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Preferential Trade Agreements – an effective policy tool in climate change governance?

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ABSTRACT

This dissertation explores the nexus between environmental provisions in Preferential Trade Agreements (PTAs) and greenhouse gas emissions. It aims to shed some light on the inconclusive debate of issue linkage in PTAs as a policy instrument in climate change. Using a mixed-method approach, the study examines (1) whether environmental provisions in PTAs lead to a reduction in greenhouse gas emissions of trading partners, and (2) how the design and legal nature of climate provisions influence their effectiveness. The empirical analysis is conducted using data for 184 countries over a time frame from 1990-2019. A case study on the US-Peru Trade Promotion Agreement explores the mechanisms through which PTAs take effect. The study finds that countries which include numerous environmental provisions in PTAs will tend to reduce per capita GHG emissions compared to those without environmental provisions. Provisions explicitly targeted at climate change appear especially effective. The study adds new findings to the yet small body of literature by identifying long-term effects on trading partners' emissions. It finds PTAs to be an effective tool in climate governance due to their enforceability. They can take effect through changes in domestic law and through fostering civil society activity.

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Abbreviations

EKC	Environmental Kuznets Curve
EU	European Union
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GHG	Greenhouse gas emissions
MEA	Multilateral Environmental Agreement
PTA	Preferential Trade Agreement
TPA	Trade Promotion Agreement
US	United States of America
WTO	World Trade Organisation

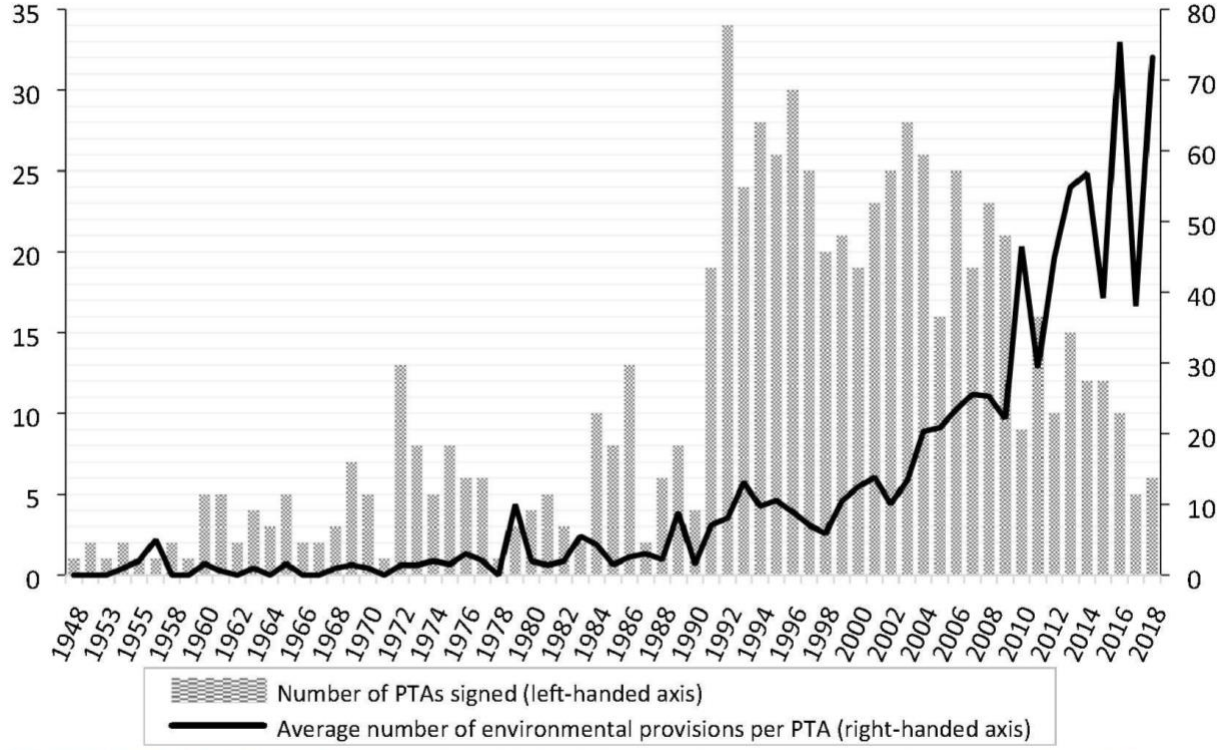
I. Introduction

At the World Economic Forum in 2022, climate action failure was deemed the most severe risks on a global scale over the next 10 years (World Economic Forum 2022, 14). Rising greenhouse gas (GHG) emissions are continuously responsible for the anthropogenic climate change. Average annual emissions between 2010 – 2019 have been higher than in any previous decade (IPCC 2022, 10). In response to these developments, there has been a consistent expansion of policies and laws addressing climate change and climate change mitigation on the national and trans-national level (IPCC 2022, 17). The multitude of approaches have led to the emergence of — what Keohane and Victor (2011) term — the climate change regime complex, with the central task to cut emissions. One of the main institutional elements that the complex comprises is the international trade regime.

The World Trade Organisation (WTO) rarely touches upon environmental concerns, as the inclusion of non-trade issues remains largely outside its regulatory jurisdiction. Therefore, countries have increasingly turned to bilateral and regional trade agreements to address environmental concerns through trade. The EU proclaims the negotiation and implementation of environmental provisions in trade agreements as a key element of EU policy on a regional and bilateral level (European Commission 2019). Since the end of the 90s, the number of environmental provisions included in trade and investment agreements has risen sharply (Figure 1). In 2016, each new Preferential Trade Agreement (PTA) contained, on average, approximately 100 different environmental provisions (Brandi et al. 2020). Such provisions include climate protection, deforestation, and/or the regulation of hazardous waste.

Using trade agreements to govern state behaviour in non-trade issues is not a new phenomenon. Issue linkage initially started with the inclusion of human and labour right standards. Nevertheless, the effectiveness of such clauses is still heavily debated. While some see PTAs as an effective policy instrument in the fight against climate change, others are convinced that PTAs will not only yield no improvements but also lead to detrimental effects on the environment or the climate. A common critique is that such provisions constitute “green protectionism”, which refers to high income economies raising environmental standards so as to protect the market from cheaper

Figure 1: Average number of environmental provisions per PTA (Source: Brandi et al. 2020)



products from developing economies (Krugman 1997; Lechner 2016). Others argue that environmental provisions are mere "fig leafs" that are included in modern PTAs to make them less controversial in the eyes of the public and legislators (Berger et al. 2017, 1). A narrow line of reasoning also criticises the idea of environmental provisions belonging in trade agreements at all. They believe that everything should be negotiated in the appropriate sphere: tariff reductions in trade agreements and environment laws in environmental treaties (Condon 2015, 136).

However, from a negotiation perspective, issue linkage has convincing advantages. Taking Putnam's two-level theory, at level two, interests group know that their issues are far more likely to find approval if they are tied to other issues that the majority supports (Condon 2015). Furthermore, negotiation between two parties is far easier than multilateral negotiations in the international sphere. We have repeatedly seen how difficult negotiations towards multilateral environmental agreements are, and thus linking it to trade can be a very efficient tool. Proponents also identify PTAs as a way to make multilateral environmental agreements (MEAs) enforceable. In a regime that is otherwise mostly governed by reputational concerns, trade sanctions, private

remedies, or dispute, settlement mechanisms have the potential of making environmental issues enforceable.

Issue linkage does not have to take a specific form. The range of how environmental issues can be included in PTAs is wide. Some merely refer to environmental protection in the preamble. Others include provisions which obligate the parties not to lower environmental standards, or conversely higher the level of environmental protection. Further approaches include cooperation on environmental issues, technical assistance, or the commitment to implement MEAs. Some PTAs include best-effort obligations while others go as far as allowing trade sanctions or private remedies in case of a breach of the environmental provisions in PTAs.

Despite the recent surge of environmental standards in PTAs and the vastly different approaches, the actual effects on the environment and greenhouse gas emissions are not well understood and have not been studied extensively in the literature. Therefore, it is interesting to examine what role PTAs can play as a policy instrument in the fight against climate change. The following research studies the effect of the inclusion of environmental provisions in PTAs. More specifically, it aims to answer the following questions: Do environmental provisions in PTAs lead to a reduction in GHG emissions of trading partners? And do PTAs, which specifically address the problem of climate change, yield stronger results? Furthermore, insights are missing which would allow negotiating parties to design environmental linkages in PTAs so as to maximise their impact on climate change mitigation. The question this research asks is, how does the design and legal nature of climate provisions influence their effectiveness? In other words, it shall be examined both *why* and *how* environmental provisions take effect in PTAs.

The paper analyses these questions by using a mixed method approach. The effect of environmental provisions in PTAs is tested in a large-n quantitative analysis for 184 countries over the span of 30 years using panel data. A case study on the US-Peru Trade Promotion Agreement of 2006 complements the quantitative approach to exemplify the empirical findings and explore the issue of reverse causality. Findings show that PTAs with numerous environmental clauses, for example in the form of an environmental chapter or an annex, are an effective policy tool towards the goal of reducing emissions.

Section II provides an overview of what we currently know about the effects of trade and PTAs on the environment, which leads to the formulation of the main hypotheses to be tested. Subsequently, I explain the methodology, data, and model for the analysis (Section III). Results are discussed in Section IV, followed by a case study on the US-Peru-TPA to examine potential reverse-causality issues (Section V). From these insights a conclusion with policy advice is drawn (Section VI).

II. Literature Review and Hypotheses

Differing levels of GHG emissions over time and between countries depend on a multitude of political, economic, and environmental factors. As the following research is interested in understanding the variation in GHG emissions in relation to trade and trade agreements, the literature review focuses on this nexus specifically. The literature review is structured in two parts, starting with the effects trade has on the environment and continuing with how to effectively govern non-trade issues in PTAs.

1. Trade and greenhouse gas emissions

The effects of trade on the environment are contested in the literature. Overall, the literature on trade openness and the environment is largely inconclusive about the environmental consequences. I will first review the literature on the trade-environment nexus and then move to literature specific to the effects of trade agreements on emissions.

A change in trade policy can affect the level of pollution through three separate mechanisms: The scale effect, the composition effect and the technique effect (Krueger and Grossman 1991). The scale effect is assumed to have a negative effect on the environment. As trade liberalisation leads to an increase in economic activity, if this activity is unchanged it will result in higher GHG emissions. Theories on the scale effect presume a positive effect of trade liberalisation on the economy (Dollar 1992; Edwards 1992; Frankel and Romer 1999). A specification of the scale effect was theorised by Grossman and Krueger (1991), who studied the link between the environment and increasing income levels in consequence to the North American Free Trade

Agreement, (NAFTA) finding an inverted U-relationship between pollution levels and income per capita. Panayotou (1993) coined the term environmental Kuznets curve (EKC) for this phenomenon. It gets its name from Kuznets (1955) who hypothesised that income inequality first rises and then falls with economic development. Transferred to environmental issues the theory implies that although in the early stages of development emissions increase, beyond a certain level of income per capita environmental improvements occur (Krueger and Grossman 1991). Subsequently a body of literature emerged arguing that trade may in fact have positive effects on the environment as the scale effect is outweighed by the technique effect (Shafik and Bandyopadhyay 1992; Selden and Song 1994; Suri and Chapman 1998; Antweiler, Copeland, and Taylor 2001; Dinda 2004). However, today we know that the EKC is not robust when analysed statistically (Agras and Chapman 1999; Copeland and Taylor 2004; Stern 2004; Carson 2010). It experiences a lack of theoretical base and can be rejected as an adequate model of emissions and concentrations (Copeland and Taylor 2004; Stern 2004). Carson (2010) found that more plausible explanations for the observed data revolve around good government, effective regulation, and technological change.

The technique effect has a positive effect on the environment. It describes that the methods of production might change after trade liberalisation. Holding the scale of the economy constant, emissions will drop if the intensity of pollution per unit of output drops (Krueger and Grossman 1991). In Krueger and Grossman's (1991) study of the NAFTA agreement, they showed that the technique effect can outweigh the scale effect. Three main arguments support the theory: First, pollution per unit of output drops because of the transfer to more modern and cleaner technologies (Krueger and Grossman 1991). Second, with an increasing income level due to trade liberalisation, the body politic may demand a cleaner environment as an expression of their increased national wealth (Krueger and Grossman 1991, 5). And third, both trade agreements and the increased demand for environmental protection may call upon the government to impose more stringent environmental regulations. The Porter-Hypothesis stipulates that a tightening of environmental regulation stimulates technological innovation, which has a positive effect on both the environment and the economy (Porter and van der Linde 1995). With increasing globalisation, competition will increase and in order to stay competitive, firms will invest in the newest and most efficient technology. All these arguments are based on the assumption that newer technologies will be

cleaner or better for the environment, which as such is equally debatable. Jaffe et al. (1995) also contest that it can be empirically proven that environmental regulation stimulates innovation.

The composition effect can have either a negative or a positive effect on the environment, depending on whether we follow the determining elements identified by the factor endowment theory or the pollution haven hypothesis. With trade liberalisation, countries specialise to a greater extent in sectors where they have competitive advantage (Heckscher and Ohlin 1991). In the case that the competitive advantage is based on differences in environmental regulation, the composition effect of liberalisation will be damaging to the environment (Krueger and Grossman 1991). This links to the issue of *pollution havens*, describing the effect that with a reduction in trade barriers a shift of pollution-intensive industries to countries with less stringent regulations can be expected (Copeland and Taylor 2004). The pollution haven hypothesis refers to the phenomenon that multinational firms engaged in polluting activities might relocate to countries with lower environmental standards (Leonard 2006; Cole 2004). In that sense the pollution haven hypothesis suggests that poor countries get dirtier with trade, while rich countries get cleaner (Antweiler, Copeland, and Taylor 2001). Even though discussed at length in literature, the pollution haven hypothesis does not provide robust results (Eskeland and Harrison 2003). Krueger and Grossman (1991) and Jaffe et al. (1995) find that rather than the simple haven hypothesis, the effect depends on factor endowment considerations rather than pollution abatement costs. The predictions of factor endowment considerations stand in stark contrast to the pollution haven theory: Countries abundant in factors in emission-intense industries will increase pollution, as trade liberalises, while countries relatively abundant in clean industry factors, will get cleaner with trade (Copeland and Taylor 2004). As capital intensive goods are more polluting, exports of capital abundant countries will be more polluting. In other words, poor countries will get cleaner with trade, while rich countries will get dirtier.

When moving away from the broader sphere of trade and the environment, to studying the effect between trade agreements and emissions, the body of literature is still very small. The following articles provide the core literature on which the research of this dissertation is based. As one of the earliest papers, Ghosh and Yamarik (2006) find no evidence of a direct effect between signing FTAs and emission reductions. They show that the effect of reduced pollution is indirect and

derives from the positive effect of increased trade on per capita income, which in turn affects environmental quality. However, they base their analysis on a single year and thus cannot control for time, as well as country-specific effects.

