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**Institutions and the Environment:
Existing Evidence and Future
Directions**

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Summary

In this review we synthesize the existing contributions that use econometric approaches to examine the influence of institutions and governance on environmental policy, environmental outcomes, and investments. The paper describes how the relationship between institutions and various response variables related to environmental performance and environmental policy have been conceptualized and operationalized in the literature, and it summarizes the main findings. The second part of the paper outlines avenues for future research in the specific context of energy and climate change. We identify various opportunities for empirical work that have recently emerged with the growing availability of data in the field of green investments, climate, and energy policy. Expanding the current empirical literature towards these research topics is of scientific and policy relevance, and can provide important insights on the broader field of sustainability transition and sustainable development.

Keywords: Institutions, Environmental Performance, Environmental Policy, Investments

JEL Classification: O10, Q5, Q00, P16

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Institutions and the Environment: Existing Evidence and Future Directions

Shouro Dasgupta*, Enrica De Cian*

Abstract

In this review we synthesize the existing contributions using econometric approaches to examine the influence of institutions and governance on environmental policy, environmental outcomes, and investments. The paper describes how the relationship between institutions and various response variables related to environmental performance and environmental policy have been conceptualized and operationalized in the literature and summarizes the main findings. The second part of the paper outlines avenues for future research in the specific context of climate change and energy. We identify various opportunities for empirical work that have recently emerged with the growing availability of data in the fields of green investments, climate, and energy policy. Expanding the current empirical literature towards these research topics is of scientific and policy relevance and can provide important insights into the broader field of sustainability transition and sustainable development.

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1. Introduction

The transition toward a low-carbon and sustainable economy will require a fundamental transformation of energy, economic, and social systems. Designing targeted economic and environmental policies will play a crucial role in steering and fostering the transition but will need to be combined with a more general improvement of institutions to ensure that policies are implemented and monitored effectively (Dasgupta, De Cian, and Verdolini 2016). Environmental interventions are essentially economic policies ultimately implemented by bureaucrats in a broader institutional setting (Lockwood 2013). Therefore, the ability of environmental policies to achieve their objectives depends on the political process leading to policy adoption as well as on the nature of the underlying institutions, dominant ideas and cultural discourses, the industrial structure, and the distribution of resources and power (Jacobsson and Lauber 2006; Meyer 2003; Hughes and Lipsy 2013).

While the role of governance and institutions has been generally overlooked by the scenario analysis approach to sustainability transition using quantitative system models (van Vuuren and Kock 2012), other disciplines such as socio-technical transition studies do highlight the importance of these contextual factors (Turnheim et al. 2015). The methods used by these approaches are usually qualitative in nature and often limited to specific case studies, which makes up-scaling or generalization difficult. Empirical studies within the applied economic literature on institutions and environment fall in-between these two approaches. They examine the relationship between institutions, or more broadly political economy factors and indicators of policy adoption, policy effectiveness, and environmental outcomes quantitatively. They rely on observed cross-sectional time series, or longitudinal data, and in some cases on natural experiments. Reduced-form equations building on hypotheses grounded in theoretical frameworks are generally utilized to formalize simple models testing a causal relationship between quantifiable variables. The degree of aggregation varies from

studies focusing on country aggregates to more micro approaches analyzing the behaviors of consumers, households, and firms.

In this review we synthesize the existing contributions from the applied economic literature using econometric approaches to examine the influence of institutions and governance on environmental policy, environmental outcomes, and investments at the national level. We describe how the relationship between institutions and various response variables influencing environmental performance or environmental policy have been conceptualized and operationalized and summarize the main findings.

Review papers usually face a trade-off between inclusiveness and degree of detail. In this paper we review 55 papers dealing with the impact of institutions and governance on a range of environmental performance and policy adoption indicators. We classify the main indicators of institutional quality, environmental performance, and policy that have been used and summarize the main hypotheses that have been tested. We conclude by outlining avenues for future research in the specific context of climate change and energy and describe opportunities for future work. We find that 39 out of the 55 reviewed papers have evaluated the impact of institutions and governance on environmental performance indicators such as emissions (methane, carbon dioxide, sulphur dioxide, and nitrogen dioxide), other pollutants (carbon monoxide, chlorofluorocarbon, and lead), deforestation, land degradation, and protected areas, while only 5 of these 39 studies have examined the impact of institutions and governance on green investments. Of the reviewed papers, 16 have investigated the impact of institutions and governance on policy adoption, half of which use policy stringency as the dependent variable. The remaining papers focused on the decisions to participate into international or multilateral environmental agreements.

Our review points out three main findings; first, democratic countries and open societies are more likely to provide public goods such as environmental protection, and civil and political

rights are rather influential in ensuring environmental quality, especially in comparison to authoritarian regimes. More democratic countries are generally associated with greater participation into international environmental agreements and with better environmental performance. Second, good governance encourages the adoption of environmental policies and generally leads to better environmental outcomes. Finally, corruption can be a channel for environmental degradation, as it could lead to a sub-optimal use of resources and inefficiencies.

We also highlight that, although the empirical literature on this topic is quite broad, it has mostly focused on physical performance indicators (e.g. emissions or different kinds of pollutants) or on policy adoption choices that have become dated (e.g. signing and ratification of the Kyoto Protocol). We conclude that the field of research to analyze the impact of institutions on green investments or policy stringency in a more systematic manner is ripe for investigation and review the few papers that have started approaching this topic.

The remainder of paper is structured as follows; Section 2 provides definitions and concepts of institutions and governance, Section 3 presents the review of the existing literature organized in three sections looking into the impacts of institutions and governance on environmental performance (3.1), environmental policy (3.2), and investments (3.3), Section 4 discusses research gaps and priorities with a focus on the political economy of green transition, while Section 5 concludes.

2. Definitions and Concepts

The concept of institutions has been used in different contexts but often with different definitions, making it difficult to provide an unequivocal definition. For example, sociology refers to institutions as a broader set of a) regulatory, b) cultural-cognitive, and c) normative rules (Scott 1995). According to this perspective, institutional change refers not only to the

direct effect of policies and formal prescriptions (institutions type a) but also to changes in how we see and understand the world, how our mindset influences our decision (institutions type b), as well as changes in our normative aspirations, and what we consider 'good' (institutions type c).

Socio-technical transition studies also use a broad notion of governance and institutions (Turnheim et al. 2015) as describing the key processes of steering and decision-making. This discipline gives emphasis to the role of different actors beyond the national and state governments, including actors, organizations, structures, networks and relationships that contribute to decision-making and influencing societal processes. It highlights the difference between institutions as referring to the actions of the state or the government and governance (e.g. the role of non-state actors, such as businesses and nongovernmental organizations in the process of societal steering).

In this review we adopt an economic perspective and refer to formal institutions (Acemoglu et al. 2005) as the rules of 'how markets operate'. They can be further grouped into legal, political, and economic institutions. Legal institutions take the form of legislature, public or state-devised legal institutions, and private legal institutions. In economics, political institutions are defined as the institutions shaping policy decisions by constraining the set of feasible choices of the decision-makers. They determine the process of creating and enforcing laws and of governmental policy making. Economic institutions also have overlapping characteristics with political institutions and their functions are often difficult to disentangle (Acemoglu et al. 2005). In the political economy literature, political institutions often determine the scope of economic institutions. Economic institutions must perform functions such as establishing and protecting property rights, facilitating transactions, permitting economic co-operation, and organization (Acemoglu and Robinson 2010). A related and to some extent overlapping concept is that of governance, which can be broadly defined as the

traditions and institutions that determine how authority is exercised in a country (Kaufmann et al. 2000). The World Bank defines governance as the power exercised through a country's institutions. In other words, governance is a political concept that includes measures involving setting the rules for the exercise of power and settling of conflicts over these rules. Normative and cognitive institutions as defined by Scott (2005) are difficult to measure and most of the existing environmental economic literature has focused on regulatory institutions or formal institutions (Joskow 2008 and Kunčič 2014). Table A1 summarizes the indicators of institutional quality classified into the groups of economic, legal, and political institutions that have been most frequently used by the economic literature.

