



DEPARTMENT OF POLITICAL SCIENCE

# EFFECTIVENESS OF INTERNATIONAL ENVIRONMENTAL AGREEMENTS

A Quantitative Study

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## Abstract

Environmental risks are one of the top three threats to human population, according to World Economic Forum. It is known that human activities are important contributor to environmental disasters, and for decades policy makers have tried to address this problem. One of the instruments for protecting the environment are international agreements. Their number at the beginning (1960s) was around ten per year, on the peak (1990's) – about thirty a year, and for year 2016 it reached lowest number of six. It seems that policy makers are losing faith in their effectiveness.

The aim of this thesis is to answer the question whether international environmental agreements are an effective policy instrument in hands of the international community for protecting the environment. The identified gap in the literature is that perception of main concepts is one-sided and that there is a lack of comprehensive quantitative research on this topic. The thesis develops a new theoretical argument explaining why countries comply with obligations of the environmental agreements they signed, even though there is a lack of central enforcement mechanism. The argument is tested empirically with the data on 166 countries and 666 agreements. The hypothesis that higher number of environmental agreements leads to higher performance is accepted in this case.

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# 1 Introduction

Environment is the natural surrounding we live in. Environment is air, water, land, plants and animals that surround us. A river that spreads only through the land of our little town, is part of our local environment. Tree lobster is an insect that lives only on Lord Howe islands in Australia and is part of Australia's regional environment. Iran's oil wells are part of their national environment. Air is a resource shared by everyone in our global environment. A common problem with all levels of environment, is that people tend to misuse it to the extent until it becomes a threat to themselves. To illustrate, World Economic Forum has named environmental risks among the top 3 pressing threats to global community in years 2017 and 2018 (WEF, 2018). Some of these threats are water pollution, air pollution, and the global warming. On a real-world example it means that people often use their local rivers as garbage disposals. That pollutes the water, small local river flows into a bigger river, the bigger river flows into an ocean, and polluted water becomes a global problem. Then Lord Howe farmers decide to use pesticides against crops-eating tree lobsters, inject pesticides in soil, air, underground water cycles, and pollute both its environment, and environment of other countries by spreading polluted water/air. Last example is global warming, where oil produced in Iran is consumed by billions of people. Oil consumption releases carbon dioxide, which traps heat in the air, and consequently, increases temperature on the earth (greenhouse effect).

The point is that environmental dangers are real, local misuse leads to transboundary problems, and global response is needed for protecting nature's and our own health. In the 1960's the international community has started making treaties where countries would recognize a certain environmental issue and commit themselves to tackle it. In this thesis such treaties are referred to as *international environmental agreements (IEAs)*. While in the 1960's the average number of IEAs signed per year was 10, the peak was reached between 1990 and 1994 with more than 30 agreements a year. In 2016 the number of signed environmental agreements was only 6 (Mitchell, 2002-2017). Moreover, one of the unofficial leaders of the ecological movement – USA, announced its withdrawal from Paris Agreement<sup>1</sup> in June 2017.

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<sup>1</sup> "First ever universal, legally binding global climate deal" with 195 signatories (EC Climate Action).

It seems that the future of international environmental agreements is not bright, and that participants are losing faith in its effectiveness as a policy instrument. The problem deepens when we turn to science in hope to find a support for IEAs, because literature on environmental agreements does not offer a comprehensive empirical research on their effectiveness. Qualitative studies are much more frequent than quantitative studies, and the quantitative studies mostly focus in a subset of IEAs. This paper will perform a large-N analysis with 166 countries world-wide and 666 international environmental agreements.

The aim of this paper is to answer the question whether international environmental agreements are an effective policy instrument in protecting the environment. This question will be answered by developing a theory in support of its effectiveness, and by statistically testing it through the relationship between the number of signed environmental agreements per country and environmental performance of respective countries. If countries take part in international agreements because they have genuine intention to protect the environment, then compliance to the agreements is expected to be high, and, consequently, environmental performance will also be better. A higher number of signed environmental agreements should lead to higher environmental performance in respective country. By answering the question of agreements' effectiveness, the purpose of this paper is fulfilled: helping scientific and policy community to make thoughtful choices on engaging and spending resources in environmental agreements.

The paper proceeds as follows: Section 2 is the literature review which starts with a discussion of some central concepts of the literature. The review will confront views of principal political science theories on international cooperation, narrow it to a discussion on compliance to environmental agreements, and finish with presenting results of some quantitative studies. Section 3 presents a new theoretical argument on why environmental agreements may be effective, which relies on rational functionalism and Robert O. Keohane's *demand theory*. This leads to section 4 where the aim, research question and hypothesis of this paper are defined. Section 5 is analysis. It presents the used method (OLS regression), variable choice, discusses results, and answers the research question. Section 6 is the conclusion.

## 2 Literature Review

This chapter will present theoretical and empirical perspectives in the literature on compliance to international environmental agreements. Reasoning is that if countries enter an agreement with a sincere intention to comply with its obligations and protect the environment, those agreements will be effective. As we will see in the literature, there is a lot of skepticism on states' compliance, and what are the real reasons for joining agreements. After discussing different views in the theory, this chapter will present confronting results of empirical papers on the question of compliance and effectiveness of agreements. The gap emerges from this as a final element of the section.

Reasons for concern are notable. IEAs are created and exist in the international community, a place for which both realists and liberals say that is an anarchy. In that system there is no central authority that can punish states for breaking their commitments. For that time, states are mainly concerned for its own well-being, and it is reasonable to suspect that in a system without control, many will follow their own interest, and take advantage of others' compliance to agreements.

Therefore, in answering the question whether IEAs are an effective instrument in making states to improve the environment, several concepts in theory appear as relevant. One of them is compliance. Compliance by Mitchell (1994) is "an actor's behavior that conforms with an explicit treaty provision." (p. 6). Compliance can even be named as central concept of this work. A country that has signed an IEA and fulfils all its obligations from the agreement is a complying country. The mechanism goes *higher compliance = higher agreement's effectiveness*. In the reality dominated by countries self-reports on agreements' compliance and lack of international and independent control authorities, space for discussion is vast. This chapter will elaborate on whether we should expect from countries to comply with this kind of policy instruments, and if yes, what are the underlying motivations for their compliance.

The next concept is international cooperation. IEAs are a product of international cooperation. Some theories even doubt that international cooperation exists (e.g. realism). Deductive thinking would lead us then that even IEAs are an illusion. Discussing international cooperation is discussing the grounds for IEAs.



Realists' approach on international cooperation is very pessimistic. We are living in a world of anarchy and chaos on the international level. If we recall the 17<sup>th</sup> century work of Thomas Hobbes, situation was the same on all social levels, before developing states as a central authority. The problem is peoples' selfish nature and the basic instinct for survival. Every cooperation is a zero-sum game because empowerment (gain) of others is a direct threat to its own existence. A state is developed as the central authority because people needed a third actor that will take care of what people had agreed and punish the ones that do not comply with agreed. If people can predict actions of others, then they are not living in a chaos. On an international level there is still no central authority than can prescribe behavior and punish violators, therefore the international community is in a state of chaos and anarchy. (Waltz 1979; Baylis et al, 2014).

Neo-realism develops further the notion of chaos in the international community and recognizes cooperation between states. Joseph Grieco (1988) talks about two concepts that guide it. First concept is absolute gains: states will cooperate with each other because that increases their absolute gains. On the other side, they will be concerned with the gains from others and abandon the arrangement if partners gain more (relative gains, second concept). That caution is in line with the basic postulates of realism that all countries are enemies to each other and stronger others are a direct threat to its own survival. Therefore, countries do not cooperate if they decide to cheat or if relative gains of others are higher (Ibid). A real-life example of this relative gains concept is the case of Rio talks for UN Convention on Climate Change in 1992 when G-77 countries were threatening to abandon the talks because restrictions imposed by the agreement were putting them in a disadvantageous position to developed Western countries. The argument was that the restrictions hinder their economic development while Western countries had already reached optimal level of development, and they do not have to sacrifice anything (Susskind, 2008).

While the main concern for realism is self-survival and obtaining the most from international relations, liberals are concerned with how to promote and support cooperation in that anarchical and competitive system (Baylis et al, 2014). In liberal perception, people are also selfish, but not to the cost of others. Ruling values are individual liberty, tolerance, free trade, prosperity and interdependence. Their critique to realism is that not every issue is an issue of self-survival, and

realism does not offer explanations for contemporary phenomena as globalization, supra-national organizations or transboundary environmental problems. Liberals understand mutual gains of cooperation and perceive it as a win-win situation. Environmental problems are complex and hard to be addressed unilaterally. Existence of supra-national bodies as United Nations is favorable because it helps countries to coordinate their actions in joint ventures. Cooperation is the preferred model of behavior as long as it is not disturbed by free riders and by states that refuse to cooperate, because they know that there are no mechanisms for eliminating free-riders (Young, 1999).