Baghdadi et al. (2013) show that while merely signing a FTA does not reduce CO_2 emissions, if the FTA includes environmental provisions a direct effect on the reduction of emissions can be observed. They distinguish between agreements with and without environmental provisions between 1980 and 2008. Martínez-Zarzoso and Oueslati (2018) focused on Deep and Comprehensive Regional Trade Agreements, showing that countries who have ratified RTAs with environmental provisions show lower levels of pollution, measured in $PM_{2.5}$. The study includes OECD countries over the period from 1999-2011 but the results also hold for a broader sample of 173 countries and other pollutants as CO_2 and NO_2. Zhou, Tian, and Zhou (2017) also study the effect of PTAs on $PM_{2.5}$ air pollution but use a difference-in-difference approach. They find that RTAs without environmental provisions lead to poorer air quality, whereas environmental provisions reduce the level of $PM_{2.5}$ pollution levels. They also show a convergence of $PM_{2.5}$ concentration levels between contracting parties. The main limitation of these papers is that they only differentiate between RTAs with and without environmental provisions, and do not consider the level of environmental provisions. However, using a dummy variable is over simplistic, when considering that this would also include RTAs where the environment is merely mentioned once in the preamble.

When targeting climate-related provisions more specifically, Sorgho and Joe (2020) found that the inclusion of such provisions in PTAs affect the reduction of greenhouse gas emissions significantly more than the inclusion of general environmental provisions in the trading countries. They conclude that this suggests that governments seem to comply with the climate-related commitments they make in PTAs. The authors use the TREND database and panel data covering 165 countries using dynamic data models.

Focusing on the flow of goods, Brandi et al. (2020) conducted a study to test whether environmental provisions in trade agreements make exports from developing countries greener. Using the Trade Environment Database (TREND), the authors regressed the effect of

environmental norms (overall, trade-restrictive, liberal) on the share of dirty and green goods in overall exports from developing countries. The study showed that while restrictive environmental provisions reduce dirty exports, liberal provisions can incentivise exports of green goods. It also concluded that there does not seem to be a general trade-off between environmental and economic implications, as the exports are not substantially limited through environmental provisions in PTAs.

Building on the studies conducted by Baghdadi (2013) and Martínez-Zarzoso and Oueslati (2018), I want to test whether the following hypotheses hold:

> **H1:** Countries with environmental provisions in PTAs will tend to reduce per capita GHG emissions compared to those without environmental provisions in PTAs.

Testing the above hypothesis will expand the currently small body of literature that focuses on the relationship between environmental clauses in trade agreements and GHG emissions. Furthermore, as all the studies are very econometrics heavy, they do not explore the mechanisms through which PTAs may take effect. This work can advance the literature by deep-diving into these different mechanisms.

As a sub-hypothesis to the first one, I want to focus on climate-specific provisions. Specifically, I want to compare the effect of general environmental provisions and climate specific provisions. This differentiation so far has only been tested by Sorgho and Joe (2020) and is only published as a working paper. All other studies focus on environmental provisions in general. However, the differentiation is important when analysing PTAs as a tool in climate change governance. Therefore, I will test whether the following statement holds:

> **H2:** In a comparison of countries, climate specific provisions in PTAs lead to a stronger reduction in the level of per-capita GHG emissions compared to general environmental provisions.

The findings will provide new insight on whether it is useful to include climate specific clauses rather than broadly focused environmental clauses to reduce emissions in trading partners. The differentiation will allow the deduction of applicable policy implications in the end.

2. Issue linkage and legalisation

Non-trade issues in PTAs are increasingly deepening in terms of their enforceability and legal bindingness. Broadly speaking, compliance in PTAs can be based on legalised or managerial approaches. The legalised approach relies mostly on law as a binding and enforceable tool, while the managerial approach relies more on a cooperative approach and the transferral of knowledge. The concept of legalisation was coined by Abbott et al. (2000) to be determined along the measures of precision, obligation, and delegation. Precision refers to the detail to which the obligated conduct is described. Obligation refers to the legally binding nature of the commitment. Delegation describes the degree to which third parties have been granted the authority to determine and enforce the compliance as well as the power to resolve disputes. These do not constitute hard categories but provide for a continuum from soft law to hard law (Abbott et al. 2000).

The trade regime emerged as a regime with low legalisation, which changed significantly after the conclusion of GATT and the subsequent formation of the WTO (Kahler 2000; Gstöhl 2010; Ford 2002). Today the trade regime is a highly legalised regime, with a framework of high precision and obligation and even its own dispute settlement mechanism. The demand for legalisation has been fuelled by a growing interdependence of actors as strong legalisation provides solutions to commitment and collective action problems (Kahler 2000; Gstöhl 2010).

On the other hand, the environmental regime experiences a very low level of legalisation. Most treaties and agreements are not legally binding but instead governed by soft law or based on voluntary measures. Compliance is ensured by leveraging reputational and normative force (Jinnah and Morgera 2013). One explanation for the low level of legalisation is the lack of sufficient bargaining power, as environmental norms are often promoted by weakly organised NGOs and consumers (Gstöhl 2010). Another explanation argues that more powerful states avoid legalisation because they can obtain better results through ad hoc bargaining (Kahler 2000).

This explains why issue linkage is often used strategically in diplomacy to make environmental norms more enforceable. The question whether legalisation measurably adds to the level of compliance has controversial viewpoints in the literature. One stream of thought assumes that mandatory and enforceable commitments (legalised approach) are more likely to secure compliance (Abbott et al. 2000; Böhmelt and Pilster 2010; Hafner-Burton 2005; Kahler 2000). Hafner-Burton (2005) provides evidence that persuasion (soft law) is less effective than coercion (hard law). She examined the role of PTAs as an instrument for state compliance with human rights. She showed that persuasion to be more costly and less effective than coercion, as it requires changing deeply-rooted state beliefs which takes a lot of time. Böhmelt and Pilster (2010) argue that a regime's effectiveness does not depend on whether soft- or hard-law governs it. Instead, high legal precision is the important determinant for performance. They thus confirm Abbott et al. (2000) by linking effectiveness to precision, as precision narrows the scope for reasonable interpretation (Abbott et al. 2000, 402). It does so by establishing an objective measure for compliance. Highly legalised commitments thus allow the assertion of legal claims and resort to legal remedies in case of breach (Abbott et al. 2000). Furthermore, well-developed forms of delegation are assumed to increase regime effectiveness (Böhmelt and Pilster 2010). Benefits of legalisation arise from the fact that it increases information access, decreases transaction costs and monitors state behaviour, which in turn makes it harder for a party to behave opportunistically or defect (Goldstein and Martin 2000).

There is also evidence opposing the legalised approach, which suggests that more managerial provisions lead to increased environmental cooperation (Jinnah and Morin 2020). The perception that states will only adhere to treaties with "teeth" relies on the realist perspective that compliance of a rational-actor is only obtained if it is in their self-interest to do so by avoiding sanctioning or punishment (Chayes and Chayes 1998). However, it must be acknowledged that states also have a normative obligation in international affairs which make them willing to comply with the treaties drafted, negotiated, and ratified. Chayes and Chayes (1998) show how a normative framework, reporting and transparency, verification, review and assessment, dispute settlement and interpretation can be combined to a coherent compliance strategy more effective than merely a high level of legalisation. This also addresses legitimacy concerns arising for the enforcement of

treaty obligations in a system where only weak states can be made to comply (Chayes and Chayes 1998).

Goldstein and Martin (2000) argue that tightly binding and unforgiving rules, as advocated by the legalisation proponents, may even have negative effects on trade and the environment. Punishment in international treaties is often viewed as too costly, too political and too coercive (Downs, Rocke, and Barsoom 1996, 381). The right degree of legalisation is thus a balancing act between binding governments sufficiently to avoid cheating and allowing the flexibility to react to changing information and domestic politics (Goldstein and Martin 2000). Flexibility here refers to the possibility of derogation, withdrawal, reservation and opt-out clauses (Linos and Pegram 2016).

While the literature usually focuses on the level of legalisation when discussing the design of treaties or regimes, enforcement measures are the central focus when discussing compliance. However, these are in fact two sides of the same coin. Dispute settlement mechanisms (DSM) and centralised enforcement measures show a high level of delegation and thus legalisation (Abbott et al. 2000). But the purpose of including DSMs is not to ensure a high level of legalisation but to ensure compliance (Allee and Elsig 2016, 94). In other words, if there is a high level of legalisation, compliance tends to be ensured by hard enforcement measures such as sanctions or remedies. However, if a treaty is designed with a more soft-law approach, compliance will be ensured by a more managerial approach, as laid out by Chayes and Chayes (1998).

The EU and the US portray this contrast in approaches. While the US uses hard law and sanctions as means of enforcement, the EU emphasises consultative measures and dialogue with civil society actors. Postnikov and Bastiaens (2014) study the different approaches in PTAs towards labour standards and find that, in general, US PTA labour provisions are stronger legalised than EU PTA labour provisions. Nevertheless US agreements exhibit a lower level of obligation and precision in their climate change provisions in PTAs (Morin and Jinnah 2018). Depending on the approach, PTAs take effect at different points in time. Kim (2012) was the first to argue that many of the effects of non-trade issues remain unseen because they are implemented *ex ante.* He analysed improvements in labour protection as a result to US PTAs. This means that, even in absence of *ex post* enforcement, PTAs can be an effective instrument in raising labour standards. He goes as far

as claiming that this even counts for countries who are aspiring to negotiate a PTA (Kim 2012, 718). Postnikov and Bastiaens (2014) confirm these findings but conclude that, despite the initial improvements *ex ante*, the biggest effects occur *ex post.* Later they refine their findings when focusing specifically on environmental clauses in PTAs: For the US centralised enforcement approach, effects tend to outweigh *ex ante* (Bastiaens and Postnikov 2017). For the EU, however, the impact occurs during the implementation phase, as it mainly focuses on policy dialogue. They find soft law learning mechanisms pursued by the EU an effective approach to promote environmental norms, even in the absence of coercive measures.

Enforcement mechanisms in PTAs differ widely. Enforcement must be differentiated from implementation as it only focuses on the identification and sanctioning of persons violating environmental measures. Some PTAs call for cooperation on enforcement or authorise a commission to conduct a factual report on the failure of a Party to enforce its environmental law. Other PTAs include specific actions that governments have to take as enforcement measures for domestic environmental policies. For example, the Japan-India PTA stipulates in art. 8(2): "Each Party shall take appropriate governmental action such as monitoring compliance with and investigating suspected violations of its environmental law and regulation." Even more far-reaching are provisions which allow private access to remedies, procedural guarantees and appropriate sanctions. This includes the right to sue another person for environmental damage. The NAAEC exemplifies this in art. 5(2) and (3) stating "2. Each Party shall ensure that judicial, quasi-judicial or administrative enforcement proceedings are available under its law to sanction or remedy violations of its environmental laws and regulations. 3. Sanctions and remedies provided for a violation of a Party's environmental laws and regulations shall, as appropriate: (a) take into consideration the nature and gravity of the violation, any economic benefit derived from the violation by the violator, the economic condition of the violator, and other relevant factors; and (b) include compliance agreements, fines, imprisonment, injunctions, the closure of facilities, and the cost of containing or cleaning up pollution."

Therefore, as a third hypothesis I want to test whether strong enforcement measures increase compliance, using the proxy of reduction in greenhouse gases as an indicator.

H3: Countries signing PTAs with strong enforcement provisions will experience a stronger reduction of per capita GHG emissions compared to countries signing PTAs with soft enforcement provisions.

So far, the literature studying the link of environmental clauses in PTAs and their effect on the environment mainly focuses on whether environmental provisions are included in a PTA or not. My findings can add to the literature by considering different compliance approaches. If the hypothesis is confirmed, important policy implications for future PTAs can be deduced.

III. Methodology

This chapter outlines the methodology for the empirical analysis, describing the data and variables (Section III.1) as well as the regression model in detail (Section III.2). Section III.3 explains the choice of the case study.

1. Data and Variables

This study aims at testing the effect environmental and climate specific provisions in PTAs have on the greenhouse gas emissions of a country. It comprises 184 countries over 30 years, from 1990 – 2019. While there were some treaties with environmental provisions even before 1990, the clear increase of issue linkage to environmental topics happened in the 1990 and early 2000s. The most complete data is available until 2019. Therefore, the time-period is most suitable to yield the most meaningful results. CO_2 per capita is used as dependent variable. Even though, CO_2 is only one of many sources of pollution, it is a good proxy to test for the effect of greenhouse gas emissions for three reasons. Firstly, CO_2 is considered to be the primary greenhouse gas responsible for global warming and is therefore used as the most common measure to evaluate the performance of countries towards climate change (IPCC 1996, xi; United Nations 1992). Secondly, the correlation coefficient with other major polluters like NO and SO_2 is very high (> 0.95), making CO_2 a valid proxy (Hoffmann et al. 2005, 313; Yang 2001). Thirdly, among the different greenhouse gases, the most reliable and comprehensive data exists for CO_2. The data is retrieved from the Emissions Database for Global Atmospheric Research (EDGAR) by the European Commission. The variable describes the total CO_2 emissions as tonnes of CO_2 per capita per year. Large-scale biomass

burning, forest fires, and sources and sinks from land-use, land-use change, and forestry (LULUCF) are excluded. Further analyses on other greenhouse gas emissions can be found in the Annex.

554 Preferential Trade Agreements are considered as the main independent variables. The agreements stem from the Trade and Environmental Database (TREND) which was established in 2018 (Morin, Dür, and Lechner 2018). The dataset tracks more than 300 environmental norms, relying on the full text of PTAs signed since 1945. It includes norms in the main text, annexes, protocols, side agreements, and side letters of the PTAs (Morin, Dür, and Lechner 2018). Five independent variables were created to measure the effect of environmental and climate provisions in PTAs (Hypothesis 1 and 2). First, a dummy variable, to check whether a trade agreement including environmental provisions is in place. Second, a continuous variable counting the number of trade agreements entering into force that year. Third, a variable including the cumulative count of PTAs in place. Fourth, a variable providing a count on the number of environmental provisions included in a trade agreement. This variable is used to test whether the weight given to environmental measures in a PTA has an effect. In other words, does it matter whether environmental issues are only addressed in the preamble or if they have their own chapter or Annex including multiple provisions. Fifth, a variable including only climate specific provisions. This includes all clauses promoting renewable energy, reduction of GHG emissions, climate change adaptation, harmonisation of legislation regarding climate change or addresses air pollution.

To test the third hypothesis, a simple additive index for the enforceability of domestic environmental norms in a PTA was created. This includes first, binding obligations referring to the general commitment of states to enforce environmental measures. The wording must include "shall", "should", "must" etc. Best effort obligations are not sufficient. The second category of norms included are specific governmental action for enforcement. The third category is private access to remedies, procedural guarantees, and appropriate sanctions. Such clauses include the right to sue another person for environmental damages, as well as the right to issue sanctions for a violation of environmental laws. Fourth, it includes state-state dispute settlement mechanisms that only applies in case of failure to enforce domestic environmental measures. Specifically, clauses

which allow remedies or the suspension of trade benefits. Non-jurisdictional measures as mediation or consultation were not counted.