3. Institutions and the environment

The theoretical argument for government activity in the context of the environment is provided by the public-good nature of environmental protection. Private agents systematically fail to take into account the full costs of pollution due to the associated externalities, creating the scope for government intervention (Stavins 2004). Relevant questions include the degree of government intervention and how different forms of government (political institutions) and electoral arrangements affect environmental regulations and ultimately environmental performance. The following three sections review the literature examining the relationship between institutions, environmental outcomes (3.1), environmental policy adoption (3.2), and environment-related investments.

3.1. Institutions, Governance and Environmental Performances

A number of papers have investigated whether a statistical relationship exists between various institutional quality indicators and environmental performance. Table A2 summarizes the most common environmental performance indicators¹ used in the literature as dependent

¹ The terms environmental performance and environmental quality are used interchangeably in the literature.

variables. They refer either to pollutants, such as carbon monoxide, chlorofluorocarbon (CFC), methane, carbon dioxide, sulfur dioxide, nitrogen dioxide, and lead content of gasoline, or to activities related to environmental degradation (deforestation). The most commonly used institutional indicators are democracy from Polity IV and Freedom House databases, voice and accountability from the World Governance Indicators (WGI), and corruption perception index from Transparency International (TI). Some papers have also used rule of law from WGI and indicators related to the strength of civil society. Indicators such as lobbying, veto power, and composition of parliamentary systems have also been used. The main hypothesis being tested using the aforementioned indicators is whether democracy, transparency, and free flow of information allow the electorate to exert policy pressure on the government (Barrett and Graddy 2000 and Midlarsky 1998) and facilitate or constraint the ability of governments to implement such measures. Another hypothesis is whether democratic countries and open societies are more likely to provide public goods such as environmental protection (Hughes and Lipsy 2013). In this context, Dasgupta and Mäler (1995) suggest that civil and political rights are rather influential in ensuring environmental quality, especially in comparison to authoritarian regimes.

3.1.1 Democracy and Environmental Performance

The most common indicators of institutions and governance used by this subset of literature are the polity scores and democracy variable from the Polity (III and IV) database, the Freedom House Index, and the rule of law indicator from WGI. Deacon (1999) finds that democracies are more likely to ensure positive environmental performance, arguing that non-democratic regimes or autocracies are less likely to provide such public goods since resources are concentrated in the hands of a small group, as a result, the burden of public good costs fall mostly on those controlling these resources. This finding is further supported by a number of papers including, Deacon (2003); Bueno de Mesquita et al. (2003); and Bernauer and Koubi

(2009). Fredriksson et al. (2005) also conclude that both democratic competition and democratic participation reduces lead content in gasoline while Li and Reuveny (2006) find that higher levels of democracy (Polity IV) reduces emissions of CO₂ and NO_x along with organic pollution in water, deforestation rates, and land degradation.

Torras and Boyce (1998) report that political and civil rights as measurement of democracy in low-income countries have a positive effect in reducing smoke, heavy particles, and dissolved oxygen and Etsy and Porter (2005) conclude that civil and political liberties help reduce urban particulates and SO₂. Similarly, Binder and Neumayer (2005) find evidence of greater democracy resulting in lower pollutant levels with respect to sulfur dioxide, smoke, and heavy particulates, while Neumayer (2002), using data from 150 countries concludes that higher democratic quality may result in a greater share of land area being protected. Barrett and Graddy (2000) also find that greater political freedom leads to better air and water quality, while comparing democracies and autocracies Ward (2008) concludes that stable autocracies perform worse on sustainability measures than stable democracies.

However, a number of papers have found negative influence of democracy on environmental performance. Midlarsky (1998) finds negative effects of democracies on CO₂, deforestation, and soil erosion while Shandra (2007) finds that democracy has no significant effect in reducing deforestation. Similarly, Ehrhardt-Martinez et al. (2002) report that weak democracies are unable to reduce deforestation. Carlsson and Lundstrom (2003) conclude that political freedom has no effect on reducing levels of emission of carbon dioxide while Jorgenson (2006) state the same for CH₄ emissions. Deacon (1999) also shows a negative effect of democracy (Polity III) on lead levels. While Scruggs and Rivera (2008), using cross-section OLS find no evidence that countries with long-established democracies have better environmental performance. Statistical and socio-political arguments have been used to explain the differences in results. Statistical arguments include different sample sizes and

different indicators used across the literature. Regarding the issue of sample size, the environmental data gap between developed and developing countries resulting in selection bias may have also affected the estimations, while different methodologies have also played their part. In order to include as many countries as possible authors have often resorted to using cross-sectional regressions, which only provide a snapshot of situations in a specific point in time and are more likely to be affected by endogeneity and omitted variable issues. In general, the use of simple OLS type regressions might lead to results that are not as robust. A socio-political argument explaining the lack of evidence of a relationship between democracy and environmental performance has been put forward by Olson (1982), stating that as democracies become more mature, the growing number of interest groups is less likely to act and cooperate in common interest since the gains from the collective good environmental protection decreases. Congleton (1992) also argue that democracies often have shorter policy span due to political uncertainty hence cannot undertake the long-run reforms required for climate change.

3.1.2 Governance and Environmental Performance

Unlike the indicators of political institutions such as democracy and corruption, rule of law has a rather clear-cut prediction implication - stronger governance usually leads to better environmental policy adoption measures and outcomes. Castiglione et al. (2013) show that stronger rule of law results in a reduction of pollution, while Castiglione et al. (2012) find negative relationship between rule of law and pollution, demonstrating that when rule of law is strong, the turning point of the Environmental Kuznet Curve (EKC) occurs at a lower level of income per capita, thus, decreasing emissions. Culas (2007) conclude that enforceability of contract by governments reduces rate of deforestation, while Bhattarai and Hammig (2001) find that political rights and civil liberty results in a reduction of the annual deforestation rate of forest and woodlands.

However, a selection of papers have found no significant effect or even an opposite relationship. However, these results seem to vary depending on the indicator for environmental performance, e.g. Murdoch et al. (1997) find that civil liberties and political freedom has positive impact on sulfur cutbacks but less so for NO_x in Europe.

3.1.3 Corruption and Environmental Performance

Corruption can be a channel for environmental degradation as it could lead to a sub-optimal use of resources and inefficiencies. When officials are more susceptible to being bribed, they are more likely to allow activities that are damaging to the environment. Welsch (2004) studies the impact of corruption on pollution and finds that corruption has both direct and indirect impact on pollution, where direct impact refers to the effect of corruption on pollution via less stringent environmental laws and indirect effect refers to the effect of corruption on per capita income and the resultant impact on pollution. The author concludes that corruption increases the levels of pollution regarding NO₂, CO₂, total suspended particulate concentration, total suspended particulate concentration, phosphorus concentration, and suspended solids. Similarly, Cole (2007) finds that corruption increases per capita emissions of sulphur dioxide and carbon dioxide while the indirect impact also increased in higher income countries.

A number of other papers have found evidence of corruption adversely affecting biodiversity and negatively affecting sustainability (Lopez and Mitra 2000; Meyer et al. 2003; Damania et al. 2004; Wright et al. 2007; and Koyuncu and Yilmaz 2009)². However, a common criticism of these papers is the use of aggregate measure of sustainability such as the Ecological Sustainability Index (ESI).