Scott et al. (1995) and Frey (1995) claim that countries' motivation for international agreements compliance is driven by two motives: interests and sociality. Individual countries are rational actors, driven by self-interests. Decision upon participating in a certain environmental action will depend on cost-benefit analysis i.e. will benefits of taken actions outweigh the costs. By that logic a country can take unilateral actions on protecting the environment if it sees that a certain environmental problem is threatening to the society. It can even influence other countries to take actions, because it realized that polluting activities from those countries are passing the country's borders. Other motive *sociality* emphasizes also an altruistic side in every country. Namely, countries are aware that we are all living in a community, and cooperative behavior is necessary minimizing uncertainties and tackling transboundary issues. Therefore, some countries can feel not threatened by certain environmental issues, but nevertheless offer its cooperation to others, as a sign of cooperativeness.

This theory opens some concerns in positioning interests and altruism as co-functioning values. For example, if a country on domestic level has no interest to tackle a certain environmental issue, but regardless of that, decides to participate in an IEA to show its altruism to other countries, a demanding IEA can make problems for that country when it comes to implementation on domestic level. Citizens can refuse to bear costs of regulations that do not contribute to their well-being, and there emerges a direct conflict between interests and altruism. Further consequence is that governments are not able to fulfill commitments that they have taken by signing the agreement, and treaty compliance decreases. This theory does a good job by describing interest-based motivation for countries compliance, but the second part leaves space for further investigation.

In line with non-genuine interests for participating in IEAs, there are theories where reputational concerns are one of the main causes why countries comply to international law (Brewster, 2009; Guzman, 2002; Terai, 2002; Hathaway, 1936). Reputation is defined as a perception of a state's future actions, based on previous behavior (Brewster, 2009). A country with better reputation, will be more attractive to other countries for cooperation. Underlying mechanism for Brewster's theory is the *prisoner's dilemma*. In that theory actors are individually better-off if they pursue their individual interest, but if everyone pursues its individual interest, results are sub-optimal. Therefore, the best outcome for all actors is cooperation. Condition for reaching optimal results is that actors know that cooperation is the best option, and that they can trust each other (that no one will betray the other). Key point is that reputation adds the value on the cooperative option i.e. assures actors that cooperants will not betray them in a cooperative option (Ibid.).

Basic theorizing by Brewster (Ibid.) claims that countries will both sign and comply with international agreements if they care for its reputation. Reputation is important because besides reputation, only direct sanctions can make countries behave in the international arena (Guzman, 2002). Since the lack of direct sanctions in the international community is obvious, "a state's commitment is only as strong as its reputation" (Ibid, p.1849). Influence by Oona Hathaway (1936) makes this theory shed a light on difference between reputational points that can be earned by signing the agreements, and reputational points for compliance.

Reputation can be the reason why countries comply with international agreements, but if this is true, reputational theory leaves us with several reasons for belief that compliance is not a sustainable concept. First reason is that the most points to reputation come from signing an agreement (e.g. media attention), and when it comes to enforcement, countries are aware that there is no central enforcement authority which can report on their behavior and affect their reputation. Second is cost-benefit analysis. Whenever motives for non-compliance outweigh reputational gains, country will prioritize its interests. For example, those interests can be of domestic nature, like redirecting resources to economic development or excluding a green party from a ruling coalition. What is more important, those interests can outweigh reputational gains both before signing an IEA, and after a country has taken commitments to the IEA. Brewster (2009) claims

that in this second case, countries would rather non-comply silently, than to get attention and negative reputation by abandoning the agreement.

A theory that emphasise the key role of domestic factors is institutionalism. That theory claims that the quality of state's political, economic and social institutions is a crucial determinant of countries compliance to international obligations. The mainstream of institutionalism identifies democracy as the most relevant to higher compliance rate institution (Slaughter, 1995; Simmons, 1998). One explanation is that democracies cooperate better than autocracies. That claim is based on free-trade regimes and *democratic peace* theory (which claims that democratic regimes do not wage war against each other). Second is rule of law. Democracies have stronger rule of law since their judiciary is independent. With independent judiciary, power of political leaders is limited, and international law cannot become subject of arbitrary manipulation. Third explanation is that in democracies civil society is strong which is reflected in a higher number of NGOs. A developed NGO network articulates public interest, disseminates information, puts pressure on governments, and increases international cooperation by connecting with NGOs from other countries (Farzin & Bond 2006; Alvarez et al, 2014).

Carbonell & Allison (2013) have tested institutional theory empirically and found out contradictory results on its explanatory power for countries' compliance to IEA. The study found that democratic states have better IEA compliance, environmental NGOs help countries to increase compliance, but when it comes to severe environmental problems<sup>2</sup>, autocratic regimes are more cooperative than democracies.

Dependent variable is operationalized with opinion-based survey data<sup>3</sup>, where respondents were asked to rate, on a scale from 1 to 7, the following question: "compliance with international environmental agreements is a high priority in your country". Measuring compliance with the opinion-based data is a valuable contribution to the scholarship since, in general, it sheds light on importance of the public opinion as driving force in policy implementation, and offers an alternative to the outcome-based measuring method. On the other side, this paper makes us

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<sup>2</sup> Severe environmental problem in this research was *access to clean water*

<sup>3</sup> Data available from 70 states (cases)

question whether the freedom to express critical opinion is developed to a comparable level for democracies and autocracies. My assumption is that citizens in democracies are more critical to public policies, than citizens in autocratic countries.

Roberts et al. (2004) used agreement ratification in domestic law as measure of countries commitment to international treaties. It is found that domestic factors, namely civil society strength (number of NGOs; voice & accountability) and diversity of natural resources, are significant predictors for countries' participation in international arrangements.

Alvarez et al. (2014) is one more paper that has tested the institutional theory, and what is more interesting, has employed the same dependent variable as this paper intends to do. That variable is environmental performance index, a country-level measure of environmental health and ecosystem vitality<sup>4</sup>. Alvarez's paper was not interested in the relation between domestic system and international environmental commitments, but more on direct relation between type of institutions and observed state of the environment. Its results are useful in evaluating institutional theory appropriateness on environmental issues. The results suggest that economic wealth, education, and corruption do matter, while on other hand, government effectiveness and ruling political ideology are irrelevant for the environmental performance.

The question whether international environmental agreements are an effective instrument for protecting the environment was studied in the literature by looking at specific treaties and their impact. Helm & Spritz (2000) devised a quantitative measure for assessing their effectiveness. It is a scale from 0 to 1, where the 0 represents zero compliance to a treaty, and the 1 is "a collective optimum" (a situation of perfect compliance to a treaty prescriptions by all participants). If a treaty participatory country scores 0, it means that it has the same performance as countries that are not participating in the treaty. In other words, the treaty does not make any effect. The score 1 is made by countries whose performance is perfectly matching with targets prescribed by the treaty they are participating in.

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<sup>4</sup> Yale Center for Environmental Law and Policy

The scale is tested on two environmental agreements<sup>5</sup>: 1985 Helsinki Protocol for reduction of sulfur dioxide (SO<sub>2</sub>) and 1988 Sofia Protocol for reduction of nitrogen oxides (NO<sub>x</sub>) emission. Results have shown that on a scale from zero (0) to complete compliance (1), agreements had a success rate of 0.39 and 0.31, respectively. Interpretation is possible in two directions: either we can say that IEAs are not effective since results are closer to 0, or that they are effective, but compliance capacities are on about one third of prescribed. This makes policy relevance of results vague as figures are far from both ends of the scale.

The 1988 Sofia protocol was also a matter of interest for Bratberg et al. (2003). Their research on 25 European countries from 1980 to 1996, has showed that ratifying countries had 2.4 percent higher annual reduction in nitrogen oxides, than non-ratifying countries.

Ringquist and Kostadinova (2005) assessed the effectiveness of Helsinki Protocol (1985) on sulfur dioxide emission reduction. Results have shown that the protocol did not have a significant impact on emission reduction. From 1980 to 1994 countries had a trend of constant SO<sub>2</sub> emission reduction, signatory countries showed higher reduction rates, but the appearance of Helsinki Protocol in 1985 did not make a change in emission ratios between signatory and non-signatory countries. Authors say that, even though purpose of the protocol is not fulfilled, there are some other contributions of it, as raising awareness about air pollution and establishing a system for monitoring, data collection, and knowledge sharing. This claim could be challenged by asking the question how can we measure effectiveness of these contributions, if not by measuring by their ultimate purpose - CO<sub>2</sub> reduction (which is already proven as non-existing in the analysis).

The key problem with research on single issues (as one specific international environmental treaty) is the issue of generalizability of findings to the whole population of treaties. Based on isolated case studies like this, sceptics could conclude that the whole population of international environmental agreements is ineffective. We need an approach that will include the number of cases that is much closer to entire statistical population, thereby producing more accurate estimates.

