0.0183)	(0.0174)
projected GDP *per capita*			-0.000122***	-0.000176***
			(3.61e-05)	(4.11e-05)
trade openness			0.0405***	0.0534***
			(0.00645)	(0.00769)
renewable energy supply			0.0238*	0.0120
			(0.0123)	(0.0192)
Constant	1.983***	2.052***	2.301**	2.226*
	(0.143)	(0.336)	-1,144	-1,248
Observations	70	70	70	70
R-squared	0.153	0.217	0.386	0.768
Panels	14	14	14	14

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Notes: Regressions coefficients with panel-corrected standard errors. Models 1 & 2: disturbances are heteroskedastic and contemporaneously correlated. Model 3: in addition to Models 1 & 2: AR1.Model 4: in addition to Models 1 & 2: panel-specific AR1.