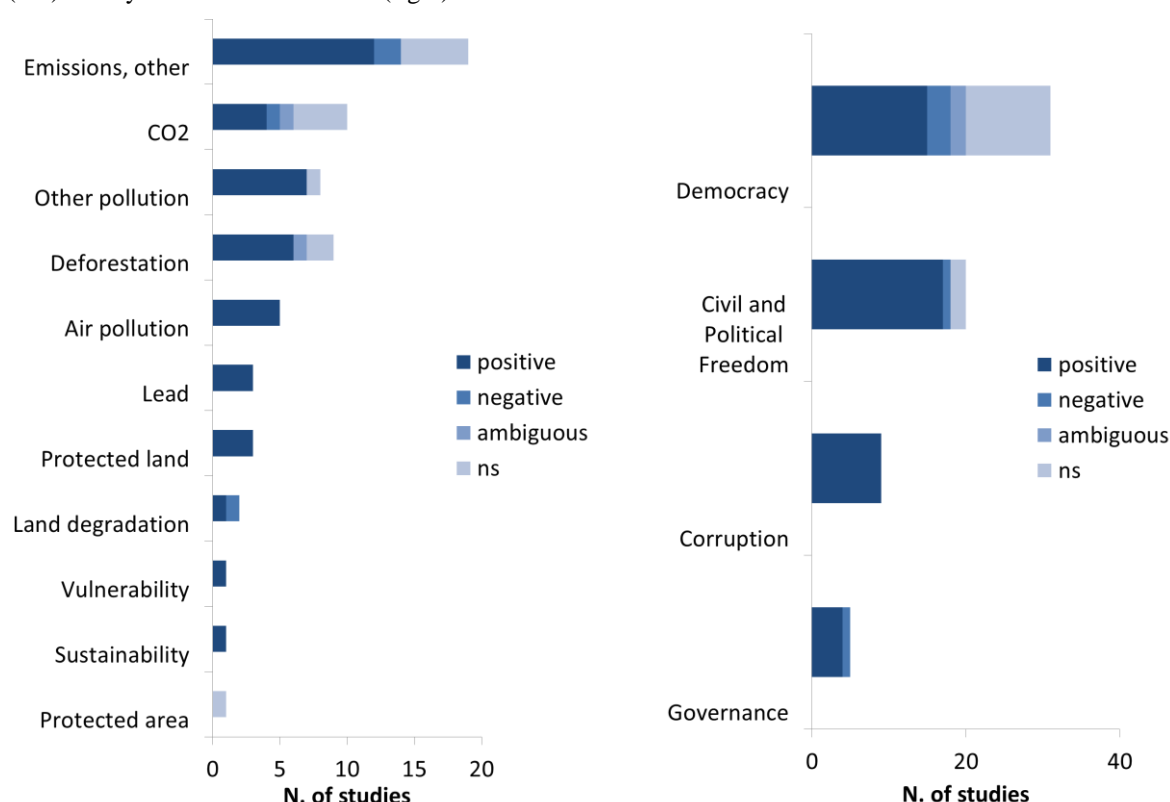
As summarized in Table 2A, papers considering multiple performance indicators such as Torres and Boyce (1998), Welsh (2004), Li and Revuveny (2006), and Scruggs and Rivera

² For a detailed review on natural resources and corruption, see Kolstad and Søreide (2009).

(2008), generally find robust results across indicators. The only studies finding variation across indicators are Murdhoch et al. (1997) and Milarsky (1998).

Figure 1 summarizes the main findings from this branch of literature (also listed in Table 2A) by performance indicators and institutional variables. The studies that find a prevailing positive effect are those on air pollution and other emissions, which include mostly SO₂, NO₂, and CH₄, while the evidence on CO₂ emissions is mixed. The right panel of Figure 1 shows that whereas democracy tends to have an ambiguous effect, civil and political freedom, and governance tend to have a positive impact.

Figure 1: Institutions, Governance, and Environmental Performances - Main findings by performance indicator (left) and by institutional variables (right).



Note: Positive values refer to a positive relationship between institutional quality (e.g. more democratic countries, less corrupted countries, more civil and political freedom, better governance improve environmental performance) and the performance indicator. Negative values refer to a negative relationship. Ambiguous values are studies finding evidence for both. NS refer to a not-statistically significant relationship.

3.2 Institutions, Governance, and Environmental Policy

In this section we examine the literature on the impact of different institutional settings on governments' decisions to adopt environmental policies. We focus on the literature investigating the impact of institutions and governance on environmental policy adoption and implementation (see Table 3A). This body of the literature is less extensive than the one on institutions and environmental performance. The most commonly used indicators of political institutions are democracy (Polity IV and Freedom House), corruption (TI), composition of parliaments and government, economic institutions, and various governance indicators from WGI.

3.2.1 Democracy and Environmental Policy

Neumayer (2003) concludes that democracies exhibit stronger international environmental commitment than non-democracies while political freedom seems to have a positive impact on environmental policy but economic freedom has no effect. Similarly, Damania et al. (2003) show that civil freedom has an insignificant effect on compliance with international environmental agreements. Murdoch et al. (2003) use a two-stage game and spatial probit analysis to find that democracy can be a barrier to collective action on international environmental treaties. Fredriksson and Ujhely (2005) conclude that greater number of government units reduces the positive impact of environmental agreements and that greater environmental lobby group strength raises the probability of ratification. Fredriksson et al. (2005) find that greater political competition and number of environmental groups raises the stringency of environmental policies but democratic participation affects environmental policy stringency only in countries with sufficiently high degree of political competition. These papers use environmental lobbying, democratic participation, and political competition as the major independent variables. Battig and Bernauer (2009) use a panel regression approach and show that the effect of democracy on levels of political commitment to climate

change mitigation is positive but the effect on policy outcomes, measured in terms of emission levels and trends, is ambiguous (see previous section). In one of the earliest papers on this topic, Congleton (1992) concludes that authoritarian regimes enact less stringent environmental standards than democratic regimes, liberal democracies are more willing to regulate environmental pollution and that international agreements on environmental matters attract more signatories as the number of democratic regimes increases.

3.2.2 Governance and Environmental Policy

Fredriksson et al. (2007) find that increased environmental lobby group activity raises the probability of Kyoto Protocol ratification and that this effect increases with levels of corruption. Fankhauser et al. (2014), using negative binomial and logit models report no significant impact of political orientation on the number of climate laws passed. The authors also find that propensity to legislate is heavily influenced by the passage of similar laws in other countries, indicating towards the potential role of peer pressure and/or learning effects. Very few papers have attempted to investigate the impact of factors such as lobbying and veto power on environmental policy. This remains one of the important gaps in the literature. Roberts et al. (2004) find that freedom of expression and citizens' ability to participate in selecting their government, and pressure from NGOs are the most important factors in determining a country's propensity to sign environmental treaties, while Fredriksson et al. (2004), using stratified hazard models find similar results. Fredriksson and Millimet (2004), using propensity score matching find that countries with propositional systems tend to have stricter environmental policies and Fredriksson et al. (2005) show that environmental lobby groups tend to increase the stringency of environmental policy. Moreover, the authors conclude that political competition tends to raise policy stringency, in particular where citizens' participation in the democratic process is widespread.

3.2.3 Corruption and Environmental Policy

Using the Corruption Perception Index (CPI) to investigate the impact of corruption on environmental policy, Fredriksson et al. (2004) state that corruption increases energy waste by reducing the stringency of energy regulations and that lobbying is less successful in the larger sectors. Murdoch et al. (2003) also suggested that lobbying by environmental groups is an influencing factor for the ratification of Kyoto Protocol. This particular notion has been empirically tested in recent papers that show that the strength of the environmental lobby and the level of corruption in that country are drivers of ratification of Kyoto (Fredriksson et al. 2007 and Fredriksson and Ujhelyi 2005)³.