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<sup>5</sup> 1) and 2), to the 1979 Convention on Long-Range Transboundary Air Pollution

This chapter discussed a diverse set of perspectives on the effectiveness of IEAs as a policy instrument in environmental protection. All listed theories leave us, to a certain extent, with a possibility that compliance is an issue and IEAs are an ineffective policy instrument. That can be traditional realism which says that international relations is a state of war and conflict, and no kind of cooperation is possible; liberalism which says that a regime can fail if committed members realize that there is no authority which can contain free-riders; theories based on cost-benefit analysis which postulates that whenever a country understands that the treaty is producing more costs than benefits, the country will abandon its commitment; or, institutional theory where it is claimed that strong democracy is a necessary condition for expecting countries to comply. When discussing the results of empirical research papers and find contradictory results. Contradictory is expected because all these papers focus on different type of agreements, different number of countries, and differently defined research aims.

*Gap* – Based on the discussion above, this paper identifies an empirical gap in the literature as the lack of a comprehensive, empirical and quantitative (large-N) research, which could answer the question whether countries comply with agreements they have signed i.e. are environmental agreements an effective policy instrument.

The gap in theory is that the anarchy of international community, interests of individual countries, and the lack of enforcing mechanisms have been considered as some of main impediments for the effectiveness of environmental agreements. My theory presents a different perspective on their role, and argues that those three concepts are, in fact, crucial for the effectiveness of international environmental agreements.

### 3 Theoretical Approach

International Environmental Agreement, defined by Mitchel (IEA Database Project, 2002-2016), is:

*“an intergovernmental document intended as legally binding with a primary stated purpose of preventing or managing human impacts on natural resources”*

I emphasize the *intergovernmental* feature of international agreements as this paper will consider only agreements with countries as contracting parties. Agreements with and between NGOs, business or supra national organizations are excluded. Furthermore, depending on number of contracting parties, international agreements can be *bilateral* (between two countries) and *multilateral* (between more than two countries). Both types of agreements are included in this paper, because my research does not find any difference in the number of participants as relevant to this study of IEAs.

An important notion of this work is that international environmental agreements will be considered only on procedural grounds, and not on substantive. In other words, it is a question of procedural (implementational) effectiveness. Discussing substantive grounds is questioning the content of agreements and claiming e.g. that an agreement is ineffective in solving a certain environmental issue because its solutions are unviable and inadequate. This paper assumes, that every environmental agreement which is internationally recognized by countries' decision to participate, offers effective solutions that improve environment. If countries would perfectly comply with agreements' provisions, environment would prosper.

Procedural grounds is a question of international environmental agreements' effectiveness as a policy instrument in hands of the international community. If the international system, where they exist, is not established properly and participants are not cooperating, then IEAs can turn out as an inefficient (inappropriate) policy instrument for environmental protection.

First issue with international environmental agreements is that they generate doubts on its effectiveness because the literature does not offer a comprehensive research on IEAs with sample



size that would cover most of the population worldwide and throughout an extended period. By now, empirical research on effectiveness offers findings based on case studies and limited number of countries/agreements. This leaves the scientific, policy and general community in doubt and maybe misleads whether IEAs are a waste of resources or a useful policy instrument. Therefore, the analysis part will try to address this issue by conducting a comprehensive research on the population of IEAs.

Next ground for concern is that IEAs originate from the international community. International community is problematic because in the previous chapter we have seen that even realist and liberals agree in defining it as an anarchy. The question is how something can be sustainable and predictable in the state of anarchy. There comes the need for a sovereign authority on the international level that monitors how participants comply and punish free-riders. In international relations that sovereign does not exist, and that is one more reason why there is skepticism on the effectiveness of IEAs.

Deductive thinking from having the international community as an anarchy, and IEAs as products of that anarchy, bring us to the next concern: participation in international agreements is optional. There are no mechanisms for making countries to join agreements. Even if there is a central authority that does coordinate agreements creation and implementation (as United Nations), that authority does not have mandate to make countries join or mandate to punish free-riding countries. Sovereignty on the national level is still strongest type of sovereignty, and protector for countries to implement international agreements as they wish.

I stipulate that countries comply with obligations taken by signing international environmental agreements and that they are an effective policy instrument in fighting environmental problems. My reasoning is based on following arguments:

- 1) My view of the relationship between international community and agreements is not that agreements are *offspring* (product, consequence) of international community but rather a *solution* (reaction) to the conditions in it. If the international community is in a state of chaos, as all main theories claim, then deductive thinking leads to perceiving agreements

as unpredictable (chaotic), as well. I argue that making regimes as international environmental agreements is a way of getting the international system in order. Countries meet because that is in their interest, they define common problems and standpoints, and come up with solutions. This increases predictability and decreases uncertainty.

- 2) Second argument is that agreements emerge because countries have a genuine need for them. Agreements are not imposed to countries as “given” from the side of international community, but rather relation is reversed. Countries make agreements. The international arena is just a meeting point. They negotiate, bring out its stand-points, and agree on a common framework for how the problem will be tackled. As a final step, an agreement is made as a formulation of all agreed. Countries that are not satisfied with outcomes of negotiations, are free to withdraw from the agreement. But it is in the interest of all participants to find common grounds because they are aware that they need each other for tackling environmental issues.
- 3) Third point why I argue IEAs as an effective policy instrument is their feature of being voluntary. It means that countries cannot be forced to participate in it and threatened with sanctions for non-compliance. As we have seen in the literature review this one of the main objections to IEAs and reason for skepticism in their effectiveness. Critics say that lack of central enforcing mechanism, allows free-riders to flourish and makes honest countries reluctant to participation because they are afraid that others will take advantage of their commitment. My argument is that feature of being voluntary is an advantage of agreements. Countries do not have to take the part in an agreement if it goes against their interests/does not concern them. They have free will to perceive their interests and make assessment on agreement. Free-riders are bigger concern for regimes where countries are forced on participation and implementation. Politicians and citizens of those impelled countries do not believe in regulations that they have to implement, and free-riding will be their preferred option on a first favorable opportunity. A good example for effect of forced participation is European Union’s quota regime for accepting immigrants, and compliance of member countries that are forced to participate.

All these arguments lean on the rational functionalism and as a part of it, Robert O. Keohane's (1982) demand theory.

Rational functionalism (Simmons, 1998, Keohane, 1994) is on common grounds with e.g. realism in perceiving humans' nature as selfish. People will always choose an option that brings them the most benefits. But the difference between realism and functionalism is that interests of one country are not, by default, a threat to other countries. Interaction with other countries is not a zero-sum game, where for one player to win, another player must lose. Rational functionalism recognizes issues as transboundary air and water pollution as a common problem to all countries in the world. In solving this problem there are not different solutions that benefit to certain countries and leave others in sub-optimal position. Mitigating transboundary pollution is the best outcome for all countries.

Regarding the second argument, functionalist approach on international agreements is "*as a way to address a perceived need: International legal agreements are made because states want to solve common problems that they have difficulties solving any other way, e.g. unilaterally or through political means alone*" (Bilder 1989, according to Simmons, 1998). Environmental issues as transboundary pollution cannot be tackled individually. For example, one country can decide to protect its river from pollution because it has realized that polluted water endangers river's biodiversity and causes health issues. That policy can have absolute compliance in the country, but the problem are countries in the river's upper stream which do not have that policy, and their pollutants will still reach that environmentally aware country. Therefore, resources for implementing the protection policy are wasted in vain, and a country realizes that only cooperation with other countries can successfully tackle the river pollution.

Keohane's (1982) demand theory claims that countries need international environmental agreements because world's politics lacks authority and it is characterized by "*pervasive uncertainty*" (p. 332). Purpose of these agreements is reducing uncertainties. This goes in line with the argument 1 that sees agreements as a solution to the state of international relations. Supply of agreements depends on countries' demand for them. The demand will be determined by presence of complex environmental problems, and countries trust in agreements effectiveness. It turns out

that more agreements there is, and more agreements a country enters, trust in their effectiveness is higher. I hypothesize that trust and agreements' effectiveness are positively correlated since people will comply with the things they believe in.

Last notion is how rational functionalism and my theory explain “unsuccessful” environmental agreements. Simmons (1998) says that there will be always cases where problem severity or strong defeating incentives make countries either intentionally or unintentionally to disregard their obligations. In other cases, various occurrences as economic crises and regime changes can disturb countries commitment to their obligations. Moreover, agreements' content can be crucial for its successfulness, because some agreements are prescribing unrealistic or inappropriate solutions. This theory strived to cover a mainstream of relationship between countries and their commitment to international agreements. It recognizes that there are some exceptions, where e.g. two countries joined a certain agreement because it came in a package with other bilateral agreements. Offering a theory that would include exceptions of this type, is not in the capacities of this paper.