Several control variables were chosen to account for the scale, technique, and composition effect. The squared GDP per capita is included to test for the Environmental Kuznets Curve. Trade openness (Trade as percentage of GDP) will give an indication on the scale effect (Antweiler, Copeland, and Taylor 2001; Baghdadi, Martinez-Zarzoso, and Zitouna 2013). The value added from manufacturing to GDP accounts for the composition effect, with manufacturing typically being a GHG heavy industry (Suri and Chapman 1998; Cole 2004). Additionally, the composition of international trade reflects the energy consumption of a country (Agras and Chapman 1999), and countries exporting more manufactured goods tend to have a higher energy consumption (Suri and Chapman 1998). Thus, controlling for manufacturing-heavy economies also controls for the higher emissions associated with energy production.

Domestic social and political factors can also influence pollution levels of a country. As urban and industrialised societies tend to emit more, the variable urban population was included, measuring the percentage of people living in urban areas of the total population (Sharma 2011). While there is no environmental policy stringency index that is available for the time span and number of countries included in this study, a countries' environmental treaty commitments were found to be a good proxy (Neumayer 2002; Prakash and Potoski 2014). Several studies could show that the *de jure* stringency of environmental regulation is highly correlated (r = .88) to the number of environmental treaty commitments, making it a good proxy (Prakash and Potoski 2014). It also gives an indication on the willingness for international cooperation in climate change (Kolcava, Nguyen, and Bernauer 2019) — which in turn might influence the effectiveness of environmental clauses included in PTAs. The number of international environmental agreements in force per country per year is taken from the international environmental agreements data base project (Mitchell 2002-2020). More details on the definitions and sources of the variables used are found in Annex I.

2. Model

A linear panel data model was chosen for the analysis. The regression uses ordinary least squares as the data shows linear characteristics. Panel data techniques were chosen to control for

endogeneity issues of the target variables, in this case the PTAs and enforceability (Martínez-Zarzoso and Oueslati 2018). Following Antweiler, Copeland, and Taylor (2001) variables were added to reflect the scale, composition, and technique effect to the regression model. To examine the direct effect of environmental provisions in PTAs on the emissions of a country, the following equation estimates the regression model:

$$\begin{aligned}\ln(CO2pcap) = \ & \alpha * PTAs_{it} + \beta * ENVPROV_{it} + \gamma_1 \ln(pop_{it}) + \gamma_2 \ln(GDPcap_{it}) \\ & + \gamma_3 \ln(GDPcap_{it})^2 + \gamma_4 \, open_{it} + \gamma_5 manufact_{it} \\ & + \gamma_6 urbPop_{it} + \gamma_7 iea.inforce + \gamma_8 polity2 + \delta_t + \delta_i + \varepsilon\end{aligned}$$

where *CO2pcap* stands for CO_2 emissions per capita. *PTAs* is a count of the number of different PTAs entered into force, including environmental provisions. *ENVPROV* is a count of the number of environmental provisions included in the PTAs. Including the number of PTAs and provisions rather than a dummy variable allows to address the selection bias problem of PTAs again (Sorgho and Joe 2020). *Pop* denotes the population of a country, whereas *UrbPop* is the share of the population in a country living in urban areas. *Open* stands for the trade openness of a country, measured as the sum of exports and imports as a share of GDP. *Polity2* is a measure of democracy, ranging from -10 (strongly autocratic) to 10 (strongly democratic). *Iea.inforc*e is a proxy for a country's environmental policy stringency, measured by the number of international environmental agreements in force, excluding terminated agreements. δ_t and δ_i denote time and country time fixed effects. For *CO2pcap*, *GDPcap*, *squared GDPcap,* and *pop* the natural logarithm is taken. Testing the hypothesis on climate specific clauses and enforcement is based on the same model. To test hypothesis 2, the variable ENVPROV is replaced by *CLIMPROV,* a count of climate specific provisions; for hypothesis 3 it is replaced by *ENFORCE,* a simple additive index of provisions ensuring domestic enforcement.

The main model does not include time-lags, however, several models with different time-lags were tested. Following Kim (2012), effects during the negotiation phase are tested by leading our main independent variables. The negotiation phase is usually assumed to be 3 years (Kim 2012), a lead of up to 4-years was tested, to see whether a cut-off point in effect can be determined empirically. The model was then lagged up to 10 years to test short- and long-term effects.

Missing data was imputed if it was missing for single years only. The average value of the year before and after was taken, assuming a linear change over these two years. For categorical values no data was imputed. This left the analysis with 3,557 observations. The data shows time and cross-sectional variance (Annex II). The data does not show traits of multicollinearity. The multicollinearity assumption was tested using the variance inflation factor, showing that between all predictor variables the correlation and strength of correlation is sufficiently low (Annex II). To account for unobservable factors relevant for the model, time- and country-fixed effects were included (Antweiler, Copeland, and Taylor 2001). The inclusion of these fixed effects also addresses the endogeneity issue of our main independent variable and accounts for the self-selection of states into PTAs (Baier and Bergstrand 2007; Wooldridge 2010, 289). It further allows for the elimination of unobserved time-invariant heterogeneity (Allison 2009; Wooldridge 2010, 285).

3. Case Study

A case study complements the quantitative analysis. Case studies allow us to capture nuances and patterns that other research methods might overlook (Lune and Berg 2016, 171). A case study — in addition to the quantitative analysis — allows one to look beyond correlations and explore the real-life processes behind the numbers. In this work, the case study takes the form of an instrumental case study. Instrumental case studies are suitable to illustrate a single issue of concern (Lune and Berg 2016, 175). Here, it can help address doubts of endogeneity and reverse causality. Even though one case study is not sufficient to prove causality, it can provide a strong conjecture towards causality.

For an instrumental case study any one of a number of cases to explore the issue of investigation may be chosen (Simons 2009, 30). The following will analyse the US-Peru Trade Promotion Agreement (TPA), which entered into force in 2009. This has several reasons. Firstly, the research is interested in analysing the effect of domestic enforcement measures. The US-Peru TPA was one of the first agreements to include such enforcement measures. Secondly, the environmental approach in the TPA marked a rapture with previous US trade environmental policies. This does not mean the agreement is an outlier, but rather that it provides an example, along which many future agreements have orientated their provisions. Therefore, studying this trade agreement can

allow broader and transferable insights on the matter. And finally, due to time and resource limitation, the case study must rely on secondary resources. The US-Peru TPA is one of the few cases which provides sufficient literature and data to base a case study on.

IV. Quantitative Results and Discussion

The following section will discuss the quantitative results obtained from the regression analysis. First, the effect of trade agreements on greenhouse gas emissions is examined (Section IV.1), followed by the discussion on domestic enforcement measures (Section IV.2).

1. Trade and greenhouse gas emissions

Results show that environmental clauses included in PTAs have a significant effect on the per capita CO_2 emissions of trading partners. Table 1 focuses on the PTA level, while Table 2 portrays results on a more detailed level, examining environmental and climate specific provisions. The different models explore the main independent variables of interest separately: The dummy variable indicating whether a PTA with environmental clauses is in place or not has a significant positive effect on CO_2 per capita (Table 1, Model 1 & 4). This means that the conclusion of a PTA leads to an increase in emissions, even if environmental clauses are included. The observation leads to the conclusion that merely including any environmental provisions does not lead to a positive effect for the climate. Only looking at this variable could thus nurture the criticism that environmental provisions are mere "fig leafs" (Berger et al. 2017, 1). This interpretation, however, fall short of the complexities of the issue. A dummy variable is over-simplistic, as it can neither reflect the number of different PTAs concluded per country nor the breadth of environmental norms included in a PTA.

The number of different PTAs a country signs containing environmental provisions does not seem to matter for emissions, as it does not show up as significant (Table 1, Model 2 & 4). In contrast, the number of environmental provisions make a difference. The coefficients have a negative sign, indicating that the effect of PTAs on CO_2 emissions in fact depends on the number of environmental provisions included in PTAs (Table 2, Model 1 & 2). This seems logical when considering that in the count of PTAs, agreements are included which only refer to environmental efforts in the preamble. It seems very unlikely that this kind of weak acknowledgements have a

Table 1: Regression results for PTAs on CO_2 emissions per capita

	Dependent variable:				
	co2.pc.ln				
	(1)	(2)	(3)	(4)	(5)
PTA.dummy	0.0212**			0.0310**	0.0312***
	(0.0092)			(0.0123)	(0.0110)
PTAs		0.0026		-0.0065	-0.0115**
		(0.0040)		(0.0054)	(0.0048)
PTA.cum			-0.0106***		
			(0.0009)		
gdp.cap.ln	0.6230***	0.6242***	0.5787***	0.6226***	0.4202***
	(0.0231)	(0.0231)	(0.0229)	(0.0231)	(0.0218)
pop.ln	0.3668***	0.3684***	0.1465***	0.3658***	0.3088***
	(0.0413)	(0.0414)	(0.0448)	(0.0414)	(0.0371)
urb.pop.pp	0.0193***	0.0193***	0.0171***	0.0193***	0.0140***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0014)
open	0.0004*	0.0004*	0.0009***	0.0004*	0.0005**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0131***	0.0131***	0.0127***	0.0131***	0.0091***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0012)
iea.inforce	-0.0007***	-0.0007***	-0.0002	-0.0007***	-0.0009***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	0.0002	0.0001	-0.0018	0.0002	0.0037***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0014)
co2.pc.ln.lag1					0.2842***
					(0.0098)
Observations	3,555	3,555	3,555	3,555	3,548
R^2	0.2634	0.2624	0.2910	0.2638	0.4048
Adjusted R^2	0.2230	0.2219	0.2521	0.2231	0.3716

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns

Table 2: Regression results for environmental and climate norms on CO_2 emissions per capita

	Dependent variable:					
	co2.pc.ln					
	(1)	(2)	(3)	(4)	(5)	(6)
ENVPROV	-0.0004***	-0.0009***			-0.0006***	
	(0.0001)	(0.0001)			(0.0001)	
CLIMPROV			-0.0081***	-0.0145***		-0.0101***
			(0.0015)	(0.0019)		(0.0017)
PTAs		0.0323***		0.0272***	0.0183***	0.0149***
		(0.0055)		(0.0052)	(0.0050)	(0.0047)
gdp.cap.ln	0.6168***	0.6075***	0.6164***	0.6091***	0.4138***	0.4145***
	(0.0230)	(0.0230)	(0.0230)	(0.0230)	(0.0218)	(0.0218)
pop.ln	0.3305***	0.2919***	0.3257***	0.2934***	0.2583***	0.2589***
	(0.0419)	(0.0422)	(0.0419)	(0.0422)	(0.0380)	(0.0381)
urb.pop.pp	0.0185***	0.0179***	0.0183***	0.0178***	0.0133***	0.0132***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0014)	(0.0014)
open	0.0006**	0.0006***	0.0006**	0.0006***	0.0006***	0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0133***	0.0131***	0.0133***	0.0132***	0.0091***	0.0091***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0012)	(0.0012)
iea.inforce	-0.0006***	-0.0005***	-0.0006***	-0.0005***	-0.0007***	-0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	-0.00003	-0.0002	-0.00002	-0.0001	0.0033**	0.0033**
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0014)	(0.0014)
co2.pc.ln.lag1					0.2784***	0.2789***
					(0.0098)	(0.0098)
Observations	3,555	3,555	3,555	3,555	3,548	3,548
R^2	0.2681	0.2755	0.2686	0.2745	0.4097	0.4093
Adjusted R^2	0.2279	0.2355	0.2284	0.2345	0.3768	0.3764

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns

measurable effect on emissions. However, with specific environmental chapters or annexes, comprehensive provisions, implementation strategies and potential enforcement measures countries can be expected to adapt policies and legislation, leading to a decrease in emissions. The regression results reflect this theory. H1 can thus be confirmed with certain limitations: While the mere inclusion of environmental provisions in PTAs does not show a reduction in greenhouse gas emissions per capita compared to PTAs without environmental provisions, the number of environmental clauses does. In so far, the hypothesis can be amended to: "countries with *numerous* environmental provisions in PTAs will tend to reduce per capita GHG emissions compared to those without environmental provisions in PTAs."

The effect in reduction of per capita CO_2 is even stronger when PTAs include climate specific clauses. The coefficient increases from -0.0004 to -0.0081. As dependent and independent variables are logged, coefficients can be conveniently interpreted as elasticities — in other words, the relative change in *y* per relative change in *x*. Thus, for every additional climate specific clause included in a PTA, emissions per capita decrease by 1,45% (Table 2, Model 4). Models 5 and 6 include the dependent variable lagged by one year as a robustness check. Lagged dependent variables are frequently used as a robust strategy to eliminate autocorrelation in the residuals (Wilkins 2018). Even though, the effect diminishes slightly, the coefficients remain significant and seem robust. For further robustness checks data imputation was used, to test the computations with more observations. Additionally, different control variables were added and dropped to identify potential unproportionate effects on the outcome variable. Results remain robust (Annex IV). The findings can thus confirm the second hypothesis.

Diving into the respective PTAs reveals how different countries give different importance to environmental and climate clauses in PTAs. As expected, the EU is the frontrunner when it comes to climate specific clauses in PTAs. They are leading with up to 22 new climate related clauses per year – especially in the years 2014, 2015, 2016, 2018. The dates show how young the phenomenon of using PTAs intentionally as an instrument in climate governance is. Trade agreements in these years by the EU with climate specific clauses include the Association Agreement with Georgia and the Republic of Moldova (2014), the FTA with Vietnam (2016), the EU-Singapore Investment Protection Agreement (2018), and the EU-Japan Economic Partnership

Table 3: Timely effect of PTA

	Dependent variable:				
	co2.pc.ln				
	(1)	(2)	(3)	(4)	(5)
CLIMPROV.lead3	-0.0022				
	(0.0014)				
CLIMPROV.lead2		-0.0040***			
		(0.0015)			
CLIMPROV			-0.0145***		
			(0.0019)		
CLIMPROV.lag2				-0.0087***	
				(0.0016)	
CLIMPROV.lag10					-0.0089***
					(0.0026)
PTAs	0.0018	0.0047	0.0272***	0.0068*	0.0011
	(0.0041)	(0.0041)	(0.0052)	(0.0041)	(0.0041)
gdp.cap.ln	0.6236***	0.6210***	0.6091***	0.6172***	0.6215***
	(0.0231)	(0.0231)	(0.0230)	(0.0230)	(0.0230)
pop.ln	0.3623***	0.3538***	0.2934***	0.3242***	0.3533***
	(0.0416)	(0.0417)	(0.0422)	(0.0420)	(0.0415)
urb.pop.pp	0.0192***	0.0190***	0.0178***	0.0184***	0.0190***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
open	0.0004*	0.0004*	0.0006***	0.0005**	0.0005**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0131***	0.0131***	0.0132***	0.0133***	0.0132***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
iea.inforce	-0.0007***	-0.0006***	-0.0005***	-0.0006***	-0.0006***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	0.0001	0.0001	-0.0001	0.00005	-0.00001
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Observations	3,555	3,555	3,555	3,555	3,555
R^2	0.2629	0.2639	0.2745	0.2684	0.2650
Adjusted R^2	0.2222	0.2233	0.2345	0.2280	0.2244

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns

Agreement (2018). All these agreements contain specific clauses for the reduction in GHG emissions. Korea also has a very strong profile in climate-relevant PTAs. Dent (2021) identifies Korea as the only other notable norm influencer regarding climate specific provisions outside the EU. The US on the other hand barely includes climate related provisions in their PTAs. An exception forms the USMCA of 2018. In the environmental chapter aspects are covered like the protection of the ozone layer (Art. 24.9) and the issue of air quality (Art. 24.11).