Damania (2002) state that environmental regulations are imposed and monitored by bureaucrats who may be corrupted and act on their personal interest. While Fredriksson et al. (2004) investigate the impact of corruption⁴ on energy policy and find that higher degree of corruption among the bureaucrats result in less stringent policies and increased coordination costs for special interest groups means more stringent policies and capital owners and workers have opposite lobbying interests on energy policy. Fredriksson and Svensson (2003) and Damania et al. (2003) show that higher corruption reduces environmental regulations stringency, which is reflected in lower improvements in energy intensity but this effect declines as political stability increases. Fredriksson and Svensson (2003) also provide evidence of the adverse effects of corruption on the effectiveness of environmental regulations using cross-country data. Furthermore, Pellegrini and Gerlagh (2011) find that an increase in the CPI results in a reduction in the environmental protection index, while Ivanova (2011) concludes that though countries with more effective environmental regulations may have higher reported levels of emissions but their actual pollution levels are likely to be lower than in nations with less effective regulation. As mentioned in section

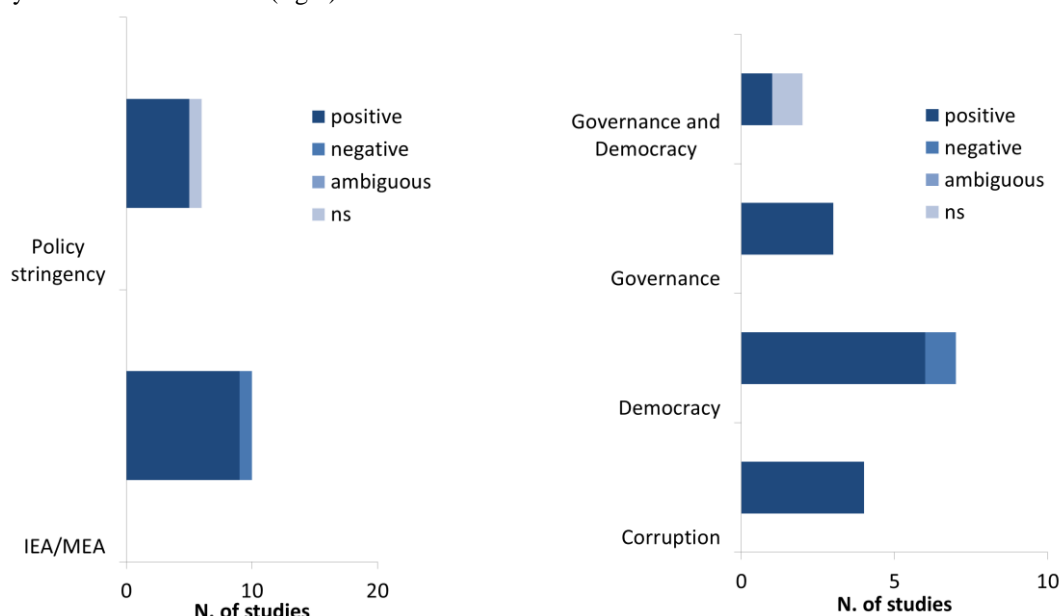
³ Corruption Perception Index, Transparency International and World Bank WGI

⁴ Corruption Perception Index, Transparency International

3.2.2, only a few papers have attempted to investigate the impact of factors such as lobbying and veto power on environmental policy.

Figure 2 summarizes the main findings from this branch of literature (also listed in Table 3A) from papers investigating the relationship between institutions and environmental policy adoption or implementation. The agreement among the reviewed papers is almost unequivocal, with only 2 out of 16 studies finding a negative or an insignificant relationship. Most studies in this branch of literature have used cross-section methods but the more recent papers have used panel data analysis.

Figure 2: Institutions, Governance, and Environmental Policy - Main findings by performance indicator (left) and by institutional variables (right).



Note: Positive values refer to a positive relationship between institutional quality (e.g. more democratic countries, less corrupted countries, more civil and political freedom, better governance improve environmental performance) and the environmental policy indicator. Negative values refer to a negative relationship. Ambiguous values are studies finding evidence for both. NS refer to a not-statistically significant relationship.

3.3 Institutions, Governance, Investments, and Innovation

The papers reviewed in Sections 3.1 and 3.2 have mostly used physical indicators such as different types of pollutants or indicators of pollution intensity as indicators of environmental performance. Since investments and innovation, even though not necessarily directly related to energy and the environment, are also important topics in the literature on sustainability

transition, we review the papers that investigate the relationship between institutions, investments, and innovation within and outside the energy and environment domain.

3.3.1 Institutions, Governance, and Investments

There is a rather broad literature on the influence of institutions and governance on investments, especially on Foreign Direct Investments (FDI). Brunetti et al. (1997) conclude that political instability increases uncertainty, which makes a country less attractive to foreign investors while Busse and Hefeker (2007) find that government stability, democratic rights, and law and order have a significantly positive influence on FDI inflows. Jensen (2003, 2006, and 2007) and Feng (2001) also find that democracy reduces political risks in countries and encourages FDI inflows.

The dominant view in the literature is that good governance and low levels of corruption is expected to promote investments and attract FDI and that a malfunctioning government increases both costs and investment risk. These findings have been empirically supported by several studies (Globerman and Shapiro 2003; Biglaiser and DeRouen 2006; Gani 2007; and Staats and Biglaiser 2012). However, a number of papers have provided contrary evidence that corruption often attracts FDI. According to Bellos and Subasat (2012), this is the result of the prevailing effect of “grease the wheels” mechanism, which argues that corruption can compensate for poor governance and speed up inefficient bureaucratic processes in order to attract FDI (Bardhan 1997; Kaufmann and Weim 1999; Meon and Sekkat 2005; Mironovm 2005; and Bellos and Subasat 2011).

In the context of green investments, Gennaioli and Tavoni (2011) study the link between public support schemes for renewable energy and corruption and find that the number of green energy projects increased in Italian provinces with corruption. Specifically, an increase in criminal activity results in an increase in the number of green projects. The authors state that inefficient institutions usually foster corruption. Bellos and Subasat (2012) also use the

term “sand the wheels” in the cases where corruption acts as a deterrent to FDI. A number of papers find a negative relationship between corruption and investment in support of this view (Mauro 1995; Mauro 1998; Beata and Wei 2000; and Habib and Zurawicki 2002).

However, the literature on the impact of these factors as determinants of environmental investment and investments on clean energy is rather limited. Iyer et al. (2015), in an Integrated Assessment Model (IAM) framework, find that investment risks are higher in regions with inferior institutions. The authors suggest that institutional reforms leading to lower investment risks could be an important element of cost-effective climate mitigation strategies. Verdolini and Vona (2015) conclude that reduced entry barriers, measured using OECD’s indicators of market regulation (rent on market entry, privatization, and unbundling), results in an increase in investment on renewable energy. However, the authors find no evidence of institutional quality influencing investments in renewable energy. Masini and Menichetti (2013) examine the impacts of non-financial factors in Renewable Energy (RE) investments, including behavioral (priori belief, propensity for radical technologies, investors’ knowledge of the RE operational context) and institutional factors (institutional pressure from peers, consultants, and published sources of information). The authors find that the behavioral context plays an important role at shaping the incentive to invest in RE and the beliefs about technical feasibility and proven performance seem to be particularly important.

3.3.2 Institutions, Governance, and Innovation

The literature on the impact of institutions and governance on innovation spans several decades but includes very few empirical studies. In one of the early studies, Freeman (1987) concludes that quality of institutions is critical for the creation of new technologies while Lundvall (1992) states that the economic structure and the institutional set-up have a strong impact on innovations.