## 4 Aim and Hypothesis

Based on the theory discussed above I argue that international environmental agreements are effective policy instrument in tackling environmental problems because participatory countries trust in them and comply with undertaken obligations. There are three reasons for this belief. First reason is changed perception where agreements are an instrument for making order in the international community, and not a product of that community and its chaos. Second reason is that countries are aware that certain problems can only be tackled in cooperation with others, and it is in their interest to make agreements to succeed. People are selfish, but cooperation is the best option because eliminating the problem is the best option for everyone. Third reason is that agreements are voluntary, and countries are not forced to participate in agreements if they consider it as irrelevant or harmful to themselves.

*The aim* of this paper is answering whether international environmental agreements are an effective policy instrument in hands of international community for protecting environment.

The research question is: *Does a participation in international environmental agreements commit countries to comply with taken obligations, and consequently, improve environment?*

*Hypothesis: The more international environmental agreements a country has signed, the better environmental performance that country has.*

## 5 Methodology and Data

### 5.1 Method

This paper will try to give an answer to the question whether obligations taken by signing international environmental agreements make countries improve their environment. In other words, are IEAs an useful instrument of the international community for protecting the environment. Room for doubt is notable, since distinctive feature of IEAs is absence of enforcement control mechanisms.

### 5.2 Research design and data selection

The paper conducts a large-N analysis, aspiring to encompass all independent and recognized countries in the world. Criterion for independence and recognition was that a country is listed as a member of United Nations. That is 193 UN member countries, with accessing South Sudan in 2011 (UN Growth, 2017). Data is on a cross-sectional level, which means that cases are on country level during one calendar year. That year is 2016.

Statistical analyses are most often performed on a limited number of cases, because they cannot obtain data for the whole population of interest. Then results of the research on selected number of cases are generalized as applicable to the whole population. Generalization of findings based on a limited number of examined cases is always an issue. It is an advantage if number of cases in an analysis is closer to the true population. Although this thesis aspired to include the whole population (all states in the world) and reduce bias in the estimates, about 15% of cases had to be dropped-out due to lack of data.

Data sources for all variables are secondary. It means that I did not devise my own measures for variables, but downloaded from other sources. The employed data sources are all internationally recognized, and their databases available online. For example, data source for independent variable is under auspices of University of Oregon, dependent variable under NASA and Colombia

University, and control variables from World Bank, Central Intelligence Agency (CIA), Freedom House, etc.

One more reliability issue can be that some variables are also in their data source acquired as secondary<sup>6</sup> data. For example, dependent variable is very complex as consistent from more than 20 indicators. Data on those indicators is gathered from both primary and various secondary sources. That is reasonable and justified because environmental performance is a very complex<sup>7</sup> concept. Moreover, I could not find any other variable that covers even close overview of indicators on environmental performance than EPI (2016) does.

## 5.3 Variables

### 5.3.1 Dependent Variable (perf\_score16DV)

Dependent variable measures countries' environmental performance. It is not focused on any specific area of environmental performance, instead *Environmental Performance Index* (EPI) is a comprehensive measure of "countries' performance on high-priority environmental issues" (EPI Report, 2016:1) categorized in two groups:

1. Ecosystem Vitality (protection of ecosystems)
2. Environmental Health (protection of human health)

Each of the categories weights 50% of the variable and they are further divided into 9 sub-categories and 20 indicators, in total. The detailed structure of the variable is presented in the *appendix B*. All the indicators and final scores are aggregated to a scale from 0 to 100, with 0 as worst and 100 as the best score. Benchmarks for measuring level of performance are: commitments to goals of international treaties, scientific thresholds, and by comparisons to best performing country. Data is on a country level for year 2016. Number of cases (states) is 166. Measure is developed by Yale University and Columbia University<sup>8</sup>

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<sup>6</sup> My source is not the one who devised the measure and conducted data gathering

<sup>7</sup> It includes a lot of parts

<sup>8</sup> Yale Center for Environmental Law & Policy (YCELP) and Yale Data-Driven Environmental Solutions Group at Yale University (Data-Driven Yale), the Center for International Earth Science Information Network (CIESIN) at Columbia University

### 5.3.2 Independent Variable (agree\_num12IV)

The independent variable measures the sum of all international environmental agreements every independent country in the world has signed between 1868 and 2012. It is operationalized by the variable: Number of Signed Environmental Agreements per Country. The data comes from Environmental Treaties and Resource Indicators, online dataset provided by CEDAC (Socioeconomic Data and Applications Center) at NASA (U.S. National Aeronautics and Space Administration), and available for 191 countries with the total of 666 agreements.

Time-Lag<sup>9</sup>: – Data for independent variable is from year 2012, and data for dependent variable is from year 2016. That choice has been made because I assume that relationship between signing an agreement and its potential effect cannot be observed with employing data from the same year. First reason is that agreements need time to enter into force (from signing to implementation). From an agreement's side, usually it is stated that the entry into force is after a certain number of countries have joined it, or several years after it became available for signing. From countries' side, there is an implementation period into domestic legislation for signed agreements, such as ratification or accession. Therefore, an agreement that is signed after 2012, most likely has not even started being implemented. Second reason is that there is a period from agreement implementation to observing effects. My dependent variable is environmental performance i.e. observing effects. Environment covers large number of issues, and it is a very hard question generalizing what is reasonable time-period for all environmental agreements to show its effect. For example, a country can join an agreement that tries to ban a certain pollutant, pass a law that forbids production, trade and usage of that pollutant, and solve the problem in a year. On the other side, there are more far-reaching agreements as Montreal Protocol where recovery of the ozone layer is expected around year 2050 (EPA, 2017). Second paragraph will show how I counted for those reasons and came to 4-year time-lag.

Why 4-year time-lag? Considering the first reason (time-period from signing to implementing an agreement), calculation is made from SEDA W ENTRI (2017) database where are listed 480 IEAs

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<sup>9</sup> This should not be confused with *data lagging* (statistical estimation method in time-series analyses)



by the period they needed for the entry into force. In first 3 years from signing, about half of the agreements went into force (230). Some agreements never get into the force, and after the third year the entry into force rate is not that concentrated as in the first three years. That is why 3-year distance is chosen. Fourth year is added to cover the second phase: implementation to effects. As I mentioned, it is not easy generalizing on time periods needed for IEAs to show its effect. In some cases, it takes months, in some it takes years. That one year is reasonable because it gives time to a country to take actions on commitments from a signed agreement. Increasing the time-lag for more than 4 years would cause issues with IV data source, and higher distance between IV and DV, e.g. more than 10 years, could question arguments for a causal relation between variables.

### 5.3.3. Control variables

#### Level of Democracy (level\_of\_demo16C)

How democracy affects environment is very well illustrated by Payne (1995). It says that if we have an environmental problem, with freedom of press we can hear about it. Freedom of speech gives us opportunity to raise a voice about it, freedom of association to fight for it, and freedom of vote power to be heard from policy makers.

Proxy for democracy in this paper is Freedom House 2016 Report for the state of freedom in the world, measured through 25 indicators in areas of political rights and civil liberties. Final score is expressed on a scale from 0 to 100, where 100 is the “absolute freedom” (top performing democracy). Neumayer (2002) used democracy as explanatory variable for IEA participation preference, and the analysis has really shown that democracies are more prone to take part in IEA. Limitations of this paper are that analysis covered only 19 countries and 4 agreements. Furthermore, democracy was coded dichotomously (democracy 1; no-democracy 0). This thesis operationalizes democracy through a continuous variable, what I argue as more useful for interpreting results to the real world. First argument is well-known that continuous measurement better catches variance between units of observation. Second argument is that in contemporary world, where majority of the countries are declared as democracies, publishing results where e.g. “democracy is better in something” mostly targets that minority of non-democratic countries by suggesting that is better converting to democracy. Then majority (democracies) can just read that

they are good as they are. But the room for improvement is big for every country<sup>10</sup> and with continuous variable result would say: “If you e.g. improve your political and civil liberties<sup>11</sup> for 1 point up, this (dependent variable) will improve/change for this much.”, and this gives a clearer picture and incentive to policy makers in all countries.

#### Rule of Law (rule\_of\_law16C)

Rule of law is operationalized through homonymous variable *rule of law*, provided by World-Wide Governance project (World Bank). Data collection method is expert surveys on questions to which extent agents comply with rules of the society. These questions are about contract enforcement, property rights, courts, etc. Data is on a country level for year 2016, and available for more than 200 independent countries and territories.

Argument for including this variable is already part of institutionalist theory in the literature review section. As Slaughter (1995) would say, strong rule of law makes strong and independent judiciary. Strong judiciary puts constraints on rulers’ behavior. Constrained rulers are guarantee that agreements will be respected and not subject of their free will. International agreements are also part of international law, and in a country where there is strong respect for rule of law, expectation is that compliance to international law in form of agreements is also high.