When examining the timely effect of PTAs, results show an impact on emissions per capita both *ex ante* and *ex post.* Kim's (2012) findings that PTAs already have an effect with start of the negotiations can be confirmed. In line with Kim's assumption of a three-year negotiation phase, the data reveals a significant negative effect on CO_2 emissions already 2 years prior to signing – or, in other words, one year after negotiations started. Any time frame earlier does not yield significant results. The effect *ex-post* is still stronger than the effect *ex-ante.* An interesting finding is that while the number of PTAs entering into force per year has a positive coefficient, the cumulative value of PTAs including environmental provisions has a negative coefficient (Table 1, Model 3). Thus, agreements including environmental provisions seem to have long-term effects. This is affirmed by lagging the main independent variables by up to 10 years (Table 3). The coefficient remains negative and significant, with the effect slightly decreasing over the years (Table 3, Model 3 – 5). These findings set this study apart and adds an interesting new aspect to the literature. As PTAs are expected to take their main effect through translation into national law, long-term effects make sense when they are placed in the context of the theory. The section examining the mechanisms through which PTAs impact CO_2 emissions (Section IV.3) and the case study (Section V) will dive deeper into the phenomenon.

2. Enforcement of domestic environmental provisions

Strong enforcement mechanisms have a significant negative effect on emissions per capita (Table 4). With a reduction of 2.43% of CO_2 emissions per capita for every additional enforcement clause, enforcement measures show the strongest effect of all explanatory variables of interest. As a robustness check again, the lagged dependent variable was added in Model 3 (Table 4). The effect remains significant and stable, indicating a robust model. The R^2 remains relatively stable

Table 4: Regression results enforcement clauses on CO2 emissions per capita

	Dependent variable:		
	co2.pc.ln		
	(1)	(2)	(3)
ENFORCE	-0.0243***	-0.0316***	-0.0210***
	(0.0046)	(0.0051)	(0.0046)
PTAs		0.0146***	0.0057
		(0.0045)	(0.0040)
gdp.cap.ln	0.6165***	0.6136***	0.4171***
	(0.0230)	(0.0230)	(0.0218)
pop.ln	0.3326***	0.3228***	0.2809***
	(0.0418)	(0.0418)	(0.0376)
urb.pop.pp	0.0187***	0.0186***	0.0137***
	(0.0015)	(0.0015)	(0.0014)
open	0.0006**	0.0006**	0.0005***
	(0.0002)	(0.0002)	(0.0002)
manufact	0.0133***	0.0131***	0.0091***
	(0.0013)	(0.0013)	(0.0012)
iea.inforce	-0.0006***	-0.0006***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)
polity2	-0.00004	-0.0001	0.0034**
	(0.0015)	(0.0015)	(0.0014)
co2.pc.ln.lag1			0.2803***
			(0.0098)
Observations	3,555	3,555	3,548
R^2	0.2684	0.2707	0.4071
Adjusted R^2	0.2282	0.2304	0.3741

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns

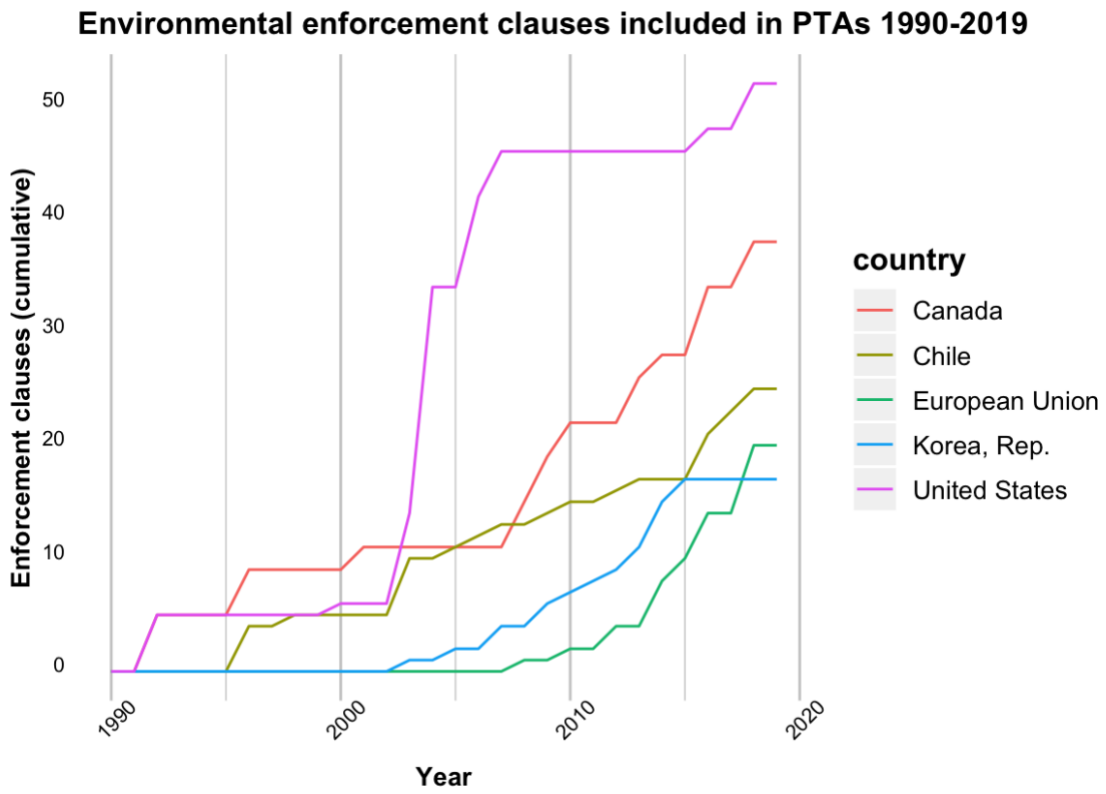
throughout all models (Table 1, Table 2, Table 3, Table 4) indicating that they can explain about 27% of the variation in CO_2 emissions per capita.

Figure 2 shows the cumulative count of strong enforcement clauses included in PTAs for selected countries from 1990-2019. The US is the strongest proponent of strong enforcement on a domestic level. The stark increase in enforcement measures for the US after 2003 can be understood as a consequence of the Trade Act passed by Congress in 2002. While the major change of the Act was to allow the President to introduce FTAs for vote to the Congress without the possibility of Congressional amendments or filibusters, it laid out specific negotiation guidelines for the President. For the first time, these guidelines extended to environmental governance provisions (Jinnah and Morgera 2013). The Chile and Singapore FTA in 2004 was the first to include a complete environmental chapter. The second substantial increase in the graph for the US in 2006 can be traced back to the US-Peru FTA.[1] When the Democrats gained control of the House and the Senate in 2007, they revised their trade policies to strengthen environmental provisions (Morin and Rochette 2017). This can be categorised as the third phase of US policies toward treating environmental issues in PTAs (Pacheco Restrepo 2019, 247). The phase was initiated through the Bipartisan Trade Deal in 2007 and is characterised by strong linkages aimed at impacting environmental policies abroad. Specifically, negotiators are required to demand domestic enforcement of environmental laws as well as compliance with signed MEAs (Bastiaens and Postnikov 2017). Canada has the second most PTAs with strong enforcement clauses. Surprisingly Chile ranks very high as well. The EU, on the other hand, only started to adopt such clauses in 2008, with the EU-CARIFORUM Economic Partnership Agreement. In general, the EU rarely uses strong enforcement clauses. Of all the EU's trade agreements, only four refer to specific governmental action for enforcement or private access to remedies: the Armenia-EU Comprehensive and Enhanced Partnership Agreement (CEPA)[2], the Moldova-EU Association Agreement (AA) of 2014, the Kazakhstan-EU CEPA 2015 and the EU-Singapore FTA 2018.

[1] The Bipartisan Trade Agreement required pending agreements, which had not yet been ratified by congress to be revised accordingly. The new approach is therefore dated back to 2006 when the US-Peru Agreement was signed, even though the revised version entered into force in 2009.

[2] The agreement is dated to 2013, when negotiations were completed. However, Armenia and the EU only signed a revised version of the agreement in 2017, after Armenia had pursued membership in the Eurasian Union in 2015.

Figure 2: Cumulative number of enforcement clauses in PTAs for selected countries



The results can thus confirm the current literature that the US prefers hard law and sanctions as means of enforcement while the EU emphasises consultative measures (Postnikov and Bastiaens 2014 and 2017). However, it must be noted that only 13% of treaties included such strong provisions in the first place. This implies that countries are reluctant to sign PTAs with such strong provisions. This might be because, in negotiations, states only promise to be bound by standards they were planning on completing in any case (Downs, Rocke, and Barsoom 1996). However, the case of Peru-US shows that this statement is not generally applicable. To understand the findings better, we must therefore, ask *why* strong enforcement measures show stronger results than general environmental provisions. While this question requires in-depth research, I will discuss different mechanisms through which PTAs function within the case study in the next section.

V. The US-Peru Trade Promotion Agreement

In this chapter, the US-Peru Trade Promotion Agreement (in the following "TPA") will allow to go beyond the quantitative findings discussed above by exploring the processes behind the correlations. The TPA was signed in 2006 and entered into force in 2009. As discussed above, the

US-Peru agreement was the first to be adopted under the third phase of US policies towards the treatment of environmental issues in PTAs, characterised by strong linkages aimed at impacting environmental policies abroad (Pacheco Restrepo 2019). The US government referred to the environmental provisions included in the US-Peru TPA as "groundbreaking" (United States 2015, 49). It includes many innovations in trade-environment linkages, with one chapter dedicated to the environment and an Annex on Forest Sector Governance.

The case study will proceed as follows: First the theoretical mechanisms through which PTAs can have an impact on emissions are laid out (Section V.1), followed by an examination of those mechanisms in the US-Peru case study (Section V.2). Finally, the causal chains are explored (Section V.3)

1. Mechanisms of influence

To understand why PTAs have an impact on CO_2 emissions per capita, I turn back to the literature. PTAs can take effect through fostering civil society activity, raising public awareness or promoting governmental capacity (Brandi, Blümer, and Morin 2019). Mainly they are expected to take effect due to changes in domestic law. Brandi, Blümer, and Morin (2019) could show the positive relationship between PTAs and the change in domestic legislation. The link between norms in PTAs and domestic law can be explained by the norm diffusion framework. Norm diffusion is the movement and adoption of norms across political borders (Jinnah and Morin 2020, 200). The four most prominent diffusion mechanisms are coercion, economic competition, learning, and imitation (Shipan and Volden 2008). In the literature on behind-the-border measures of PTAs, scholars mainly focus on the differentiation between coercion and learning/persuasion (Hafner-Burton 2005; Bastiaens and Postnikov 2017). As Morin and Rochette (2017, 641) put it: "The aim of including a selection of environmental agreements under the umbrella of a trade deal is primarily to diffuse US environmental norms, rather than to create a level playing field."

Coercion presumes a power asymmetry, where powerful countries can implicitly or explicitly influence the adoption of policies by weaker countries (Simmons, Dobbin, and Garrett 2006). For example, this can occur through international organisations or trade practices (Shipan and Volden 2008; Simmons, Dobbin, and Garrett 2006; Woolcock 2013). When powerful countries or

institutions coerce, they can influence behaviour by increasing the rewards of compliance or the costs of defection through material rewards and punishment. The rationale is that actors comply as long as the benefits of compliance outweigh the costs (Hafner-Burton 2005). Bastiaens and Postnikov (2017) have identified a fear of possible sanctions as one of the mechanisms through which the influence on CO_2 emissions can be explained. Effects in case of coercion often arise *ex ante,* as compliance is more beneficial for both the target and sender due to the avoidance of sanctioning costs (Hafner-Burton 2005, 600; Drezner 2003). Therefore, threat is often enough to reach certain ends. The clauses included in this study to test the enforcement hypothesis demonstrate such coercive measures. They not only require a change of domestic legislation, but the provisions also obligate states to enforce these measures through legal pathways. It can therefore be deduced that the reduction in GHG emissions that we have seen correlated with strong enforcement measures, works at least through the mechanism of coercion. This includes the US-Peru agreement, where the US can implement trade sanctions if Peru does not comply with the provisions.

On the other hand, learning and persuasion can also play an important role in the notion of change and policy diffusion. Learning refers to "a change in beliefs or change in one's confidence in existing beliefs, which can result from exposure to new evidence, theories, or behavioural repertoires" (Simmons, Dobbin, and Garrett 2006, 795). Persuasion is focused on driving the learning in a certain direction. It is "the active, often strategic inculcation of norms" (Goodman and Jinks 2004, 10). Changing beliefs works over time through changing the perception of legitimate behaviour in iterations of diffusion and internalisation (Hafner-Burton 2005; Finnemore and Sikkink 1998). This mechanism is supported by many views in the literature arguing that states can be persuaded without coercion to change behavioural patterns. Often this is motivated by legitimacy rather than fear of punishment (Goodman and Jinks 2004). As we have seen, the approach of learning is mainly pursued by the EU. The approach may be linked to the concept of normative power Europe (Manners 2002). An advantage of policy learning compared to coercion is that it allows for the intrinsic motivation of countries to materialise in policies, rather than one nation dictating the rules. There is a growing number of studies examining the "crowding-out" of internal motivation through coercive measures.