Weak institutions increase uncertainty and are likely to have an adverse effect on innovation while efficient institutions may expedite the process of registering new patents⁵, diffusion of knowledge, enforcement of property rights, and reduce the uncertainty of new projects (Romer 1990; Aghion and Howitt 1992; and Grossman and Helpman 2001). Sala-i-Martin (2002) states that it is rather difficult to incentivize innovation without existence of efficient institutions. Using a mixed-model approach, Levchenko (2007) shows that countries with better institutions are more likely to specialize in the production of highly technical goods. In a theoretical framework, Tebaldi and Elmslie (2008) shows that the impact of institutions on innovation spillovers to income is likely to improve as the quality of institutions improve. More recent papers also suggest that better institutions are likely to aid innovation (Habiaryemye and Raymond 2013 and Tebaldi and Elmslie 2013). Tebaldi and Elmslie (2013) uses an IV approach to study the impact of control of corruption on US patent counts between 1970 and 2003 and find that improving control of corruption increases the probability of patents filing and registration. Silve and Plekhanov (2015) that good quality of economic institutions (measured by WGI) boosts long-term economic growth through innovation. Dasgupta, De Cian, and Verdolini (2016), using data for 20 OECD countries during 1995 – 2010, investigate the impact of environmental policy stringency (both market and non-market instruments), governance, political orientation of governments, and distribution of resources to energy intensive industries on energy R&D and patents. The authors find that market-based incentives and to some extent non-market based incentives, results in dynamic efficiency gains; countries with better governance are characterized by higher levels of energy-related R&D; left-wing governments are more likely to devote R&D resources to the energy sector; while larger energy intensive sectors can induce market-size effects and have more power to lobby for more resources to be allocated to energy R&D.

⁵ In the empirical literature investigating the impact of institutions and governance on innovation, patents are generally used as a measure of innovation.

3.3.3 Corruption and Innovation

In general, the literature finds that corruption is harmful to innovation (Anokhin and Schulze 2009; Waldemar 2012). Murphy et al. (1993) argues that corruption from government officials particularly affects innovators due to the fact that these firms have a high demand for government permits and licenses. Similarly, Ayyagari et al. (2010) find that innovative firms are more likely to pay bribes compared to non-innovators. On the other hand, it has also been argued that corruption can be somewhat beneficial by creating opportunities for illicit private gains for firms, such as paying “cash for contracts” (Asiedu and Freeman 2009). These findings are in line with “grease the wheel” and “sand the wheel” by Bellos and Subasat (2011).

4. Existing Gaps and Future Directions

The literature reviewed in this paper indicates towards two major gaps in the applied economic literature on institutions and environment. The first gap concerns the relationship between institutions and policy adoption. With respect to the choice of policy indicators, only a few papers have studied the impact on policy stringency. As for the institutional factors, very few papers have investigated the influence of lobbying and veto power.

Understanding the drivers of policy adoption and stringency and how various economic and political institutions influence these decisions are some of the topics that need further investigation, especially in the context of climate and renewable energy policies. New and improved data on policies such as the Environmental Policy Stringency dataset by OECD (Botta and Koźluk 2014), offers opportunities to investigate relationships between institutional factors and policy stringency. Questions of potential interest include whether the broader institutional setting affects decisions on the choice of instruments and whether there is a causal relationship between institutions and policy stringency.

The second gap concerns the relationship between institutions and environmental performances. The existing literature has focused on physical environmental performance indicators, whereas only a few recent papers (see Section 3.3) explore how institutional quality affects green investments and clean technology costs. Future research could explore the relationship between institutions and variables related to green investments and the green economy. Possible indicators of green investment include R&D investments and electricity generation from renewable sources such as hydropower, geothermal, solar, tides, wind, biomass, and biofuels or installed capacities of these sources. Future research could also examine the influence of institution on technological change in relation to energy efficiency improvements or decarbonization patterns.

A large body of literature analyze innovation in energy and climate-friendly technologies and their diffusion across borders (see Carraro et al. 2010 for a review), including developing countries (Verdolini and Galeotti 2011; Bosetti and Verdolini 2012) but only a few of these contributions have examined the role of institutional factors. The literature on institution and the environment surveyed in this review suggests that other institutional factors such as corruption, transparency of governments, quality of bureaucratic quality are also likely to influence the ability to adopt and implement environmental policies, choice of policy instruments, and the effectiveness of the policy implemented. Governance is also a key factor, as weak governance creates frictions and leads to increased risks and associated costs in R&D and technological investments. In the case of governance, various institutional indicators are available besides the Worldwide Governance Indicators, including the Institutional Quality Dataset (Kunčič, 2014) and the Government Transparency Index (Hollyer et al. 2011).

5. Conclusion

This paper reviews the main findings of the empirical contributions examining the relationship between institutions and environmental outcomes, environmental policy adoption, green investments, and energy innovation. Our analysis reveals that the literature on environmental performance is more extensive than the one studying environmental policy. Although there is mixed evidence on the impact of institutional quality on performance and policy adoption, the majority of the studies find a positive relationship between different indicators of institutional quality, performance, and policy adoption. Our survey also shows that results are sensitive to the indicator of institutional quality being used and divergent results can often be explained by differences in methodologies and data. For example, in order to include as many countries as possible, authors have often resorted to using cross-sectional regressions, leading to results that more prone to omitted variable bias and endogeneity. Regarding the data, the gap in availability of environmental data between the developed and the developing countries often results in a selection bias.

This review indicates several unexploited opportunities for future empirical work that have emerged thanks to the growing availability of data on environmental policy and performance indicators. It suggests that the time is ripe for expanding the analysis to examine the relationship between governance, institutions, green investments, and energy innovation. Future research could also explore the impact of institutions and governance on indicators more directly related to low-carbon transformations such as carbon and energy intensity and renewable energy mix and shares. The literature on the relationship between institutions and policy also shows a gap regarding the drivers of climate policy adoption which future research could explore. Finally, there is scope of improving the estimates by using robust empirical techniques.

Broadening the empirical evidence on the relationship between institutions, environmental outcomes, and policies could also help improve the representation of institutional factors in the quantitative system models used to develop long-term sustainability transition scenarios. The new scenario framework integrating future climate and society (O' Neil et al. 2015) acknowledges the importance of policy and institutions as one of the dimensions of the Shared Socioeconomic Pathways (SSPs). The economic approach to institutions and the environment reviewed in this paper can offer empirical guidance to models. An example of how the empirical evidence could be used to inform models is provided by Iyer et al. (2015). This particular paper differentiated investment costs across regions on the basis of institutional quality and uses an Integrated Assessment Model to conclude that institutional reforms leading to lower investment risks could be an important element of cost-effective climate mitigation strategies.

Our review suggests that it is critical to expand the existing empirical literature on institutions and the environment by incorporating energy and climate change related issues, which could contribute to the broader field of sustainability transition and sustainable development.