Therefore, I assume that stronger rule of law will produce higher environmental performance. Support for this assumption is forecast of Environmental Performance Report (EPI, 2016) that only cooperation and rule of law can govern lasting environmental progress (p. 47).

Limitation of this variable can be that is based on expert surveys, where is always opened question or reliability and comparability of data obtained from people’s personal perception.

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<sup>10</sup> To reach score 100 on democratic performance indexes

<sup>11</sup> Democratic components

### Economic Development (log\_GDP16C)

The measure for economic development is gross domestic product (GDP) per capita provided by World Bank and OECD<sup>12</sup>. Variable in original data source is GDP per capita (current US Dollar). Data is on a country level for year 2016. It offers data for more than 200 countries and territories. Generalized definition of gross domestic product is that represents aggregated money value of all goods and services produced in one country in a year period. Per capita is aggregated value of all goods and services divided by population of respective country. Current US dollar means that it is taken value of the currency from that year, and not corrected for inflation.

GDP per capita is a measure of how much an economy is developed. If the economy has higher GDP per capita, it means that standard of living is higher. That society has resources to solve problems like clear water and sanitation, or investing in alternative sources of energy. Inglehart claims that societies can move to post-materialistic values only if they first secure materialistic values as food and shelter (2014). I argue that countries with higher GDP (standard of living) are better in securing food and shelter to its citizens.

This variable is already tested in papers by Scruggs (1999) on 17 western democracies and Alvarez et al. (2014) on 149 countries, and in both papers GDP per capita is proved as significant explainer of environmental performance.

### Civil Society Strength (log\_NGOs\_16C)

Measure for civil society strength is operationalized through number of non-governmental organizations (NGOs) per country. Variable source is WANGO<sup>13</sup>s Worldwide NGO directory for year 2016 and more than 170 countries. A NGO is a non-profit and voluntarily organization that is governed independently of a state. NGOs emerge in a response to states' inability to cope with problems in a society (Agarwal, 2008; Badruddin 2014). They shed light on problems i.e. inform and engage people, provide media coverage. They conduct expert analyses and formulate public interests. They put pressure on policy makers and affect policy making (Ibid.) More NGOs a

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<sup>12</sup>World Bank national accounts data and Organization for Economic Cooperation and Development National Accounts data files

<sup>13</sup> The World Association of Non-Governmental Organizations

government allows, stronger civil society that country has. Environmental NGOs are part of NGOs cluster and same line of reasoning applies to them. Environmental NGO's emerge in a response to governments' inability or unconcern to foresee and understand environmental issues, and formulate and implement appropriate responses. Based on that, I expect that higher number of NGOs in a country produces higher environmental performance.

First limitation of this variable is that number of environmental NGOs would be more appropriate measure for effects on environmental performance, than the total number of NGOs. Lack of data is the reason why this variable is not employed. Second, number of NGOs is a proxy variable for civil society strength because civil society is a wider concept. That is not an issue because NGOs are part of civil society than my analysis is interested in. Analysis aspired to consider influences on environment from 3 different levels: international (independent variable), national governmental level (rule of law) and organized national non-governmental level (NGOs). The only level that is missing is individual (citizens) and very good variable on that issue exist in World Value Survey database, where people are asked to give their opinion on environment related question. Although good, this variable is not included because it reports data only from around 60 countries, what would notably narrow number of cases in the analysis.

## 6 Analysis / Results

This section will present results of the OLS multivariate regression, on which the decision will be made either to accept or reject the research hypothesis – the more international environmental treaties a country has signed, the higher environmental performance it has.

Method employed is a multivariate (OLS) linear regression analysis because 1) it produces a correlation level between number of signed environmental agreements and environmental performance. 2) Statistical significance test says whether the correlation is genuine or by chance. 3) Furthermore, it has a predictive capacity by producing coefficients that in a regression formula can predict how much change in number of signed IEAs can make a change in environmental performance<sup>14</sup>. Four control variables are included in the analysis in order to control for other effects on the dependent variable.

First model employed is a bivariate analysis between independent and dependent variable. Then four control variables are introduced in a step-wise manner. Model 5 is the main model since it includes all variables of interest.

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<sup>14</sup> Under condition that method proves a suitable and results significant

Table 1. List of variables with descriptive statistics

<b>Variable</b>	<b>Category</b>	<b>Description</b>	<b>Number of Cases</b>	<b>Min</b>	<b>Max</b>	<b>Mean with St. Deviation</b>
<b>perf_score16DV</b>	dependent variable	environmental performance index by Yale	166	27.66	90.68	68.14 (14.61)
<b>agree_num12IV</b>	independent variable	number of signed environmental agreements by CEDAW	166	5	303	103.70 (50.28)
<b>level_of_demo16C</b>	control variable	level of democracy by Freedom House	166	2	100	60.96 (28.23)
<b>rule_of_law16C</b>	control variable	rule of law by World Bank	166	-2.37	2.04	-0.01 (0.95)
<b>log_NGOs_16C</b>	control variable	logged number of non-governmental organizations by WANGO	166	.00	4.34	1.61 (0.74)
<b>log_GDP16C</b>	control variable	logged gross domestic product per capita by World Bank	166	2.46	5	3.72 (0.63)
<b>edu_exp16C<sup>^</sup></b>	additional control variable	educational expenditure as a percent of GDP by CIA	147	0.60	13.00	4.82 (1.98)

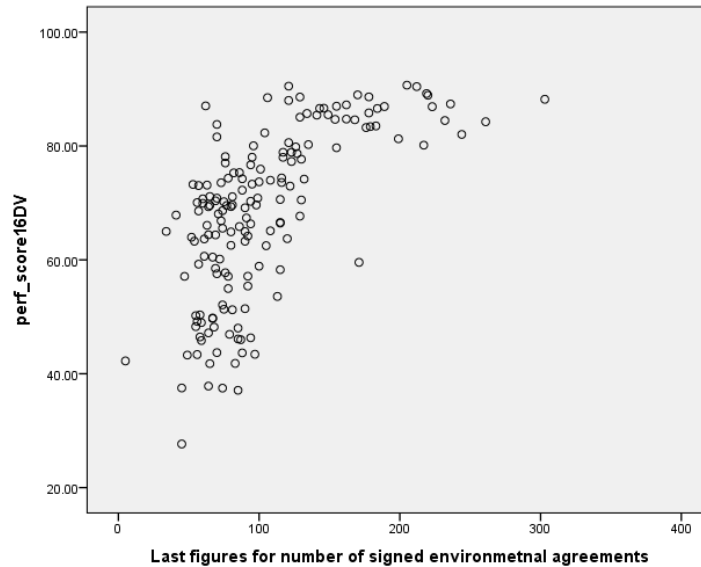
1) all variables are on continuous measurement 2) all variables are on country level

<sup>^</sup>educational expenditure variable is not part of the main model because on one side it notably decreases number of cases and on the other side it is not the best proxy for education. Lack of 2016 data for other education variables, made edu\_exp16C relevant to this analysis.

## 6.1 Preliminary statistics

*Linearity* - The scatter-plot between independent and dependent variable shows a linear relationship between values on X and Y axis what fulfills the first assumption for OLS analysis. On the higher end, the line tends to be curvilinear, what made me test a quadratic regression, but the quadratic regression did not show any improvement of the model (more detailed in 6.4.1 section).

Graph 1. Test for linearity between independent and dependent variable



Regarding control variables, two of them had to be log transformed (Log10) to approximate normal distribution. Those variables are *log\_NGOs\_16C* and *log\_GDP16C*

*Multicollinearity* – Is an assumption of OLS regression where independent variables cannot be strongly correlated among each other. If independent variables are strongly correlated, it probably means that they are measuring the same thing, leading to biased estimates. Usually, a correlation above 0.80 is considered as indicative of multicollinearity.

*Table 3* reports bi-variate correlation between all predictors. A reason for concern in this test emerges from relationship between rule of law (*rule\_of\_law16C*) and GDP (*log\_GDP16C*) where correlation coefficient reports 0.808. This value is slightly above allowed 0.800 level what suggest that one of the variables perhaps should be dropped-off. I will wait with taking actions on this until I do other two multicollinearity tests (t and VIF). Those two tests are performed together with the regression.