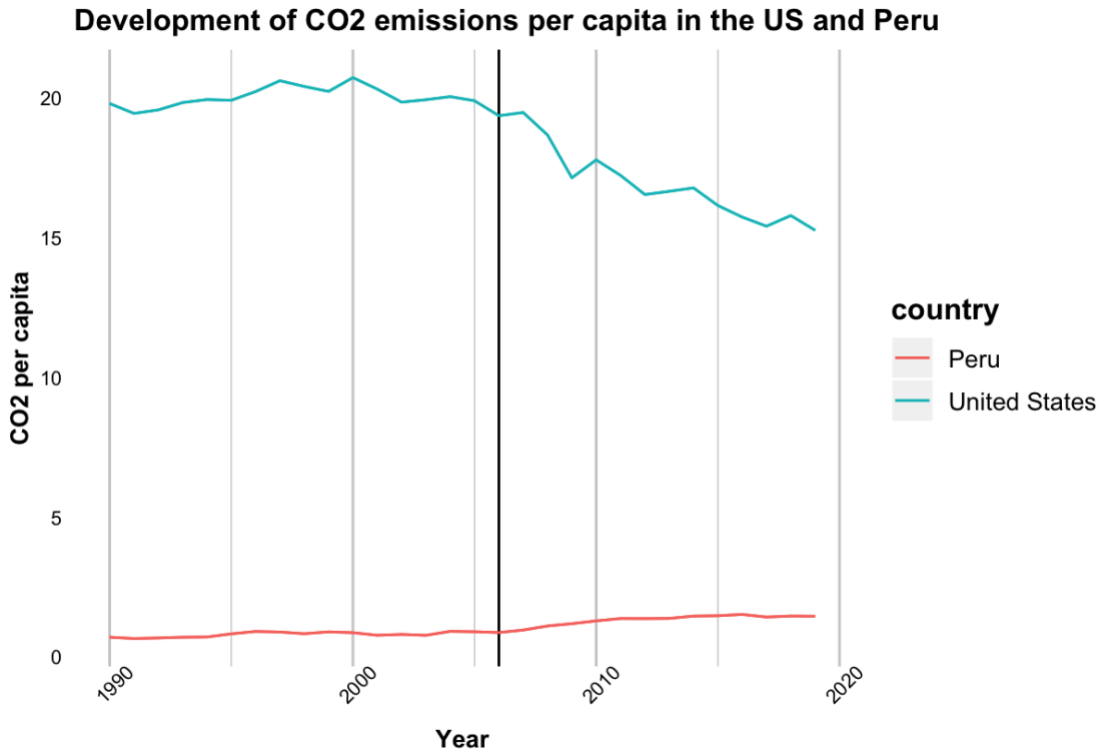
The mechanism of learning is aimed at preserving internal motivation and meeting on eye level — exchanging scientific progress, policy approaches and ideas. EU PTAs mainly rely on policy dialogue between civil society actors and their governments, both in the EU and their trading partners (Bastiaens and Postnikov 2017). While EU PTAs also include legally binding norms on environmental standards, enforcement measures stand in stark contrast to the discussed approaches by the US. Instead of sanctions, the EU relies mainly on the mechanism of Civil Society Dialogue where actors from the EU and the partner country, from both the government and civil society organisations, meet on a regular basis to discuss implementation (Bastiaens and Postnikov 2017).

2. Mechanisms in the US-Peru TPA

In this section the effect of the TPA on the countries' emissions is examined as well as the mechanisms through which they occur. When observing only CO_2 emissions per capita, a downward trend is observed for the US, in contrast to a relatively stable emission level for Peru. Peru has a far lower emissions level than the US (Figure 3). However, to truly understand the effect we would need to isolate the influences of the TPA from other local and political influences on the decrease/increase of emissions. Tracing all those effects goes beyond the scope of this research. Therefore, the case will rather exemplify the mechanisms discussed above through which PTAs are expected to work.

Existing literature and research focus solely on changes in Peru after the conclusion of the TPA (Jinnah 2011; Condon 2015; Jinnah and Morin 2020). This is due to the assumption that the stronger economic power will dictate the terms of the PTA. In other words, PTAs will only include provisions that the US already adheres to or deems important to implement. Following that view, economic powers are expected to change their policies first, and then export afterwards (Jinnah and Morin 2020). Hence, it will be difficult to find policy changes caused by PTAs for economically powerful actors. On the contrary, if weaker states are coerced into changing their national law, the effect can be traced back to the PTA. Therefore, I will also focus the case study on changes from the Peruvian side. The US-PERU TPA mainly takes effect through coercion and subsequent translation into national law (Section V.2.a) as well as the domestic enforcement of those laws (Section V.2.b).

Figure 3: CO_2 emissions per capita in the US and Peru from 1990 – 2019



a. Coercion

Numerous provisions in the US-Peru TPA refer explicitly to the implementation and enforcement of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) agreement. For example, Peru is required to adopt a strategic plan of action to implement the CITES annual export quotas for big leaf mahogany and develop systems to verify the legal origin of CITES-listed tree species (Jinnah 2011). These provisions are extremely prescriptive and mirror aspects that Peru had resisted implementation of previously (Jinnah 2011, 197). The implementation of the CITES agreement can be traced back to coercion.

Negotiations of the CITES agreement have a long history of resistance toward increased protection of mahogany, as well as numerous failures in implementing the few protective measures that exist (Jinnah 2011; Blundell 2004). Linking CITES with the trade agreement has shown effectiveness in ways that would have been impossible under CITES alone. The linkage allowed the weaker environmental regime to borrow the enforcement power of the stronger trade regime (Jinnah 2011,

194). A failure to implement the CITES provisions can be challenged under the TPA's dispute settlement chapter (CITES Chapter 21).

Peru's implementation of the CITES after the PTA has been unprecedented. It moved from repeatedly voting against the inclusion of mahogany big leaf (CITES 1994, 1997) to concurring the inclusion of mahogany in the review of significant trade and issuing scientifically based nondetriment findings (NDFs) for mahogany exports within one year (Jinnah 2011). NDFs are export permits that need to be issued by a scientific authority of the state, advising that such exports will not be detrimental to the survival of the species (CITES Art. III and IV).

Beyond the CITES commitments, the Annex on Forest Governance contains detailed commitments on actions and measures to strengthen the forest sector governance, including the creation of a Sub-Committee to oversee the Forest Sector Governance. The implementation of the Annex has positively impacted the forest protection in Peru (Pacheco Restrepo 2019, 261). It has led to the adoption of several reforms in Peru regarding forest governance. These include (1) the enacting of forest and wildlife legislation, (2) the adoption of decrees to increase penalties for forest crimes, and (3) the establishment of authority offices to support regional governments in strengthening forest sector oversight (Pacheco Restrepo 2019, 261). For example, Peru's National Forestry and Wildlife Information System (SNIFF) enables the verification and tracking of the legal origin of timber harvested from Peru (Pacheco Restrepo 2019, 261). Deforestation accounts for the largest share of CO_2 emissions in Peru (Ritchie, Roser, and Rosado 2020). Protecting forests and eliminating deforestation thus has an important impact on reducing GHG emission. However, deforestation has in fact increased in the last years (Tafur Anzualdo et al. 2022). While it can be argued that without the forest governance reforms, the extent of deforestation would have been even worse, this research cannot provide the evidence to make such a claim. The causal links are too uncertain and require further investigation. Nevertheless, the mechanism through which a PTA can take effect still becomes clear: The problem lies in the enforcement of the environmental laws, rather than a failure of translating provisions into national law.

The implementation of the Annex also has a controversial side that cannot be ignored. The measures requested by the US were met with immense public opposition in Peru (Condon 2015).

The main controversy unfolded around decree 1090, one of the instruments used to implement the action plan set out in the TPA. The decree created a new forestry and wildlife law, increasing the national government's ability to reclassify forest land as agricultural land. Concerns arose that this would decrease the environmental protection surrounding these lands and the ownership claims of indigenous people (Jinnah 2011). After protests turned violent in Bagua, the decree was repealed. Nevertheless, the US upheld pressure on Peru to pass a new forestry and wildlife law (Jinnah 2011). This example perfectly demonstrates that the process of negotiations on implementation and enforcement of environmental norms consisted of what the US deemed important, and not what Peruvians supported. It is also true that, as Condon (2015, 120) argues, "had Peru attempted to use the FTA to impose climate change mitigation legislation upon the United States through a linkage with the Kyoto Protocol, it certainly would have failed." This supports the view that the US in particular uses PTAs to diffuse its environmental norms through coercion, without a reciprocal willingness to amend its own environmental policies.

b. Enforcement of domestic environmental law

In general, the TPA demonstrates a high level of legalisation in terms of precision, obligation, and delegation. The TPA comprises of expansive dispute settlement provisions, which for the first time allows for environmental provisions to access the force of the TPA's sanction-based dispute settlement procedures (Jinnah 2011). The Annex on Forest Sector Governance contains numerous provisions related explicitly to the enforcement of the CITES agreement in Peru. The enforcement measures are stronger than any provided under CITES itself (Condon 2015). Furthermore, it authorises the US to supervise the enforcement of Peruvian law and allows the US to issue trade sanctions against Peru if it fails to meet the CITES obligations. The chapter on environmental provisions includes two different enforcement mechanisms. For one, it enables environmental consultations between the governments for the purpose of achieving a mutually satisfactory solution (Art. 18.12.1). On the other hand, Art. 18.8.1 allows any person of a Party to file a submission before the Secretariat for Submissions on Environmental Enforcement Matters (SSEEM) asserting that a Party is not effectively enforcing its environmental laws. The possibility of enforcing domestic law, is exactly what H3 focuses on. Examining the court cases can thus broaden our insight on the processes behind the correlations found in the quantitative analysis.

So far, four files have been submitted with the SSEEM: The first and second file were both submitted in 2018, one concerning the implementation of the Ramsar Convention on Wetlands, the other the adoption of a domestic law without considering Peruvian environmental law. The third one, submitted a year later, alleged that the Agency for Supervision of Forest Resources and Wildlife (OSINFOR) was not moved from the Presidency of Ministers to the Ministry of Environment. And finally, the fourth complaint addressed the sulphur content in diesel fuel. The first case lacked the fulfilment of all admissibility criteria and was not evaluated upon the merits of the case and the third case does not have a direct link to emissions. Therefore, I will focus on the second and fourth case.

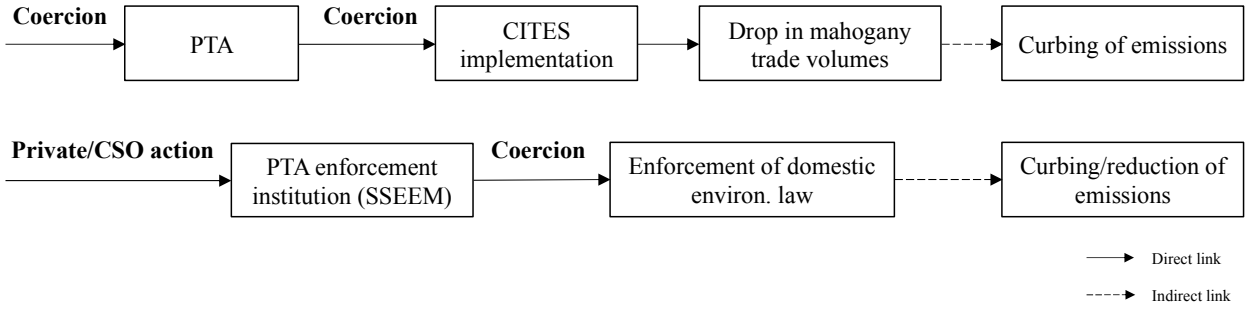
The second case was filed by the Native Federation of the Madre de Dios River and Tributaries (FENAMAD) in July 2018. The FENAMAD is an organisation representing indigenous communities of the region. The submission turns against the Law 303723, alleging that the Peruvian State has not effectively enforced its environmental laws. Specifically, this law "declares priority and national interest in the construction of roads in border areas and maintenance of truck paths in the Ucayali department" (Gutierrez 2022, 10329). The Ucayali region is an indigenous territory and a national environmental reserve. The construction of roads would thus be harmful for the environment, and subsequently lead to increased emissions. After the release of a factual record, the Secretariat formally requested the Congress of the Republic of Peru to debate a bill that would guarantee the protection indigenous rights in link to road infrastructure projects. Now the "Law for the protection of the rights of indigenous peoples and protected natural areas in the process of evaluation, design, construction, improvement, and implementation of road infrastructure projects," includes the opinions of FENAMAD, and its decision references the published factual record by the SSEEM (Gutierrez 2022, 10329). Even though all sides were eager not to strain diplomatic relations between the US and Peru, the case still provides a good example of how the TPA gave indigenous groups the possibility of a legal defence against a breach of environmental laws. This can also be connected to the long-term effect PTAs have on emissions, as identified by the quantitative analysis. The provisions do not only have a once-off effect, i.e. after signing an agreement. Rather, the translation into national law will provide grounds for environmental protection repeatedly.

The case on fuel sulphur was filed by five Peruvian citizens in July 2019, claiming that Peru failed to enforce Art. 3 of Law 28694, regulating the sulphur content in Diesel fuel. Peru responded in 2020, contesting the admissibility of the case as it must "harm the person making the submission" (Art. 18.8(4)(a)). Peru argued that the submission did not refer to a specific harm for the claimants as it only referred to a damage in the atmosphere (by GHG emissions) with a diffuse and intergenerational scope (López Zamora 2022). The Secretariat, however, concluded that it was sufficiently proven that GHG emissions from burning fossil fuels affected the entire population of Peru and that the fact that the harm was intergenerational does in no way delegitimise the submission (López Zamora 2022). The case was therefore moved to a factual record stage. Once the Secretariat will issue the final factual record, the Environmental Affairs Council (EAC), an intergovernmental organ that was created to oversee the implementation of the environmental chapter, will issue recommendations on how to proceed on the matters (Pacheco Restrepo 2019). Thus, despite the case being ongoing, it shows how a TPA can provide a framework to claim rights on the protection against damages from GHG emissions. If the case goes through and the Peruvian government regulates the sulphur content in Diesel, it will provide a good example of causality for the role of the TPA on the reduction of emissions.

3. Causal Chains

Finally, I examine the issue of reverse causality. The above analysis uncovered at least two causal chains through which the TPA led to a reduction or curbing of GHG emissions. First and foremost, the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although the implementation of the CITES cannot be attributed to the PTA entirely, it catalysed the speed at which it was implemented (Jinnah 2011, 206). The implementation also showed the intended effects: US import volumes of Peru mahogany and Spanish cedar dropped significantly (Jinnah 2011). Furthermore, illicit trading or mahogany, which is one of the biggest problems in its deforestation, currently shows promising diminishing trends (Jinnah 2011). As forests function as carbon sinks, deforestation has detrimental effects on a country's CO_2 emissions. In that sense, the protection of plant species can be assumed to have an indirect positive effect on emissions. Jinnah (2011) conducted interviews with officials from both Peru and the US. These interviews indicate not only a correlation but a causal link between the implementation of the CITES and the drop in import volumes by the US of mahogany and

Figure 4: Example of a causal chain for the US-Peru TPA



Spanish cedar. Therefore, even though the CO_2 emissions of Peru did not decline, we can note a positive impact from the TPA: In absence of the TPA, exports might have remained the same or increased, which would in turn have led to an increase in emissions. The implementation of the CITES curbed such an increase in emissions. Coercion in this case facilitated the linkage to the CITES agreement, as well as its implementation (Figure 4).