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Appendix

Table 1A: Classification of Institutional Proxies

INSTITUTIONAL PROXY	SOURCE	TYPE
Voice and Accountability Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	WORLD GOVERNANCE INDICATORS (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	GOVERNANCE
Government Effectiveness 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.	WORLD GOVERNANCE INDICATORS (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	GOVERNANCE
Regulatory Quality Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	WORLD GOVERNANCE INDICATORS (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	GOVERNANCE
Ease of Doing Business Index (1=most business-friendly regulations). Ranking of economies from 1 to 189, higher rankings (a low numerical value) indicate better, usually simpler, regulations for businesses and stronger protections of property rights.	WORLD DEVELOPMENT INDICATORS (WORLD BANK) http://data.worldbank.org/indicator/IC.BUS.EASE.XQ	GOVERNANCE
Total Tax Rate (% of commercial profits) Amount of taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions as a share of commercial profits	WORLD DEVELOPMENT INDICATORS (WORLD BANK) http://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS	GOVERNANCE
Time to resolve insolvency (years) Time to resolve insolvency is the number of years from the filing for insolvency in court until the resolution of distressed assets.	WORLD DEVELOPMENT INDICATORS (WORLD BANK) http://data.worldbank.org/indicator/IC.ISV.DURS	GOVERNANCE
Rule of Law Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	WORLD GOVERNANCE INDICATORS (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	GOVERNANCE
Strength of Intellectual Property Rights Data on the strength of the legal environment for patenting in five year-time steps from 1960 to 2005. The index contains the impacts of five categories: the coverage of research fields in which inventions can be patented, the membership in international agreements, criteria regarding the loss of patent protection, the enforcement rules, and the duration of patent protection.	Ginarte and Park (1997), Park (2008)	LEGAL
Informal payments to public officials (% of firms) Informal payments to public officials are the percentage of firms expected to make informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services, and the like.	WORLD DEVELOPMENT INDICATORS (WORLD BANK) http://data.worldbank.org/indicator/IC.FRM.CORR.ZS	POLITICAL
Control of Corruption Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	WORLD GOVERNANCE INDICATORS (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	POLITICAL
Corruption Perceptions Index (CPI) The CPI scores and ranks countries/territories based on how corrupt a country's public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions.	Transparency International http://www.transparency.org/cpi2014	POLITICAL
Bribe Payers Index (BPI) Measuring the supply side of corruption in international business transaction, the Bribe Payers Index is a ranking of leading exporting countries according to the perceived likelihood of their firms to bribe abroad.	Transparency International http://www.transparency.org/bpi2011	POLITICAL
Institutionalized Democracy (eleven-point scale; 0-10) Measured by competitiveness of political participation, competitiveness of executive recruitment, openness of executive recruitment and constraints on the chief executive.	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	POLITICAL
Institutionalized Autocracy (eleven-point scale; 0-10) Lack of political competitiveness, lack of competitiveness of executive recruitment, regulation of political participation, lack of openness of executive recruitment and the lack of constraints on the chief executive	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	POLITICAL
POLITY Computed by subtracting the autocracy score from the democracy score; the resulting unified polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic)	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	POLITICAL
POLITY2 Revised Combined Polity Score: This variable is a modified version of the POLITY variable added in order to facilitate the use of the POLITY regime measure in time-series analyses. It modifies the combined annual POLITY score by applying a simple treatment to convert instances of standardized authority scores to conventional polity scores	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	POLITICAL
Electoral Democracy An electoral democracy designation requires a score of 7 or better in the Electoral Process subcategory and an overall political rights score of 20 or better.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	POLITICAL
Civil Freedom Civil liberties, including freedoms of expression, assembly, association, education, and religion. They have an established and generally fair legal system that ensures the rule of law (including an independent judiciary), allow free economic activity, and tend to strive for equality of opportunity for everyone, including women and minority groups.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	POLITICAL
Political Freedom Range of political rights, including free and fair elections. Candidates who are elected actually rule, political parties are competitive, the opposition plays an important role and enjoys real power, and the interests of minority groups are well represented in politics and government.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	POLITICAL

Source: Compiled by the Authors.

Table 2A: Literature Survey: Institutions and Environmental Performance

Paper	Dependent Variable(s)	Explanatory Variables	Methodology	Result
Congleton (1992). Political Institutions and Pollution Control.	Methane and CFC	Democracy (Gastil, 1987)	2SLS and Cross-section Logit 118 countries	Democratic regimes produce more methane in total but significantly less per unit of national output.
Murdoch et al. (1997). A Tale of Two Collectives: Sulfur versus Nitrogen Oxides Emission Reduction in Europe	Reduction sulfur and nitrogen oxides	Indices of civil liberties and political freedom (Gastil, 1983; 1988; and 1989)	OLS 25 European countries; 1985, 1987, 1990, and 1992	Positive impact on sulfur cutbacks not for nitrogen oxides
Midlarsky (1998). Democracy and the environment: an empirical assessment.	Deforestation, carbon dioxide emission, soil erosion by water, and protected land area	Democracy	OLS Panel regression	No evidence of democracies improving soil erosion by chemicals, and freshwater availability, and even negative effects of democracies over CO ₂ , deforestation, and soil erosion by water. The study only finds a positive effect of democracy on protected land.
Torras and Boyce (1998). Income, inequality, and pollution: a reassessment of the environmental Kuznets Curve	Sulfur dioxide, smoke, heavy particles, dissolved oxygen, fecal coliform, safe water, sanitation	Political rights and civil liberties	GLS 18–52 cities in 19–58 countries 1977–1991	Civil liberties improve environmental quality, particularly in low-income countries.
Deacon (1999). The Political Economy of Environment-Development Relationships: A Preliminary Framework.	Lead content	Types of Democracy (Cross-National Time-Series Data Archive and Polity III)	Panel OLS 1972 – 1992 48 countries	Lead content declines with democratic regimes compared to dictatorships.
Barrett and Graddy (2000). Freedom, growth, and the environment.	Air pollutants, water pollutants, fecal and total coliforms	Civil and Political Freedom - Freedom House	FE and RE OLS 5-31 countries	An increase in civil and political liberties generally improves environmental quality.
Bhattarai and Hammig (2001). Institutions and the Environmental Kuznets curve for deforestation: A cross-country analysis for Latin America, Africa and Asia.	Deforestation	Sum of political rights and civil liberty (Freedom House)	FGLS 66 countries from Latin America, Africa, and Asia 1972–1991	Political rights and civil liberty reduces annual deforestation rate of forest and woodlands.
Ehrhardt-Martinez, Crenshaw and Jenkins (2002). Deforestation and the Environmental Kuznets Curve: Cross-National Investigation of Intervening Mechanisms	Annual rate of deforestation	Scope of governmental actions and Democracy (Polity II)	OLS with White correction LDCs 1980-1995	Weak democracies are unable to reduce deforestation.
Neumayer (2002). Do democracies exhibit stronger international environmental commitment? A cross-country analysis.	Percentage of their land area under protections status	Combined index of political rights and civil (Freedom House.), combined index of democracy and autocracy (Polity IV), Vanhanen's index of democracy, and Voice and accountability (WB)	Cross-section OLS 206 countries	Democracies and countries with higher Freedom Index put greater percentage of their land area under protections status.
Carlsson and Lundstrom (2003). The Effects of Economic and Political Freedom on CO ₂ Emissions.	CO ₂ emissions	Political and civil freedom (Freedom House)	Box-Cox regression 75 countries 1975-1995	Political freedom has no effect on reducing levels of emission of CO ₂ .
Deacon (2003). Dictatorship, Democracy, and the Provision of Public Goods.	Lead content of gasoline	Cross-National Time Series Data Archive (Banks, 1997) and Polity IV	FE OLS 130 countries 1980-1996	Lead concentrations are lower under democracy than autocracy.
Meyer et al. (2003). Institutional, social and economic roots of deforestation: a cross-country comparison.	Rate of deforestation	Control of corruption	Cross-section OLS 99-115 countries	Improved control of corruption reduces rate of deforestation.
Meyer et al. (2003). Institutional, Social and Economic Roots of Deforestation: Further Evidence of an Environmental Kuznets Relation?	Deforestation	Property Rights (Freedom House) and Control of Corruption Index (WB)	Cross-section OLS 117 countries	Countries with less corruption are less likely to liquidate forest assets.
Fredriksson et al. (2005). Environmentalism, democracy and pollution control.	Lead content of gasoline	Number of environmental lobby groups, democratic participation, and political competition	Cross-section OLS, Tobit, and 2SLS 104 countries Around the year 1996	Increase in the number of environmental lobby groups, democratic competition and participation reduces lead content in gasoline.
Neumayer (2003). Are left-wing party strength and corporatism good for the environment? Evidence from panel analysis of air pollution in OECD countries.	Sulphur dioxide; nitrogen dioxide; carbon monoxide; carbon dioxide	Left-wing party strength (the share of green/left-libertarian party seats as a percentage of all seats, the share of traditional left-wing party seats, and the share of cabinet portfolios of left-wing parties - Comparative Parties Data Set of Swank, 2002)	FE/RE regression 21 OECD countries, 1980, 1990 and 1999	Green or left-libertarian parliamentary strength is associated with lower levels for all five air pollutants. Traditional left-wing party strength is possibly also associated with lower pollution levels, but the evidence is less consistent and robust.
Welsch (2004). Corruption, growth, and the environment: a cross-country analysis.	Urban SO ₂ concentration, Urban NO ₂ concentration, urban total suspended particulate concentration, dissolved oxygen demand, phosphorus concentration, suspended solids, SO ₂ , NO ₂ , volatile organic compound emissions, fertilizer consumption, pesticide use, industrial organic pollutants	Corruption (ESI)	Cross-section OLS and SUR 122 countries Most recent year available; 1990–1996	Corruption generally increases pollution and the effect is particularly strong in low income countries.
Binder and Neumayer (2005). Environmental pressure group strength and air pollution:	Sulphur dioxide, smoke, and heavy particles	ENGOS' strength and Democracy (Policy IV)	Panel OLS, RE, and IV regression	ENGO strength is effective in reducing air pollution levels in the form of SO ₂ ,