Table 3. Multicollinearity check for explanatory variables

Variable	agree_nu m12IV	level_of_d emo16C	rule_of_la w16C	log_NGOs _16C	log_GDP1 6C	edu_exp16 C^
agree_nu m12IV	1	0.567**	0.590**	0.555**	0.573**	0.189*
level_of_d emo16C		1	0.689**	0.297**	0.545**	0.369**
rule_of_la w16C			1	0.314**	0.808**	0.296**
log_NGOs _16C				1	0.262**	-0.050
log_GDP1 6C					1	0.133
edu_exp16 C^						1

\* Correlation is significant at the 0.05 level (2-tailed)

\*\* Correlation is significant at the 0.01 level (2-tailed)

## 6.2. Post-regression diagnostics

*Multicollinearity* – Additional testing for this issue has been performed by using variance inflator factor (VIF) and tolerance (t) test. According to Field (2009), VIF test should report values lower than 5, and t test values higher than 0.2 for all variables, for us to say that multicollinearity is not an issue. As we can see in the *Table 4*, none of the variables is overstepping these allowed values. Even suspicious variables from preliminary multicollinearity testing (*rule\_of\_law16C* & *log\_GDP16C*) are under the allowed values. Therefore, they have been kept as part of the analysis, and multicollinearity is rejected.

Table 4.

VIF and tolerance (t) test for multicollinearity between explanatory variables

Variable	tolerance (t)	VIF
agree_num12IV	0.422	2.261
level_of_demo16C	0.486	2.058
rule_of_law16C	0.259	3.868
log_NGOs_16C	0.685	1.460
log_GDP16C	0.328	3.046
edu_exp16C^	0.779	1.283

^variable not included in the main model



*Linearity* – Plotting studentized regression residuals to predicted values we can see (graph in *appendix C(1)*) that residuals are normally distributed above and below the mean of zero, what suggest that the linear model is suitable for this regression.

*Homoscedasticity* – This same graph as for linearity (see in *Appendix C(1)*) says us about whether the size of error term is on the same level for all predicted values. If not, we have heteroscedasticity that compromises calculation of standard errors and p values (Xezonakis, 2017). Except of some potential outliers, plotted values do not make any unusual shape from beginning to the end of X axis.

*Error distribution* – Checking for error distribution is important because normal distribution of errors is important for reliable t test and statistical significance. Histogram of residuals in *Appendix C(2)* shows a normal distribution in a bell shape, evenly from the mean of zero.

Furthermore, normal probability plot of regression standardized residuals (*Appendix C(3)*) shows that data almost completely overlap with theoretical normal distribution, what suggests that data are normally distributed.

*Outliers* - Checking for studentized deleted residuals, has showed that only two cases are above value of 2.5 (2.89 and 2.95). Since the threshold for presence of outliers is  $>3$ , this method suggests that outliers are not an issue. Additionally, the plot of predicted values and studentized residuals (*appendix C*) does not show any dot surpassing value 3 on axes, what is considered an threshold for outliers. There were no outliers in this case.

### 6.3. Multivariate OLS regression

Multivariate OLS regression tests the explanatory power of main independent variable on the dependent variable, alongside with controlling for other effects (control variables). Five models are performed, starting from bivariate regression between the independent and the dependent

variable. Further models step-wise include control variables, until the main model -*Model 5*- where all variables are included (main independent, controls, and dependent variable).

To strengthen the analysis, additional model 6 is performed, with including one more control variable (education). This variable is not part of the main model 5 because its data availability would notably decrease number of cases in the analysis.

Table 5. Regression table

DV (perf_score16DV) 0-100	model 1	model 2	model 3	model 4	model 5 main model	additional model
	b (st. error)	b (st. error)	b (st. error)	b (st. error)	b (st. error)	b (st. error)
<b>IV</b> <b>agree_num12IV</b>	0.189*** (0.017)	0.142*** (0.02)	0.103*** (0.019)	0.117*** (0.022)	0.077*** (0.018)	0.067*** (0.019)
<b>level_of_demo16C</b>		0.148*** (0.036)	0.028 (0.038)	0.027 (0.038)	0.051 (0.031)	0.039 (0.034)
<b>rule_of_law16C</b>			6.847*** (1.148)	6.835*** (1.145)	-0.948 (1.248)	-2.087 (1.341)
<b>log_NGOs_16C</b>				-1.633 (1.224)	-0.734 (0.994)	-0.199 (1.075)
<b>log_GDP16C</b>					15.543*** (1.672)	16.782*** (1.782)
<b>edu_exp16C^</b>						0.309 (0.362)
<b>Constant</b>	48.57*** (1.99)	44.44*** (2.14)	55.79*** (2.72)	57.06*** (2.88)	0.42 (6.52)	-4.3 (7.26)
<b>R<sup>2</sup></b>	0.422	0.477	0.571	0.576	0.725	0.728
<b>N</b>	166	166	166	166	166	147

Significance levels \* $p > 0.1$ , \*\* $p > 0.05$ , \*\*\* $p > 0.01$

*Model 1* - The first bivariate model supports the hypothesis that participation in more environmental agreements leads to higher environmental performance. As it can be seen in regression table, relationship is positive and significant at  $p < 0.01$  level. One-unit increase in number of signed environmental agreements (i.e. one more agreement) would increase environmental performance in a country by 0.189 (0-100 scale). Level of explained variance ( $R^2$ ) in dependent variable by this model is 42.2%.

*Model 2* – Introducing level of democracy as the first control variable did not affect the impact of the main independent variable, since significance level stayed at  $p < 0.01$  level, standard error

decreased almost to 0, and unstandardized beta value decreased only slightly. Control variable showed significance ( $p < 0.01$ ) and positive relation, as well. Effect size is one-unit increase in level of democracy leads to increase in environmental performance by 0.148 (0.036). This model increased level of explained variance ( $R^2$ ) by 5%.

*Model 3* – This model introduced rule of law as second control variable. By introducing this variable, main independent variable stayed significant at  $p < 0.01$  level, but its effect size continued to decrease (b from 0.189 in model 1 to 0.103 in model 3). Level of democracy control variable lost its significance, but the new control variable (rule of law) is significant at  $p < 0.01$  level. Level of explained variance increased further in this model for about 10%.

*Model 4* – The third control variable introduced is number of non-governmental organizations. This variable did not pass significance test. Other two control variables reported the same significance level (rule of law significant and level of democracy insignificant). Independent variable is on  $p < 0.01$  significance level, with increase in the beta coefficient, and negligible change in error term. Level of explained variance ( $R^2$ ) is unchanged (58%).

*Model 5 (main model)* – In the main model, the fourth control variable is introduced: gross domestic product per capita. This variable has a strong effect on environmental performance, since it made other three control variables insignificant. Significance level for independent variable stayed constant through all the models ( $p < 0.01$ ), but beta coefficient (b) of 0.189 in the model 1 decreased to 0.077 in this model. It interprets as one-unit increase in number of signed environmental agreements leads to 0.077 increase in environmental performance (positive relationship). In other words, one more signed environmental agreement, should improve environment in the country by 0.077% (scale 0-100). Standard error of this prediction is 0.019. Level of explained variance ( $R^2$ ) in dependent variable by this model and its 5 explanatory variables is 72.5%.

This model supports the hypothesis that higher number of environmental agreements leads to higher environmental performance. It suggests that countries comply with international

agreements that they have signed, and that international environmental agreements are an effective policy instrument in hands of international community for protecting the environment.

In sum, the independent variable remains significant across all models and signed as expected.

An additional model is performed because I argue that education is an important explainer for the environmental performance, and I wanted to increase reliability of my analysis by checking for it. Even though there is a vast number of educational indicators, I have encountered difficulties finding data for year 2016. The only available indicator for year 2016 was educational expenditure as a percent of GDP. There are two reasons why this variable is not in the main model. First reason is that this is a proxy variable for level of education in one country, and the validity of this indicator can be questioned. The second reason is that this variable would decrease number of cases in the main analysis by 19, what would be a loss for goal of this paper<sup>15</sup>, and, on other side, benefits would be minimal as this variable does not make any notable difference in results.

Report from additional model says that, as in the main model, only independent and GDP per capita passed the significance test ( $p < 0.01$ ). Beta coefficient (b) and standard error for independent variable are very close to values in Model 5, and level of explained variance by the model is unchanged (0.3% increase). Number of cases in this model is 147.

## 6.4. Robustness check

### 6.4.1. Quadratic model

In plotting the independent against dependent variable (*graph 1* or *appendix D*), it seemed that relationship should be checked for non-linearity. In non-linear (curvilinear) models, regression line is more elastic (i.e. bends to fit the data), and increases level of explained variance in dependent variable. Quadratic regression is the name of employed non-linear model. Main change to linear model is squaring values of independent variable and running the regression with both the independent variable and the squared independent variable. In that way, results show whether squared term and the quadratic model make any improvement to the linear analysis.

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<sup>15</sup> Goal is making conclusions based on the most possible number of case

Results of quadratic regression (*appendix D*) suggest increase in level of explained variance 2.4% ( $R^2$  change to 0.725 to 0.749). It means that this model is better in explaining environmental performance, but only for 2.4%. Results are statistically significant at  $p < 0.01$  level. The reason why this regression model is not used instead of OLS regression is that model improvement of only 2.4% ( $R^2$ ) was not enough reason for sacrificing interpretation of beta coefficients (squaring independent variable makes regression beta coefficient irrelevant).