Secondly, the TPA provides enforcement measures for domestic environmental law. As seen in the two cases filed with the SSEEM, this provides a very promising channel for reductions in emissions. This causal chain is particularly interesting, as it empowers private and civil society actors, and thus moves away from the state-state relations. The case on fuel sulphur has the potential of leading to a significant reduction in GHG emissions if it goes through. Yet, at this point in time, the causal link is still hypothesised, rather than based on observed facts.

Even though no reduction could be found in emissions on the aggregate level, presumably the measures prevented an even greater increase in emissions. Nevertheless, the problem of reverse causality cannot be eliminated. This is especially true because of the fact that the US registers a strong reduction in emissions that cannot be traced back to the TPA. If powerful countries only include environmental (or climate related) clauses in their PTAs that they deem useful for the reduction in GHG emissions, but that they have already adopted apart from any trade agreement, only correlation can be claimed and not causality. On the other hand, for weaker countries the mechanisms of coercion and learning can in fact provide causal chains from the conclusion of a PTA to the reduction in emissions. However, economic growth through the PTA will also lead to increased emissions. Further research on these links and whether such clauses can offset that effect is still needed.

VI. Conclusion

This study has examined two main questions. First, whether environmental provisions in PTAs lead to a reduction in greenhouse gas emissions of trading partners. And second, how the legal nature of climate provisions influences their effectiveness. Like every good answer, the results show "it depends" for the first question. Merely including environmental provisions in PTAs does not correlate with a statistically significant reduction of per capita CO_2 emissions compared to PTAs that do not include such clauses. However, the number of clauses in PTAs correlates with a reduction in emissions. Even stronger is the effect for climate-specific norms, predicting a reduction of 1.42% of per capita CO_2 emissions for every additional climate-related clause. Results also confirm that effects occur both *ex ante* and *ex post,* with countries already adapting their behaviour in the negotiation phase. The study adds new findings to the small body of literature on the nexus between environmental provisions in PTAs and GHG emissions by identifying long-term effects on trading partners' emissions. The long-term effects can be theorised to occur due to the translation of PTA provisions into national law. Regarding the legal design of environmental provisions, this study found that strong enforcement measures for domestic environmental law statistically correlate with a reduction in per capita CO_2 emissions. The effects from strong enforcement measures were more substantial than that of climate-specific provisions.

Furthermore, this study explored the mechanisms through which PTAs take effect — namely, policy learning and coercion. The case study on the US-Peru TPA revealed strong coercive measures, and the analysis subsequently focused on this mechanism specifically. Linking the CITES agreement to the enforcement measures of the TPA has shown to have significant advancements in the CITES implementation in Peru. It also showed how the issuance of several new national laws on forest protection in response to the TPA led to long-term effects of trade agreements. However, these findings do not allow general implications on the effectiveness of coercion. Instead, it needs to be studied why countries would sign such invasive PTAs and why only such a small percentage includes these provisions. It seems plausible that the countries that include environmental provisions were either willing to implement these measures in the first place or that more powerful countries pressured them to adopt the provisions due to the necessity of other benefits. Both reasons uncover some fundamental governance issues related to issue linkage in PTAs, especially when it comes to the mechanism of coercion. Linking environmental issues to

trade can allow more powerful actors to diffuse their own policy views across borders. Economic powers are thus enabled to impose their environmental norms on the rest of the world. This may not only be problematic in terms of ignoring the national context of different trading partners but also poses serious legitimacy questions.

Caution also needs to be given when interpreting the results regarding causality. The causal chain linking the adoption of a trade agreement with environmental provisions to climate change mitigation is long, indirect, and uncertain. While the results provide significant statistical correlations, they are limited by the potential of reversed causality. The case study provides two examples which portray the direction of causality to be that of PTA to emissions. The first example, shows that the implementation of the CITES agreement led to reduced exports of mahogany and Spanish cedar timber. The second example shows that specific forest governance measures led to stronger laws on the protection of forests. However, the case study also uncovered that the problem of reverse causality may exist. This is especially for powerful countries, since the causal links are based on the coercive influence on weaker countries. Contrarily, the PTA does not seem to influence the behaviour of powerful countries, as they have more power to decide which provisions are included in the agreement in the first place. This finding suggests that the quantitative results may be influenced by emissions reductions in the countries that export their norms through PTAs. This is the main limitation of the paper at hand. A broader selection of case studies and a difference-in-difference comparison with similar countries should be conducted to analyse the causal pathways. Further limitations are found in the control variables. GHG emissions are influenced by so many factors that this study could only include a selection of the most relevant ones. However, proxies such as signing multilateral environmental agreements for the environmental policy stringency may further limit these controls.

The reader might still ask, are PTAs an effective policy instrument in the fight against climate change? This research has shown, yes, they can be, but should be treated with caution. PTAs are a powerful tool due to their legal enforceability. They can give MEAs their missing legal “bite”, as seen in the CITES implementation in the US-Peru case. They can lead to a strengthening of environmental laws. They can also provide legal mechanisms for private actors and civil society organisations to claim their environmental rights, which might not be available under domestic

law. On the other hand, the element of coercion bears the danger of powerful countries, like the US, dictating environmental norms to their trading partners. Most studies that make the connection between PTAs and environmental effects assume an intrinsic motivation for powerful countries to change their climate policies. At the same time, weaker states must be taught or coerced into adopting similar provisions. Such approaches may not only be ignorant but, in the worst-case scenario, lead to contradictory effects through the crowding-out of intrinsic motivation.

From the analysis in this study, important policy implications can be drawn. Firstly, environmental chapters or environmental annexes should be included in PTAs. Merely mentioning the environment in the preamble or including selective environmental clauses is insufficient. Secondly, the inclusion of climate-specific policies appears especially effective. This includes provisions aimed at reducing GHG emissions or cooperation on climate change. Policy makers can orientate themselves along EU- or Korea-PTA provisions. Further, PTAs should allow private persons and civil society organisations access to legal mechanisms to ensure compliance with environmental laws. In that sense, provisions which enable the enforcement of national environmental law seem very effective. Nevertheless, when designing PTAs, it should be ensured that they bind both sides equally and are not used blindly to impose specific ideas on environmental norms on weaker countries.

For future research, a stronger focus should be given to compare a legalised versus a managerial approach in PTA's climate provisions. Due to the limited scope, the study at hand could only shed light on the enforcement side of the legalised approach. However, only when both are compared and analysed, can broadly applicable policy implications be given. Reciprocal policy learning seems like an approach that would particularly resolve many of the governance issues related to coercion and should be researched further. Finally, to address the reverse causality concerns, future research should also focus on the different effects of PTAs, depending on whether they are concluded between two strong, two weak or a strong and a weak country. In broader terms, insights are still widely missing to understand *why* environmental provisions are included in some PTAs and not in others.

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ANNEX I: Variables, Countries and Treaties included

Table 5: Description of Variables, Data and Sources

Variable Name	Description	Source
CO_2 per capita (CO2.pc)	Total CO_2 (carbon dioxide) emissions per country, divided by each country's respective population. Units are tonnes of CO_2 per capita per year	Emission Database for Global Atmospheric Research (EDGAR), available at: https://data.jrc.ec.europa.eu/collection/edgar
CH_4	The total CH_4 (methane) emissions aggregated across sectors per country. Units are kilotonnes (kt) of CH_4 per year	Emission Database for Global Atmospheric Research (EDGAR), available at: https://data.jrc.ec.europa.eu/collection/edgar
N_2O	The total N2O (nitrous oxide) emissions aggregated across sectors per country. Units are kilotonnes (kt) of N2O per year	Emission Database for Global Atmospheric Research (EDGAR), available at: https://data.jrc.ec.europa.eu/collection/edgar
$PM_{2.5}$	The total $PM_{2.5}$ (particulate matter, 2.5 micrometers or smaller) emissions aggregated across sec- tors per country. Units are kilotonnes (kt) of $PM_{2.5}$per year	Emission Database for Global Atmospheric Research (EDGAR), available at: https://data.jrc.ec.europa.eu/collection/edgar
PTAs (PTA.dummy, PTAs, ENVPROV, CLIMPROV, ENFORCE)	PTAs with environmental provisions signed per year	TRade and ENvironment Database (TREND), Morin, JF, A. Dür and L. Lechner (2018), "Mapping the trade and environment nexus: Insights from a new dataset", *Global Environmental Politics*, vol. 18(1). Available at: https://www.chaire-epi.ulaval.ca/en/trend
Provisions (ENVPROV, CLIMPROV, ENFORCE)	Number of environmental provisions (climate provisions, enforcement provisions) contained in PTAs	TRade and ENvironment Database (TREND), Morin, JF, A. Dür and L. Lechner (2018), "Mapping the trade and environment nexus: Insights from a new dataset", *Global Environmental Politics*, vol. 18(1). Available at: https://www.chaire-epi.ulaval.ca/en/trend
Income per capita (gdp.cap)	Gross Domestic Product per capita in USD per inhabitant	WDI, World Bank

Population (pop)	Number of inhabitants	WDI, World Bank
Urban population (urb.pop)	Percentage of population living in urban areas	WITS (World Bank, UNCTAD, UNSD, WTO)
Openness (open)	Openness to trade calculated as (Exports+Imports)/GDP	WITS (World Bank, UNCTAD, UNSD, WTO)
Manufact	Percentage of GDP gained by manufacturing	WDI, World Bank
Iea.inforce	The number of international environmental agreements, amendments, and protocols in force, excluding international environmental agreements that have been terminated	Mitchell, Ronald B. 2020. International Environmental Agreements Database Project. Available at: http://iea.uoregon.edu/
Polity2	Index of democracy and autocracy, ranging from +10 (full democracy) to -10 (full autocracy)	Center for Systemic Peace Polity5 Dataset. Available at: http://www.systemicpeace.org/inscrdata.html

Table 6: List of countries

Afghanistan	Djibouti	Latvia	Samoa
Albania	Dominica	Lebanon	Sao Tome and Principe
Algeria	Dominican Republic	Lesotho	Saudi Arabia
Angola	Ecuador	Liberia	Senegal
Antigua and Barbuda	Egypt, Arab Rep.	Libya	Seychelles
Argentina	El Salvador	Lithuania	Sierra Leone
Armenia	Equatorial Guinea	Luxembourg	Singapore
Australia	Eritrea	Madagascar	Slovak Republic
Austria	Estonia	Malawi	Slovenia
Azerbaijan	Eswatini	Malaysia	Solomon Islands
Bahamas, The	Ethiopia	Maldives	Somalia
Bahrain	Fiji	Mali	South Africa
Bangladesh	Finland	Malta	Spain
Barbados	France	Marshall Islands	Sri Lanka
Belarus	Gabon	Mauritania	St. Kitts and Nevis
Belgium	Gambia, The	Mauritius	St. Lucia
Belize	Georgia	Mexico	St. Vincent and the Grenadines
Benin	Germany	Micronesia, Fed. Sts.	Sudan
Bhutan	Ghana	Moldova	Suriname
Bolivia	Greece	Mongolia	Sweden
Bosnia and Herzegovina	Grenada	Morocco	Switzerland
Botswana	Guatemala	Mozambique	Syrian Arab Republic
Brazil	Guinea	Myanmar	Tajikistan
Brunei Darussalam	Guinea-Bissau	Namibia	Tanzania
Bulgaria	Guyana	Nepal	Thailand
Burkina Faso	Haiti	Netherlands	Timor-Leste
Burundi	Honduras	New Zealand	Togo
Cabo Verde	Hungary	Nicaragua	Tonga
Cambodia	Iceland	Niger	Trinidad and Tobago
Cameroon	India	Nigeria	Tunisia
Canada	Indonesia	North Macedonia	Turkey
Central African Republic	Iran, Islamic Rep.	Norway	Turkmenistan
Chad	Iraq	Oman	Tuvalu
Chile	Ireland	Pakistan	Uganda

China	Israel	Palau	Ukraine
Colombia	Italy	Panama	United Arab Emirates
Comoros	Jamaica	Papua New Guinea	United Kingdom
Congo, Dem. Rep.	Japan	Paraguay	United States
Congo, Rep.	Jordan	Peru	Uruguay
Costa Rica	Kazakhstan	Philippines	Uzbekistan
Cote d'Ivoire	Kenya	Poland	Vanuatu
Croatia	Kiribati	Portugal	Venezuela, RB
Cuba	Korea, Rep.	Qatar	Vietnam
Cyprus	Kuwait	Romania	Yemen, Rep.
Czech Republic	Kyrgyz Republic	Russian Federation	Zambia
Denmark	Lao PDR	Rwanda	Zimbabwe

Table 7: List of Preferential Trade Agreements

Agreement	**Year**
Andorra EC	1990
Argentina Brazil	1990
Guyana Venezuela	1990
Libya Morocco	1990
Bolivia Uruguay	1991
Central American Integration System	1991
Chile Mexico	1991
African Economic Community	1991
EC Faroe Islands	1991
EC Hungary	1991
EC Poland	1991
EC San Marino	1991
Argentina Chile	1991
Economic Cooperation Organization (ECO) Preferences	1991
EFTA Turkey	1991
Egypt Syria	1991
Estonia Sweden	1991
India Nepal	1991
Laos Thailand	1991
Lithuania Sweden	1991
MERCOSUR	1991
El Salvador Guatemala	1991
Australia Papua New Guinea	1991
Belarus Ukraine	1992
Brazil Cuba	1992
Caribbean Community (CARICOM) Venezuela	1992
Central European Free Trade Agreement (CEFTA)	1992
Czech and Slovak Republic EFTA	1992
Czech Republic Slovakia	1992
EC Maastricht	1992
EFTA Israel	1992
EFTA Poland	1992
EFTA Romania	1992
Estonia Finland	1992
Estonia Norway	1992
Estonia Switzerland	1992
European Economic Area (EEA)	1992
Faroe Islands Iceland	1992
Faroe Islands Norway	1992
Faroe Islands Switzerland	1992
Finland Latvia	1992

Finland Lithuania	1992
Argentina Venezuela	1992
Jordan Lebanon	1992
Jordan Libya	1992
Kyrgyzstan Russia	1992
Latvia Norway	1992
Latvia Sweden	1992
Latvia Switzerland	1992
Armenia Russia	1992
Lithuania Norway	1992
Lithuania Switzerland	1992
Namibia Zimbabwe	1992
North American Free Trade Agreement (NAFTA)	1992
Association of Southeast Asian Nations (ASEAN) FTA	1992
Southern African Development Community (SADC)	1992
Faroe Islands Finland	1992
Bolivia Chile	1993
Brazil Peru	1993
Bulgaria EC	1993
Bulgaria EFTA	1993
Chile Colombia	1993
Chile Venezuela	1993
Colombia Panama	1993
Common Market for Eastern and Southern Africa (COMESA)	1993
Czech Republic EC	1993
Czech Republic Slovenia	1993
EC Romania	1993
EC Slovakia	1993
EC Slovenia	1993
Economic Community Of West African States (ECOWAS)	1993
Ecuador Mexico	1993
EFTA Hungary	1993
Argentina Ecuador	1993
Armenia Moldova	1993
Melanesian Spearhead Group (MSG)	1993
Russia Ukraine	1993
Slovakia Slovenia	1993
South Asian Association for Regional Cooperation, Preferential Trading Arrangement (SAPTA)	1993
Central American Common Market (CACM) Protocol of Guatemala	1993
Baltic Free Trade Area (BAFTA) industrial	1993
Bolivia Mexico	1994
Bolivia Paraguay	1994
Caribbean Community (CARICOM) Colombia	1994