An empirical analysis.			17-35 countries, 1977-1988	smoke and heavy particulates.
Etsy and Porter (2005). National Environmental Performance: An Empirical Analysis of Policy Results and Determinants.	Urban particulate levels, and sulphur dioxide	Civil and political Liberties - Environmental Sustainability Index (ESI)	OLS 40-70 countries	Civil and political liberties help reduce urban particulates and SO ₂ .
Jorgenson (2006). “Global warming and the neglected greenhouse gas: a cross-national study of the social causes of methane emissions intensity	CH ₄ intensity	Index of democratization	Cross-section OLS with listwise deletion 39-68 countries for 1995	Democratization has no effect on methane intensity
Li and Reuveny (2006). Democracy and Environmental Degradation.	Carbon dioxide, nitrogen oxides, organic pollution in water, deforestation, and land degradation	Democracy and autocracy (Polity IV),	Panel and cross-section OLS 105-143 countries 1961-1997	Democracy improves environmental quality regarding all the dependent variables.
Cole (2007). Corruption, income and the environment: An empirical Analysis.	Sulfur dioxide and carbon dioxide	Corruption (ICRG)	Instrumental Variable RE 94 countries 1987-2000	Corruption is estimated to have a positive direct impact on per capita emissions. Indirect effects are found to be negative and larger in absolute value than direct effects for the majority of the sample income range.
Culas (2007). Deforestation and the environmental Kuznets curve: An institutional perspective.	Deforestation of forests and woodlands	Enforceability of contract	FE and RE OLS 14 countries from Latin America, Africa and Asia 1972-1994	Better enforceability of Contracts reduce deforestation.
Fredriksson and Wollscheid (2007). Democratic institutions versus autocratic regimes: The case of environmental policy	Greenhouse gases - reductions in carbon dioxide per unit of GDP, and carbon dioxide emitted per capita	Democracies - parliamentary, presidential-congressional, proportional, and/or majoritarian systems compared to dictatorships.	Cross-section Propensity score matching 163 countries from late 1990's.	Parliamentary democracies achieve greater reductions in greenhouse gases. While presidential democracies act similar to autocracies.
Shandra (2007). Economic dependency, repression, and deforestation: A quantitative, cross-national analysis.	Deforestation	Average of political rights and civil liberties (Freedom House)	Cross-section OLS 67 countries around 1990	Deforestation increases in nations with higher levels of repression.
Wright et al. (2007). Poverty and corruption compromise tropical forest reserves.	Number of fires	Corruption (TI)	Non-parametric sign test and OLS 37 countries 2002-2004	Reserves are least effective at reducing fire frequency in many poorer countries and in countries beset by corruption.
Scruggs and Rivera (2008). Political Regimes, Democratic Institutions and Environmental Sustainability: A Cross-national analysis.	Carbon monoxide, biochemical oxygen demand, SO ₂ , NO ₂ , CO ₂ , CH ₄ , protected areas, and forest land	Democracy (Freedom House and Polity IV)	Cross-section OLS 169 countries,	No evidence that long-established democratic countries perform better.
Ward (2008). Liberal Democracy and Sustainability	Carbon footprint	Polity score, political system	Cross-sectional analysis 60-128 countries around the year 2000	Stable core autocracies perform worse on strong sustainability than stable core democracies. Liberal democracy too generally promotes weak sustainability
Bernauer and Koubi (2009). Political Determinants of Environmental Quality.	Sulphur dioxide	Democracy (Mesquita et al., 2003), Presidential vs. Parliamentary (Mesquita et al., 2003), Civil liberties (Freedom House)	RE GLS 107 cities in 42 countries from 1971-1996	Democracy reduces pollution, presidential democracies provide a cleaner environment than parliamentary democracies, and civil liberties improve the environment.
Koyuncu and Yilmaz (2009). The Impact of Corruption on Deforestation: a Cross-Country Evidence.	Rate of deforestation	Corruption (TI, BI, and ICRG)	WLS 100 countries 1980-90, 1990-95, 1990-2000	Corruption increases rate of deforestation.
Ivanova (2011). Corruption and air pollution in Europe.	Sulphur emissions	Corruption and law and order (ICRG)	ML with FE and SUR 39 European countries 1999-2003	Decline in corruption and improvements in law and order reduces sulphur emissions. Actual emission levels in countries with more effective regulations are likely to be lower.
Tavoni and Gennaioli (2011). Clean or “Dirty” Energy: Evidence on a Renewable Energy Resource Curse	Number of wind plants and total capacity installed	Number of charges made by police for criminal association activity and total criminal activity -	Panel OLS, difference-in-differences 34 South-Italian provinces 1990-2007	Expansion of the wind energy sector has been driven by quality of political institutions, through their effect on criminal association.
Castiglione et al. (2012). Rule of Law and the Environmental Kuznets Curve: Evidence for Carbon Emissions.	EKC and carbon emissions	Rule of law Kaufman (2010)	2SLS 28 countries 1996 to 2008	Negative relationship between pollution and rule of law, when rule of law is strong, the turning point of the EKC occurs at a lower level of income per capita, thus, decreasing emissions
Castiglione et al. (2013). Institutional enforcement, environmental quality and economic development.	Income and pollution (carbon dioxide)	Rule of law Kaufman (2010)	Panel VAR 33 high-income countries 1996-2008	Higher income implies stronger rule of law and vice-versa. Rule of law has a negative relationship with pollution.
Koubi et al. (2012). Climate variability, economic growth, and civil conflict.	1 st stage: Economic growth 2 nd stage: Onset of civil conflict	Polity (Polity IV)	2SLS Global dataset 1980-2004	No evidence that climate variability affects economic growth. Weak evidence that non-democratic countries are more likely to experience civil conflict when economic conditions deteriorate.
Masini and Menichetti (2013). Investment Decisions in the Renewable Energy Sector: an Analysis of Non-Financial Drivers.	Renewable energy share in the investment portfolio	Institutional pressure from industry peers, consultants, and published technical information	Cross-section OLS and logistic regression. Survey data from 93 investors in Europe	Institutional pressure of both peers and outside consultants has a strong negative impact on portfolio - forces them to concentrate investments on a few specific technologies.
Iyer et al. (2015). Improved representation of investment decisions in assessments of CO ₂ mitigation.	Investment risks across technologies and regions in the electricity generation sector	Institutional quality	IAM - Global Change Assessment Model	Investment in low-carbon technologies is lower in regions with inferior institutions.