#### 6.4.2. Using alternative measures for control variables

In order to check for stability of results produced by the main model, this paper changed control variables. Out of four, three control variables are changed (see Appendix E) because for *number of NGOs* there was no suitable change in the year of measurement. *GDP per capita* variable source is changed from the World Bank to International Monetary Fund, *level of democracy* from Freedom House to V-Dem, and rule of law is changed with government effectiveness<sup>16</sup>. Independent and dependent variable remained the same.

The rerun regressions showed the stability of the estimates, since they remained almost unchanged compared to the main analysis.

Table 6. Comparative view of regressions with changing control variables

	R2	Significance	B (st. error)
Main model (Model 5)	0.725	$P < 0.01$	0.077 (0.018)
Changed control variables model	0.724	$P < 0.01$	0.071 (0.019)

\*Due to lack of data, number of cases for second model is decreased from 166 to 150

#### 6.5. Limitations of the study

Potential control variables as corruption level and government effectiveness are excluded from the main model because of multicollinearity with rule of law control variable. Reason for opting for

<sup>16</sup> Government effectiveness, alongside with corruption, had to be removed from main model because of multicollinearity issue with the rule of law variable.

rule of law rather than for corruption is because I see corruption as a feature of weak rule of law. Therefore, rule of law was more encompassing variable. Reason for not taking government effectiveness is that I was more interested in countries respect for international law and policies that they committed to obey, than in their capabilities to create and implement sound national policies.

Second limitation can be that agreements are considered only on procedural<sup>17</sup> grounds. I believe that in reasons why some agreements fail, its content can give the answer. I also believe that those are isolated cases, and majority of agreements depend on countries' attitude to obligations taken by agreements.

Third potential limitation is reversed causality where we hypothesize that country with high environmental performance is more prone to sign an environmental agreement. In analysis part, I tried to tackle this issue by finding an explanatory variable that affects the independent variable, and does not affect the dependent variable directly. By proving correlation between the new variable and the independent variable, and using predicted values for the main regression between IV and DV, the causal pathway could be "locked". Finding this variable was hard and closest candidate was *participation in international organizations*, but it had to be dropped-off because of multicollinearity with *number of signed agreements*. It would be interesting for some future research to find this type of variable and improve the model.

Then I addressed this issue on theoretical grounds. Environmental agreements are issue specific. Countries enroll in them because they have a specific environmental issue that they want to solve. The need makes them address the issues, not a good performance in other areas. Regardless of country that signs it, an agreement always obliges participants to take actions. Purpose of them is to make countries to protect, preserve or improve (what changes condition of environment, and its performance). Moreover, a time-lag between IV and DV is introduced, where it cannot be argued that environmental performance from 2016 (DV) can explain cumulative number of agreements between 1868 and 2012 (IV).

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<sup>17</sup> implementational

The last limitation to discuss is omitted variable bias, which I see as more important issue than reversed causality. It is a threat of a variable not included, and which is the explanatory variable for both independent and dependent variable. Variable of that type can be *environmental awareness*<sup>18</sup>. That variable could not include environmental performance scores since that would mix with the dependent variable. That variable can be opinion based like in World Value Survey Project, but, as mentioned earlier, that project offers data for only 60 countries. For someone who is not trying to encompass all countries, it would be interesting checking for explanatory power of this variable.

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<sup>18</sup> On country level

## 7 Conclusion

The aim of this paper was to answer the question whether international environmental agreements are an effective policy instrument in the hands of international community for protecting the environment. Skepticism lies in reasons why countries take part in those agreements and whether they intend to comply with them. The lack of established mechanisms for tracking countries' compliance is obvious. International agreements do not have a central enforcing authority that can ensure countries' compliance and punish free-riders. Moreover, there is a consent in political science literature that the place where environmental agreements originate from (international community) is in a state of chaos.

To answer this question the thesis developed a new theoretical argument. My theory gives a different perspective on these issues and suggests that countries comply with environmental agreements that they have signed. The empirical analysis using data for most of the countries in the world, provided support to the claim that higher number of environmental agreements lead to higher environmental performance. Method used is multivariate OLS regression. The robustness of the estimates is tested through several models, and across all models and specifications the independent variable remained significant  $p < 0.01$  level and signed positively as expected. The final model, level of explained variance of dependent variable by the model was 72.5 percent.

The main takeaway from this research is that environmental agreements are an effective policy instrument. It seems that countries comply with agreements that they have signed, even though enforcing mechanisms are not in place. The research tends to bring back faith in environmental agreements. Its findings can assist policy makers in its national countries during discussion for participation in this type of projects. It can challenge political science and law theory by claiming that enforcement mechanisms are unnecessary for functioning of certain regimes. Lastly, it offers to environmental treaties theory a comprehensive quantitative analysis with 166 countries and 666 agreements.

As a concluding remark of this paper I would like to name some potential limitations whose consideration would be enriching to future research on this topic. First is reversed causality issue



where finding a variable that explains independent variable and affects the dependent just through the independent variable, would strengthen the causal pathway in this paper. Second limitation is omitted variable bias where it would be interesting to test the explanatory power of a variable as environmental awareness on both independent and dependent variable. I am looking forward to seeing how those challenges will be tackled.

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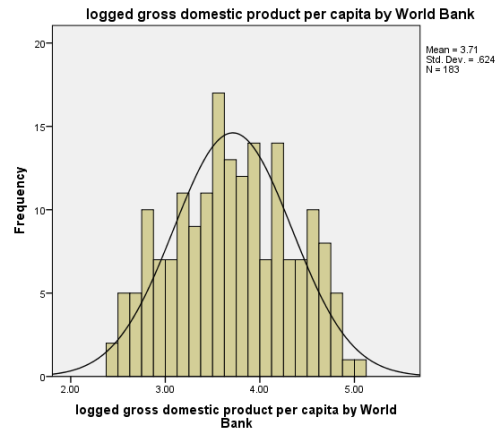
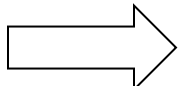
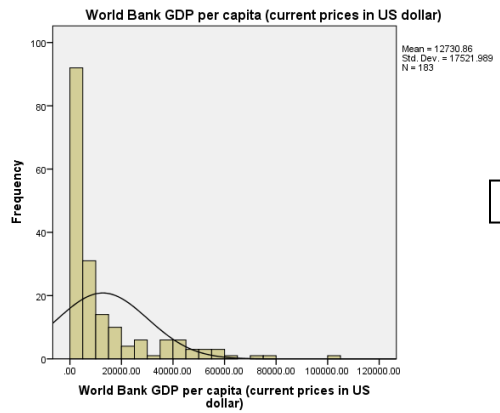
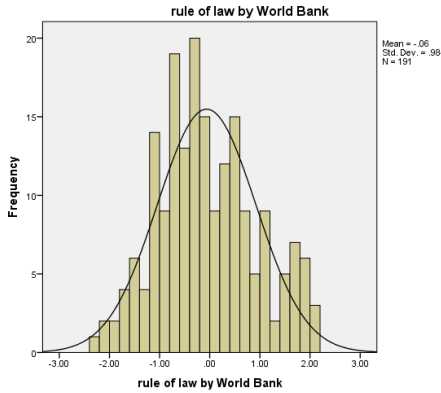
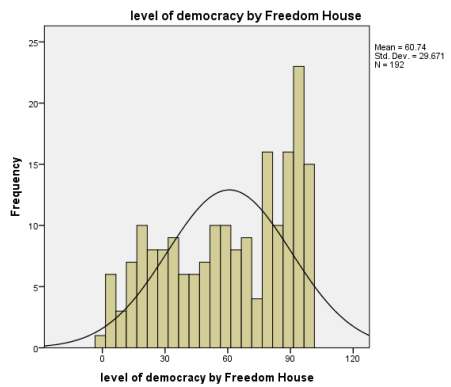
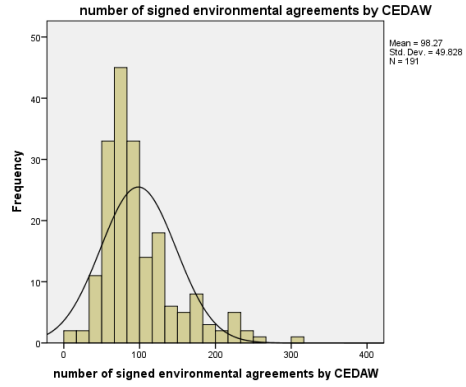
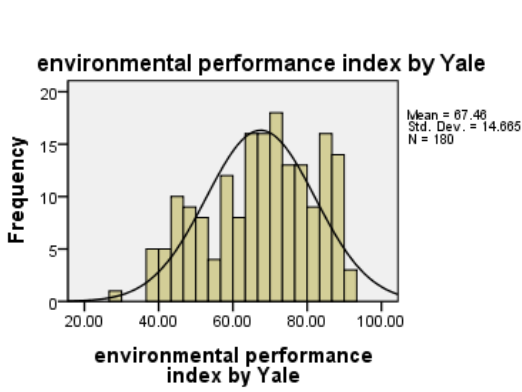
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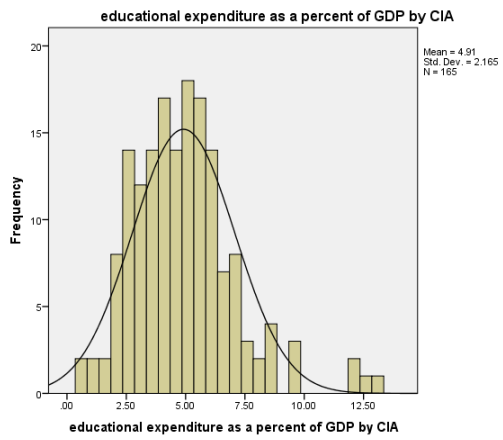
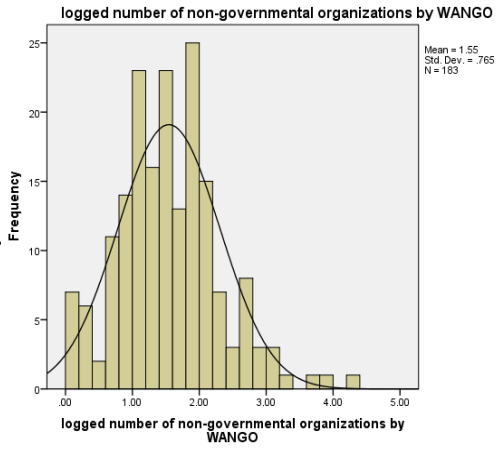
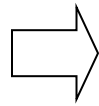
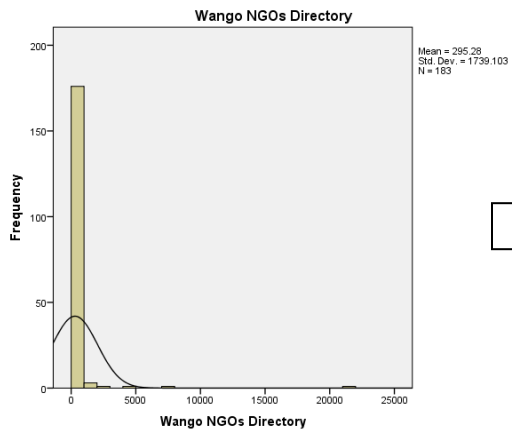
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# Appendices