Chile Ecuador	1994
Commonwealth of Independent States (CIS)	1994
Costa Rica Mexico	1994
Czech Republic Romania	1994
EC Estonia	1994
EC Latvia	1994
EC Lithuania	1994
EC Maastricht (15) Enlargement	1994
Economic and Monetary Community of Central Africa (CEMAC)	1994
Ecuador Paraguay	1994
Ecuador Uruguay	1994
Georgia Russia	1994
Group of Three	1994
Hungary Slovenia	1994
Israel PLO	1994
Jordan Morocco	1994
Kazakhstan Ukraine	1994
Armenia Kyrgyzstan	1994
Armenia Ukraine	1994
Moldova Romania	1994
Association of Caribbean States	1994
Romania Slovakia	1994
Turkmenistan Ukraine	1994
Ukraine Uzbekistan	1994
West African Economic and Monetary Union	1994
WTO Agreements	1994
Bulgaria Czech Republic	1995
Bulgaria Slovakia	1995
Central European Free Trade Agreement (CEFTA) Slovenia accession	1995
Czech Republic Lithuania	1995
EC Estonia Europe Agreement	1995
EC Israel Euro-Med Association Agreement	1995
EC Latvia Europe Agreement	1995
EC Lithuania Europe Agreement	1995
EC Tunisia Euro-Med Association Agreement	1995
EC Turkey	1995
EFTA Estonia	1995
EFTA Latvia	1995
EFTA Lithuania	1995
EFTA Slovenia	1995
Estonia Ukraine	1995
Georgia Ukraine	1995
Israel Jordan	1995
Armenia Georgia	1995

Armenia Iran	1995
Jordan PLO	1995
Kazakhstan Kyrgyzstan	1995
Kyrgyzstan Moldova	1995
Kyrgyzstan Ukraine	1995
Armenia Turkmenistan	1995
Association of Southeast Asian Nations Services	1995
Azerbaijan Ukraine	1995
Bolivia MERCOSUR	1996
Bulgaria Slovenia	1996
Canada Chile	1996
Canada Israel	1996
Chile MERCOSUR	1996
Andean Community Trujillo Protocol	1996
Czech Republic Estonia	1996
Czech Republic Israel	1996
Czech Republic Latvia	1996
EC Faroe Islands	1996
EC Morocco Euro-Med Association Agreement	1996
EC Slovenia Europe Agreement	1996
EFTA Annex H	1996
Egypt Jordan	1996
Estonia Slovakia	1996
Estonia Slovenia	1996
Georgia Turkmenistan	1996
Israel Slovakia	1996
Israel Turkey	1996
Kyrgyzstan Uzbekistan	1996
Latvia Slovakia	1996
Latvia Slovenia	1996
Lithuania Poland	1996
Lithuania Slovakia	1996
Lithuania Slovenia	1996
Macedonia Slovenia	1996
Southern African Development Community (SADC)	1996
Azerbaijan Georgia	1996
Armenia Cyprus	1996
Baltic Free Trade Area (BAFTA) agriculture	1996
Caribbean Community (CARICOM) Protocol on Services	1997
Algeria Jordan	1997
Central European Free Trade Agreement (CEFTA) Romania accession	1997
Croatia Macedonia	1997
Croatia Slovenia	1997
Czech Republic Turkey	1997

EC Amsterdam	1997
EC Jordan Euro-Med Association Agreement	1997
EFTA Morocco	1997
Estonia Faroe Islands	1997
Estonia Turkey	1997
Georgia Kazakhstan	1997
Greater Arab Free Trade Agreement	1997
Hungary Israel	1997
Hungary Turkey	1997
Israel Poland	1997
Latvia Poland	1997
Lithuania Turkey	1997
MERCOSUR services	1997
Mexico Nicaragua	1997
Romania Turkey	1997
Slovakia Turkey	1997
Andean Community Sucre Protocol	1997
Guinea Morocco	1997
Baltic Free Trade Area (BAFTA) Non Tariff Barriers	1997
Pan-Arab Free Trade Area PAFTA	1997
Bulgaria Turkey	1998
Caribbean Community (CARICOM) Dominican Republic	1998
Central America Dominican Republic	1998
Central European Free Trade Agreement (CEFTA) Bulgaria accession	1998
Chile Mexico	1998
Chile Peru	1998
Egypt Jordan	1998
Egypt Morocco	1998
Egypt PLO	1998
Estonia Hungary	1998
Faroe Islands Poland	1998
Hungary Lithuania	1998
India Sri Lanka	1998
Israel Slovenia	1998
Jordan Morocco	1998
Jordan Tunisia	1998
Latin American Integration Association Cuba accession	1998
Latvia Turkey	1998
Slovenia Turkey	1998
Latvia Ukraine Agriculture	1998
Belarus Russia (Union State)	1999
Brazil Cuba	1999
Bulgaria Macedonia	1999
Central America Chile	1999

Andean Community Brazil	1999
Cuba Guatemala	1999
Cuba Uruguay	1999
Cuba Venezuela	1999
EC South Africa	1999
Argentina Cuba	1999
Eurasian Economic Community (EAEC)	1999
Guatemala Mexico	1999
Hungary Latvia	1999
Armenia Kazakhstan	1999
Macedonia Turkey	1999
Morocco Tunisia	1999
Poland Turkey	1999
Andean Community Auto Agreement	1999
Chile Cuba	1999
East African Community (EAC)	1999
EC Switzerland Bilaterals I	1999
Bolivia Cuba	2000
Bosnia and Herzegovina Croatia	2000
Caribbean Community (CARICOM) Cuba	2000
Colombia Cuba	2000
Andean Countries Argentina	2000
Cotonou Agreement	2000
Cuba Ecuador	2000
Cuba Mexico	2000
Cuba Paraguay	2000
Cuba Peru	2000
EC Mexico	2000
EFTA Macedonia	2000
EFTA Mexico	2000
Israel Mexico	2000
Jordan UAE	2000
Jordan US	2000
New Zealand Singapore	2000
United States Vietnam	2000
Bosnia and Herzegovina Slovenia	2001
Brazil Guyana	2001
Bulgaria Estonia	2001
Bulgaria Israel	2001
Bulgaria Lithuania	2001
Canada Costa Rica	2001
Caribbean Community (CARICOM) revised	2001
Croatia EC	2001
Croatia EFTA	2001

EC Egypt Euro-Med Association Agreement	2001
EC Macedonia SAA	2001
EC Nice	2001
EFTA Jordan	2001
EFTA services	2001
Gulf Cooperation Council (GCC)	2001
Israel Romania	2001
Jordan Kuwait	2001
Jordan Syria	2001
Macedonia Ukraine	2001
Morocco UAE	2001
Pacific Island Countries Trade Agreement (PICTA)	2001
Tajikistan Ukraine	2001
Bahrain Jordan	2001
Albania Macedonia	2002
Bosnia and Herzegovina Macedonia	2002
Bosnia and Herzegovina Moldova	2002
Bosnia and Herzegovina Serbia Montenegro	2002
Bosnia and Herzegovina Turkey	2002
Brazil Mexico	2002
Bulgaria Latvia	2002
Algeria EC Euro-Med Association Agreement	2002
Central America Panama	2002
Central European Free Trade Agreement (CEFTA) Croatia accession	2002
Chile EC	2002
Croatia Lithuania	2002
Croatia Macedonia (amended)	2002
Croatia Serbia Montenegro	2002
Croatia Turkey	2002
EC Lebanon Euro-Med Association Agreement	2002
EFTA Singapore	2002
GUAM GUUAM Organization for Democracy and Economic Development	2002
Armenia Estonia	2002
Japan Singapore	2002
Jordan Lebanon	2002
MERCOSUR Mexico Auto Agreement	2002
Pakistan Sri Lanka	2002
Southern Africa Customs Union (SACU)	2002
Albania Croatia	2002
Afghanistan India	2003
Albania Kosovo	2003
Albania Moldova	2003
Bosnia and Herzegovina Bulgaria	2003
Albania Romania	2003

Bosnia and Herzegovina Romania	2003
Bulgaria Serbia	2003
Chile Korea	2003
Chile US	2003
China Hong Kong	2003
China Macao	2003
Common Economic Zone	2003
EC Nice (25) Enlargement	2003
Economic Cooperation Organization Trade Agreement (ECOTA)	2003
Argentina Uruguay	2003
Albania Bosnia and Herzegovina	2003
Jordan Sudan	2003
Macedonia Romania	2003
Albania Bulgaria	2003
Mexico Uruguay	2003
Moldova Serbia	2003
Moldova Ukraine	2003
Panama Taiwan	2003
Romania Serbia	2003
Singapore US	2003
Australia Singapore	2003
MERCOSUR Mexico	2003
Albania Serbia	2004
Bulgaria Moldova	2004
Caribbean Community (CARICOM) Costa Rica	2004
Central American Free Trade Agreement (CAFTA)	2004
Central American Free Trade Agreement (CAFTA) Dominican Republic	2004
Andean Countries MERCOSUR	2004
Croatia Moldova	2004
EFTA Lebanon	2004
Agadir Agreement	2004
EFTA Tunisia	2004
Group of Three Auto Agreement	2004
India MERCOSUR	2004
Iran Pakistan	2004
Japan Mexico	2004
Jordan Singapore	2004
Macedonia Moldova	2004
MERCOSUR Southern African Customs Union (SACU)	2004
Morocco Turkey	2004
Morocco US	2004
South Asian Free Trade Area (SAFTA)	2004
Association of Southeast Asian Nations China	2004
Syria Turkey	2004

Tunisia Turkey	2004
Australia Thailand	2004
Australia US	2004
Bahrain US	2004
Brazil Suriname	2005
Chile China	2005
EC Nice (27) Enlargement	2005
EFTA Korea	2005
Egypt Turkey	2005
Faroe Islands Iceland	2005
Guatemala Taiwan	2005
India Singapore	2005
Japan Malaysia	2005
Korea Singapore	2005
Malawi Mozambique	2005
MERCOSUR Peru	2005
Asia Pacific Trade Agreement (Bangkok Agreement amended)	2005
New Zealand Thailand	2005
Trans Pacific Strategic EPA	2005
Peru Thailand	2005
understanding establishment secretariat environmental matters CAFTA-DR	2005
Belize Guatemala	2006
Bhutan India	2006
Albania Turkey	2006
Central European Free Trade Agreement (CEFTA)	2006
Chile Colombia	2006
Chile India	2006
Chile Panama	2006
China Pakistan	2006
Colombia US	2006
Andean Countries MERCOSUR Venezuela accession	2006
Cuba Mercosur	2006
D8 PTA	2006
EFTA Southern African Customs Union (SACU)	2006
Iran Syria	2006
Japan Philippines	2006
Nicaragua Taiwan	2006
Oman US	2006
Panama Singapore	2006
Peru US	2006
Chile Peru	2006
Association of Southeast Asian Nations Korea	2006
Malawi Zimbabwe	2006
Albania EC SAA	2006

Bangladesh India	2006
Agreement Secretariat Environmental Matters FTA	2006
EFTA SACU	2006
Brunei Japan	2007
Chile Japan	2007
Colombia Northern Triangle	2007
EC Lisbon	2007
EC Montenegro SAA	2007
EFTA Egypt	2007
El Salvador Honduras Taiwan	2007
Georgia Turkey	2007
Indonesia Japan	2007
Israel Mercosur	2007
Japan Thailand	2007
Korea US	2007
Malaysia Pakistan	2007
Mauritius Pakistan	2007
Panama US	2007
Association of Southeast Asian Nations China Services	2007
Association of Southeast Asian Nations Korea services	2007
Honduras Panama	2007
EAC Burundi	2007
Bosnia and Herzegovina EC SAA	2008
Canada Colombia	2008
Canada EFTA	2008
Canada Peru	2008
CARIFORUM EC EPA	2008
Algeria Tunisia	2008
Chile Ecuador	2008
China Singapore	2008
Colombia EFTA	2008
EC Serbia SAA	2008
Economic and Monetary Community of Central Africa (CEMAC) revised	2008
Gulf Cooperation Council (GCC) Singapore	2008
Japan Vietnam	2008
Montenegro Turkey	2008
Peru Singapore	2008
Association of Southeast Asian Nations Japan	2008
Australia Chile	2008
Paraguay Venezuela	2008
Uruguay Venezuela	2008
MERCOSUR Southern African Customs Union (SACU)	2008
Guatemala Panama Protocol	2008
Belarus Serbia	2009

Canada Jordan	2009
Chile MERCOSUR Protocol on Services	2009
Chile Turkey	2009
China Pakistan Services	2009
China Peru	2009
Cote d'Ivoire EC EPA	2009
EFTA GCC	2009
EFTA Serbia	2009
India Korea	2009
India Nepal	2009
Japan Switzerland	2009
Jordan Turkey	2009
Malaysia New Zealand	2009
Serbia Turkey	2009
Association of Southeast Asian Nations Australia New Zealand FTA (AANZFTA)	2009
Association of Southeast Asian Nations Goods	2009
Association of Southeast Asian Nations India	2009
Nicaragua Panama Protocol	2009
Albania EFTA	2009
East African Community Common Market	2009
India Korea	2009
Canada Panama	2010
Chile Malaysia	2010
China Costa Rica	2010
Costa Rica Singapore	2010
EC Korea	2010
EFTA Peru	2010
EFTA Ukraine	2010
Hong Kong New Zealand	2010
MERCOSUR Egypt	2010
EC (28) Enlargement	2011
Chile Vietnam	2011
Commonwealth of Independent States	2011
Costa Rica Peru	2011
EFTA Hong Kong	2011
EFTA Montenegro	2011
Guatemala Peru	2011
India Japan	2011
India Malaysia	2011
Japan Peru	2011
Korea Peru	2011
Mauritius Turkey	2011
Montenegro Ukraine	2011
Panama Peru	2011

Central America Mexico	2011
Group of three	2011
Australia Malaysia	2012
Central America EC	2012
Colombia Peru EC	2012
Korea Turkey	2012
Peru Venezuela	2012
Chile Hong Kong	2012
Revised Agreement on Governement Procurement	2012
Canada Honduras	2013
Chile Thailand	2013
Colombia Costa Rica	2013
Colombia Israel	2013
Colombia Korea	2013
Colombia Panama	2013
New Zealand Taiwan	2013
Pacific Alliance	2013
Bosnia and Herzogovina EFTA	2013
China Switzerland	2013
Central America EFTA	2013
Armenia EC	2013
Panama Trinidad Tobago	2013
China Iceland	2013
Singapore Taipei	2013
Australia Japan	2014
Canada Korea	2014
EC Georgia	2014
EC Moldova	2014
EC Ukraine	2014
Mexico Panama	2014
Agreement on Trade Facilitation	2014
China Korea	2014
Australia Korea	2014
Malaysia Turkey	2014
EC West African states	2014
Moldova Turkey	2014
Australia China	2015
Korea New Zealand	2015
Korea Vietnam	2015
Belarus Kazakhstan Russia Vietnam	2015
Honduras Peru	2015
Japan Mongolia	2015
COMESA EAC SADC	2015
Colombia Peru EC Croatia accession	2015