Vona and Verdolini (2015). Drivers of investments in cleaner energy.	Change in installed capacity of renewable and fossil efficient as a fraction total capacity	Policy instruments supporting either renewable or fossil efficient technologies -WEO Policy Database	FE difference-in-differences 27 OECD countries over the years 1990-2007	Environmental policy has a positive effect on investment in renewable energy technologies but fossil efficient technologies seem less affected.
Dasgupta, De Cian, and Verdolini (2016). The political economy of energy innovation.	Innovation measured by power and energy R&D intensity and power and environmental patent intensity	Institutional quality (WGI), governments' political orientation, and lobbying	FE OLS 20 countries 1995-2010	Stringent environmental policies better governance provide incentives for energy innovation while left-leaning governments and market size attract energy R&D investments but not patents.

Source: Compiled by the Authors. This table summarizes 39 studies on institutions, governance, and environmental performance. Studies dealing with investments and innovation not explicitly related to the energy and environmental domains are not included in this table.

Table 3A: Literature Survey: Institutions, Governance, and Environmental Policy (Adoption and Implementation)

Paper	Dependent Variable (s)	Explanatory Variables	Methodology	Result
Congleton (1992). Political Institutions and Pollution Control.	Signature of Vienna and Montreal Protocol on CFC	Democracy (Gastil, 1987)	Cross-section Logit 118 countries	Authoritarian regimes enact less stringent environmental standards than democratic regimes. Liberal democracies are more willing to regulate environmental effluents and international agreements on environmental matters attract more signatories as the number of democratic regimes increases.
Neumayer (2002). Do democracies exhibit stronger international environmental commitment? A cross-country analysis.	Signing and ratification of multilateral environmental agreements; membership in environmental intergovernmental organizations; reporting requirements for the Convention on International Trade in Endangered Species of Fauna and Flora; percentage of a country's land area under protection; existence of a National Council on Sustainable Development; and availability of environmental information	Democracy (Freedom House, Polity IV, Vanhanen's Index, and Voice and Accountability - WB)	Cross-section Probit and OLS 100-175 countries, around the year 2000	Democracies sign and ratify more multilateral environmental agreements, participate in more environmental intergovernmental organizations, comply better with reporting requirements under the Convention on International Trade in Endangered Species of Fauna and Flora.
Fredriksson and Svensson (2003). Political instability, corruption and policy formation: the case of environmental policy.	Index of stringency of environmental regulations on agricultural sector.	Corruption (Political Risk Services and ICRG) and Democracy (Freedom House)	Cross-section OLS 63 countries for 1990	More corrupt countries have less stringent environmental regulations while democratic countries also have less stringent regulations.
Murdoch et al. (2003). The participation decision versus the level of participation in an environmental treaty: a spatial probit analysis	Helsinki protocol ratification and sulfur emissions (1990 levels minus 1980 levels)	Democracy proxy - civil and political freedom Gastil (1989)	Two-stage game and spatial probit 25 European countries	Democracy reduces probability of protocol ratification.
Damanian et al. (2003). The Persistence of Corruption and Regulatory Compliance Failures: Theory and Evidence.	Compliance with international environmental agreements.	Judicial efficiency (Kauffman), political stability (Kauffman), civic freedom (Fraser Institute), and corruption (TI)	Cross-section OLS and 2SLS	Corruption reduces the level of compliance of environmental regulations while civic freedom and judicial efficiency increases compliance.
Fredriksson et al. (2004). Corruption and Energy Efficiency in OECD Countries: Theory and Evidence.	Sector specific energy policy stringency	Corruption (TI), worker influence, and lobbying	Panel OLS 12 OECD countries (11 sectors) 1982-1996	Corruption increases energy waste by reducing stringency of energy regulations. Worker lobby is relatively influential in those sectors in which the capital owners have relatively minor impact, and vice versa.
Fredriksson and Millimet (2004). Electoral rules and environmental policy.	Environmental Sustainability Index, Environmental Governance Index, Environmental Efficiency Index, International Environmental Agreements Participation Index, and Greenhouse Gas Emissions Index	Rules governing the assignment of legislative seats	Cross-section OLS and 2SLS 86 countries	Governments set stricter environmental policies under proportional, as opposed to majoritarian systems.
Roberts et al. (2004). Who Ratifies Environmental Treaties and Why? Institutionalism, Structuralism and Participation by 192 Nations in 22 Treaties.	Environmental Treaty Participation Index - participation on 22 international environmental treaties	Index of Voice and Accountability, Government Effectiveness Index (Kauffman et al., 2003), and Number of NGOs	Cross-section OLS, 192 countries, 1999	Positive relationship with national propensity to sign environmental treaties.
Fredriksson et al. (2005). Environmentalism, democracy, and pollution control.	Regulation of lead content in gasoline	Environmental lobby; Democratic participation; and Democratic competition	Cross-section OLS, 2SLS, Tobit 104 countries, 1993, 1996, and 2000	Greater political competition and number of environmental groups raises the stringency of environmental policies. However, democratic participation affects environmental policy stringency only in countries with sufficiently high degree of political competition.
Fredriksson and Millimet (2007). Legislative Organization and Pollution Taxation.	Environmental protection and pollution taxation	Veto, bicameralism, political instability, and corruption Kaufmann et al. (2003) index	Three-stage game Cross-section 86 countries	Bicameralism has a positive effect on gasoline taxes, which is magnified as political stability increases and veto players are less corruptible. Similar interaction effect of bicameralism and the degree of corruptibility for several other measures of environmental policy stringency.
Fredriksson and Ujhelyi (2005). Political institutions, interest groups, and the Ratification of international environmental agreements.	Probability of Kyoto protocol ratification	Government units, environmental lobby, democracy (Freedom House),	Logit and stratified hazard model 170 countries 1998-2002	Greater environmental lobby strength raises the probability of ratification but greater number of government units reduce the impact of agreements.
Cole and Fredriksson (2006). Institutionalized pollution havens.	1 st stage: FDI stock 2 nd stage: Environmental policy	Government checks and balances; political constraints within the legislature; and government honesty (ICRG)	FE 2SLS 33 countries 1982-1992	FDI raises environmental policy stringency where number of legislative units is high.
Fredriksson et al. (2007). Kyoto Protocol cooperation: Does government corruption facilitate environmental lobbying?	Kyoto Protocol ratification	Democracy (Freedom House, corruption (TI), integrity (WB, TI, ICRG), and	Cox proportional hazard model 170 countries	Democratic countries ratify earlier, environmental lobbying raises the ratification probability, while

		environmental lobbying	1998-2002	increased environmental lobby group activity raises the probability of Kyoto Protocol ratification and the effect raises with the degree of corruption.
Bättig and Bernauer (2009). National Institutions and Global Public Goods: Are Democracies More Cooperative in Climate Change Policy?	Policy Index: commitment to mitigation process Policy outcomes: in terms of emission levels and trends	Democracy	Panel regression 185 countries 1990–2004	Effect of democracy on commitment to global public goods provision is positive while effect of democracy on policy outcomes are ambiguous.
Pellegrini and Gerlagh (2011). Corruption, Democracy, and Environmental Policy: An Empirical Contribution to the Debate	Environmental Protection Stringency (Eliste and Fredriksson, 2002) and Environmental Regulatory Regime Index (Esty and Porter, 2002)	Corruption (TI), Democracy (Polity IV), and Index of democracy (Vanhanen, 2000)	Cross-section OLS 51-62 countries	Effect on environmental policy stringency is negative for corruption but no evidence significant effect of democracy.
Fankhauser et al. (2014). Domestic dynamics and international influence: What explains the passage of climate change legislation?	Number of climate laws passed and flagship legislation	Polity2 (Polity IV), party-political orientation of the government, and international influences	Negative binomial and FE Logit 63 countries 1990-2012	No significant impact of political orientation. Propensity to legislate is heavily influenced by the passage of similar laws in other countries.

Source: Compiled by the Authors. This table summarizes 16 studies on institutions, governance, and environmental policy.

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