## Appendix A: Distribution of variables





## Appendix B: Dependent variable

Detailed structure of the dependent variable (2 groups -> 9 issue -> 20 indicators)

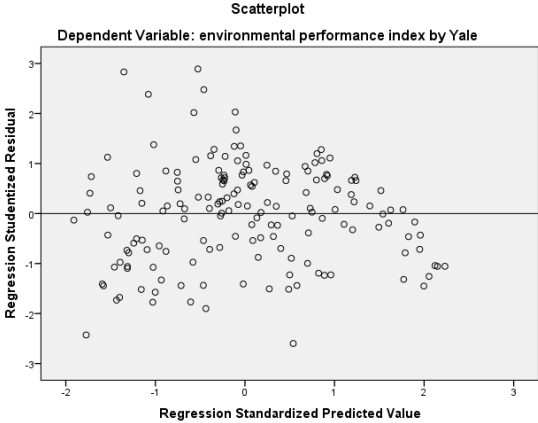


Source: Environmental Performance Index 2016 Report

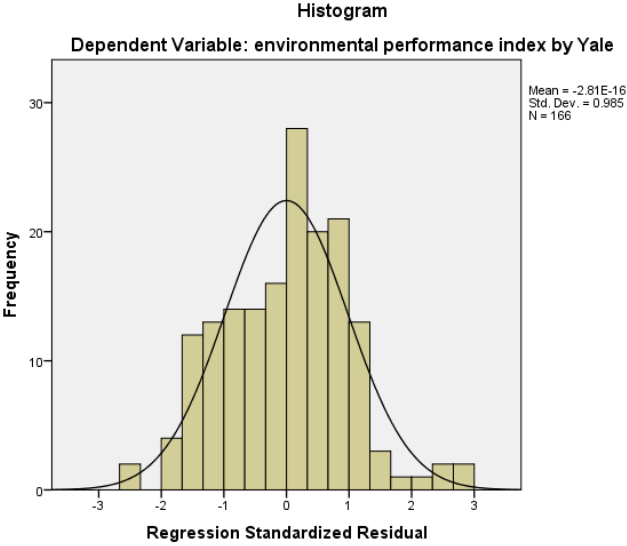


Appendix C: OLS assumptions

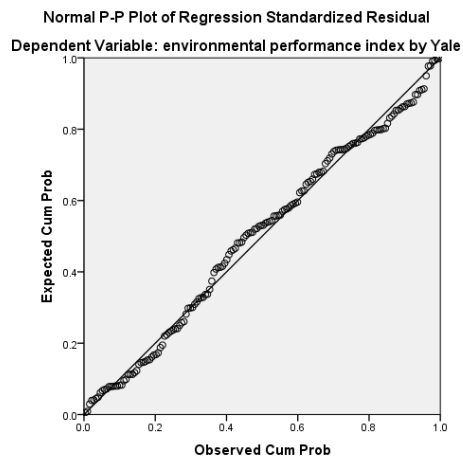
- 1. Plotting regression residuals to predicted values as check for linearity



- 2. Error distribution

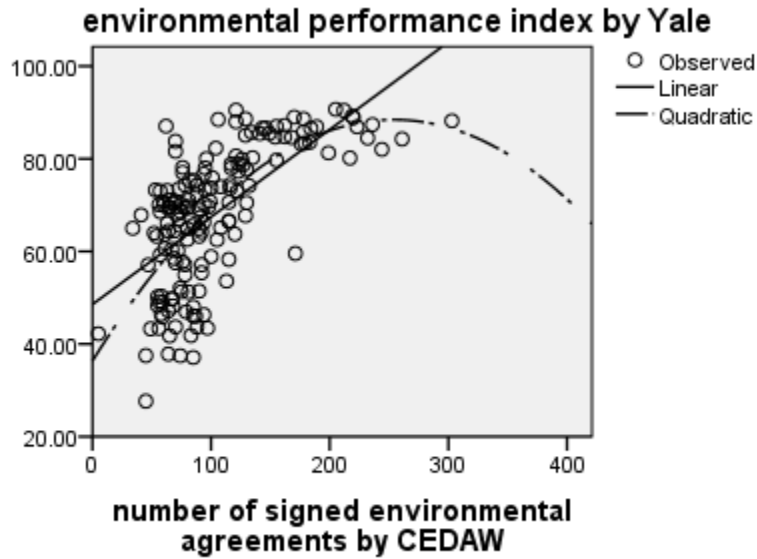


### 3. Normal probability plot of regression residuals



## Appendix D: Quadratic regression

### Linear vs. Curvilinear model



### Quadratic regression

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change
						F Change	df1	df2	
1	.851 <sup>a</sup>	.725	.716	7.78654	.725	84.229	5	160	.000
2	.865 <sup>b</sup>	.749	.739	7.46322	.024	15.163	1	159	.000

a. Predictors: (Constant), logged gross domestic product per capita by World Bank, logged number of non-governmental organizations by WANGO, level of democracy by Freedom House, number of signed environmental agreements by CEDAW, rule of law by World Bank

b. Predictors: (Constant), logged gross domestic product per capita by World Bank, logged number of non-governmental organizations by WANGO, level of democracy by Freedom House, number of signed environmental agreements by CEDAW, rule of law by World Bank, squaredIV2012

## Appendix E: Robustness check

### Description of substitute variables

Variable	Category	Description	Number of Cases	Min	Max	Mean with St. Deviation
<b>RC_libdemo_VD EM</b>	control variable	liberal democracy index by V-Dem	150	0.04	0.87	0.44 (0.24)
<b>RC_gov_effect16 C</b>	control variable	government effectiveness by Freedom House	150	-2.18	2.21	0.01 (0.96)
<b>log_RC_GDP_IM F</b>	control variable	GDP per capita by IMF	150	2.46	5.02	3.72 (0.62)

*\*all variables are continuous*

Bivariate correlation between original and substitute variables

Original and substitute variable	Pearson's r
<i>level_of_demo16C &amp; RC_libdemo_VDEM</i>	0.922**
<i>rule_of_law16C &amp; RC_gov_effect16C</i>	0.929**
<i>log_GDP16C &amp; log_RC_GDP_IMF</i>	0.998**

*Correlation is significant at the 0.01 level (2-tailed)*