Guatemala Trinidad Tobago	2015
Singapore Turkey	2015
EC Kosovo SAA	2015
EC Kazakhstan	2015
Canada Ukraine	2016
EC Vietnam	2016
Transpacific Partnership	2016
EFTA Philippines	2016
Colombia Peru EC Ecuador accession	2016
Canada EC (CETA)	2016
Chile Uruguay	2016
EC EAC	2016
EC SADC	2016
EFTA Georgia	2016
Pacific Agreement on Closer Economic Relations (PACER) Plus	2017
Hong Kong Macao	2017
China Georgia	2017
Argentina Chile	2017
Colombia MERCOSUR	2017
USMCA	2018
Colombia MERCOSUR services	2018
EC Japan	2018
EC Singapore	2018
African Continental FTA	2018
Australia Peru	2018

ANNEX II: Data Suitability for Regression

Figure 5: Cross-sectional variance of data

pv	list [4] (S3: pvar)	List of length 4
id.variation	logical [20]	FALSE TRUE TRUE TRUE TRUE TRUE ...
year	logical [1]	FALSE
country	logical [1]	TRUE
iso3c	logical [1]	TRUE
region	logical [1]	TRUE
income	logical [1]	TRUE
co2.pc.ln	logical [1]	TRUE
PTA.dummy	logical [1]	TRUE
PTAs	logical [1]	TRUE
PTA.cum	logical [1]	TRUE
clauses	logical [1]	TRUE
climate	logical [1]	TRUE
enforce	logical [1]	TRUE
gdp.cap.ln	logical [1]	TRUE
gdp.capsq.ln	logical [1]	FALSE
pop.ln	logical [1]	TRUE
urb.pop.pp	logical [1]	TRUE
open	logical [1]	TRUE
manufact	logical [1]	TRUE
iead.inforce	logical [1]	TRUE
polity2	logical [1]	TRUE

Figure 6: Time variance in data

pv	list [4] (S3: pvar)	List of length 4
id.variation	logical [20]	FALSE TRUE TRUE TRUE TRUE TRUE ...
time.variation	logical [20]	TRUE FALSE FALSE FALSE FALSE TRUE ...
year	logical [1]	TRUE
country	logical [1]	FALSE
iso3c	logical [1]	FALSE
region	logical [1]	FALSE
income	logical [1]	FALSE
co2.pc.ln	logical [1]	TRUE
PTA.dummy	logical [1]	TRUE
PTAs	logical [1]	TRUE
PTA.cum	logical [1]	TRUE
clauses	logical [1]	TRUE
climate	logical [1]	TRUE
enforce	logical [1]	TRUE
gdp.cap.ln	logical [1]	TRUE
gdp.capsq.ln	logical [1]	TRUE
pop.ln	logical [1]	TRUE
urb.pop.pp	logical [1]	TRUE
open	logical [1]	TRUE
manufact	logical [1]	TRUE
iead.inforce	logical [1]	TRUE
polity2	logical [1]	TRUE

Figure 7: Variance Inflation Factors (VIF) for independent variables

```
> vif(m1.1.1)
   PTA.dummy         PTAs      clauses   gdp.cap.ln          pop   urb.pop.pp
    2.327214     4.236315     2.702450     4.236796     1.138334     3.256114
        open     manufact      polity2 iead.inforce
    1.198553     1.123348     1.312190     1.960538
> vif(m1.1.2)
   PTA.dummy         PTAs      climate   gdp.cap.ln          pop   urb.pop.pp
    2.389716     4.144796     2.562855     4.256404     1.143321     3.302758
        open     manufact      polity2 iead.inforce
    1.198993     1.122642     1.311534     1.966840
> vif(m1.1.3)
   PTA.dummy         PTAs      enforce   gdp.cap.ln          pop   urb.pop.pp
    2.261970     2.822952     1.427016     4.238464     1.134803     3.222730
        open     manufact      polity2 iead.inforce
    1.187370     1.121214     1.309567     1.853407
```

ANNEX III: Regression results for different greenhouse gases

Running multiple models on other greenhouse gases besides CO_2, indicates that the results are robust across GHG emissions: CO_2, CH_4, N_2O and other polluter measured in $PM_{2.5}$ can be statistically significant reduced through the incorporation of environmental provisions. In line with the results for CO_2 per capita, the effect depends on the number of clauses incorporated, not on the number of PTAs concluded.

Table 8: Determinants of different greenhouse gases

	Dependent variable:			
	co2.ln	ch4.ln	n2o.ln	pm25.ln
	(1)	(2)	(3)	(4)
PTA.dummy	0.0116	-0.0181**	-0.0216***	-0.0148
	(0.0125)	(0.0072)	(0.0079)	(0.0108)
PTAs	0.0288***	0.0156***	0.0158***	0.0179***
	(0.0071)	(0.0041)	(0.0044)	(0.0061)
ENVPROV	-0.0009***	-0.0003***	-0.0003***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
gdp.cap.ln	0.6055***	0.2366***	0.2086***	0.1861***
	(0.0230)	(0.0139)	(0.0152)	(0.0208)
pop.ln	1.2693***	0.9567***	0.9476***	0.9902***
	(0.0422)	(0.0266)	(0.0291)	(0.0399)
urb.pop.pp	0.0179***	-0.0028***	0.0001	0.0018
	(0.0015)	(0.0010)	(0.0010)	(0.0014)
open	0.0006**	-0.0004***	-0.0002	-0.0010***
	(0.0002)	(0.0001)	(0.0002)	(0.0002)
manufact	0.0131***	0.0024***	0.0067***	0.0042***
	(0.0013)	(0.0008)	(0.0009)	(0.0012)
iea.inforce	-0.0006***	-0.0004***	0.00001	0.0003**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	0.0007	0.0014	0.0022**	0.0053***
	(0.0015)	(0.0009)	(0.0010)	(0.0014)
Observations	3,555	3,428	3,428	3,428
R^2	0.4105	0.3718	0.3224	0.2246
Adjusted R^2	0.3777	0.3354	0.2831	0.1795
Note:	Year and Country fixed effects included in all columns, *p**p***p<0.01			

ANNEX IV: Robustness Checks

1. Adding and dropping control variables

Table 9: Robustness checks control variables for ENVPROV

	Dependent variable:			
	co2.pc.ln			
	(1)	(2)	(3)	(4)
ENVPROV	-0.0008***	-0.0008***	-0.0005***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
gdp.cap.ln		0.5451***	0.5618***	0.6168***
		(0.0177)	(0.0218)	(0.0230)
pop.ln		0.2036***	0.5144***	0.3305***
		(0.0382)	(0.0399)	(0.0419)
open			0.0005**	0.0006**
			(0.0002)	(0.0002)
polity2			0.0023	-0.00003
			(0.0015)	(0.0015)
urb.pop.pp				0.0185***
				(0.0015)
manufact				0.0133***
				(0.0013)
iea.inforce				-0.0006***
				(0.0001)
Observations	5,185	5,019	3,906	3,555
R^2	0.0116	0.1760	0.1755	0.2681
Adjusted R^2	-0.0304	0.1395	0.1349	0.2279
Note:				*p**p***p<0.01
				Year and Country fixed effects included in all columns

Table 10: Robustness checks control variables for CLIMPROV

	Dependent variable:			
	co2.pc.ln			
	(1)	(2)	(3)	(4)
CLIMPROV	-0.0145***	-0.0145***	-0.0105***	-0.0081***
	(0.0019)	(0.0018)	(0.0015)	(0.0015)
gdp.cap.ln		0.5450***	0.5608***	0.6164***
		(0.0177)	(0.0218)	(0.0230)
pop.ln		0.1981***	0.5051***	0.3257***
		(0.0383)	(0.0400)	(0.0419)
open			0.0005**	0.0006**
			(0.0002)	(0.0002)
polity2			0.0023	-0.00002
			(0.0015)	(0.0015)
urb.pop.pp				0.0183***
				(0.0015)
manufact				0.0133***
				(0.0013)
iea.inforce				-0.0006***
				(0.0001)
Observations	5,185	5,019	3,906	3,555
R^2	0.0118	0.1762	0.1766	0.2686
Adjusted R^2	-0.0301	0.1397	0.1362	0.2284
Note:				*p**p***p<0.01
				Year and Country fixed effects included in all columns

Table 11: Robustness checks control variables for ENFORCE

	Dependent variable:			
	co2.pc.ln			
	(1)	(2)	(3)	(4)
ENFORCE	-0.0463***	-0.0447***	-0.0309***	-0.0243***
	(0.0061)	(0.0057)	(0.0048)	(0.0046)
gdp.cap.ln		0.5435***	0.5614***	0.6165***
		(0.0177)	(0.0218)	(0.0230)
pop.ln		0.2076***	0.5195***	0.3326***
		(0.0382)	(0.0397)	(0.0418)
open			0.0005**	0.0006**
			(0.0002)	(0.0002)
polity2			0.0023	-0.00004
			(0.0015)	(0.0015)
urb.pop.pp				0.0187***
				(0.0015)
manufact				0.0133***
				(0.0013)
iea.inforce				-0.0006***
				(0.0001)
Observations	5,185	5,019	3,906	3,555
R^2	0.0114	0.1752	0.1755	0.2684
Adjusted R^2	-0.0305	0.1386	0.1349	0.2282
Note:				*p**p***p<0.01
				Year and Country fixed effects included in all columns

2. Inclusion of a lagged dependent variable

Table 12: Added lagged dependent variable

	Dependent variable:					
	co2.pc.ln					
	(1)	(2)	(3)	(4)	(5)	(6)
ENVPROV	-0.0003***	-0.0006***				
	(0.0001)	(0.0001)				
CLIMPROV			-0.0066***	-0.0101***		
			(0.0013)	(0.0017)		
ENFORCE					-0.0182***	-0.0210***
					(0.0041)	(0.0046)
PTAs		0.0183***		0.0149***		0.0057
		(0.0050)		(0.0047)		(0.0040)
gdp.cap.ln	0.4167***	0.4138***	0.4166***	0.4145***	0.4175***	0.4171***
	(0.0218)	(0.0218)	(0.0218)	(0.0218)	(0.0218)	(0.0218)
pop.ln	0.2799***	0.2583***	0.2764***	0.2589***	0.2846***	0.2809***
	(0.0376)	(0.0380)	(0.0377)	(0.0381)	(0.0376)	(0.0376)
urb.pop.pp	0.0135***	0.0133***	0.0134***	0.0132***	0.0137***	0.0137***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
open	0.0006***	0.0006***	0.0006***	0.0006***	0.0005***	0.0005***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0092***	0.0091***	0.0092***	0.0091***	0.0092***	0.0091***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
iea.inforce	-0.0008***	-0.0007***	-0.0008***	-0.0007***	-0.0008***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	0.0034**	0.0033**	0.0034**	0.0033**	0.0034**	0.0034**
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
co2.pc.ln.lag1	0.2820***	0.2784***	0.2818***	0.2789***	0.2814***	0.2803***
	(0.0098)	(0.0098)	(0.0098)	(0.0098)	(0.0098)	(0.0098)
Observations	3,548	3,548	3,548	3,548	3,548	3,548
R^2	0.4073	0.4097	0.4075	0.4093	0.4067	0.4071
Adjusted R^2	0.3745	0.3768	0.3747	0.3764	0.3739	0.3741

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns

3. Fixed versus random effects

Table 13: Comparison of fixed and random effects for PTAs

	Dependent variable:			
	co2.pc.ln			
	Fixed Effects		Random Effects	
	(1)	(2)	(3)	(4)
PTA.dummy	0.0212**		0.0087	
	(0.0092)		(0.0084)	
PTAs		0.0026		-0.0007
		(0.0040)		(0.0038)
gdp.cap.ln	0.6230***	0.6242***	0.6232***	0.6228***
	(0.0231)	(0.0231)	(0.0198)	(0.0198)
pop.ln	0.3668***	0.3684***	0.1875***	0.1909***
	(0.0413)	(0.0414)	(0.0245)	(0.0247)
urb.pop.pp	0.0193***	0.0193***	0.0223***	0.0222***
	(0.0015)	(0.0015)	(0.0013)	(0.0013)
open	0.0004*	0.0004*	0.0006***	0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0131***	0.0131***	0.0133***	0.0133***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
iea.inforce	-0.0007***	-0.0007***	-0.0010***	-0.0010***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	0.0002	0.0001	-0.0001	-0.0001
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Constant			-8.9193***	-8.9635***
			(0.4264)	(0.4304)
Observations	3,555	3,555	3,555	3,555
R^2	0.2634	0.2624	0.4458	0.4431
Adjusted R^2	0.2230	0.2219	0.4446	0.4419
Note:				*p**p***p<0.01

Table 14: Comparison of fixed and random effects for ENVPROV, CLIMPROV, ENFORCE

	Dependent variable:					
	co2.pc.ln					
	Fixed Effects			Random Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
clauses	-0.0004***			-0.0004***		
	(0.0001)			(0.0001)		
climate		-0.0076***			-0.0081***	
		(0.0014)			(0.0014)	
enforce			-0.0231***			-0.0246***
			(0.0044)			(0.0044)
gdp.cap.ln	0.5917***	0.5914***	0.5909***	0.6218***	0.6215***	0.6198***
	(0.0209)	(0.0209)	(0.0209)	(0.0197)	(0.0197)	(0.0198)
pop.ln	0.2972***	0.2927***	0.2984***	0.1776***	0.1757***	0.1800***
	(0.0347)	(0.0348)	(0.0347)	(0.0249)	(0.0251)	(0.0251)
urb.pop.pp	0.0182***	0.0180***	0.0183***	0.0214***	0.0213***	0.0215***
	(0.0015)	(0.0015)	(0.0015)	(0.0013)	(0.0013)	(0.0013)
open	0.0006***	0.0006***	0.0006***	0.0007***	0.0007***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
manufact	0.0135***	0.0135***	0.0134***	0.0135***	0.0135***	0.0135***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
iea.inforce	-0.0009***	-0.0009***	-0.0009***	-0.0009***	-0.0009***	-0.0009***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
polity2	-0.0003	-0.0003	-0.0004	-0.0003	-0.0004	-0.0004
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Constant				-8.7237***	-8.6835***	-8.7539***
				(0.4331)	(0.4353)	(0.4352)
Observations	3,555	3,555	3,555	3,555	3,555	3,555
R^2	0.3971	0.3974	0.3969	0.4468	0.4463	0.4454
Adjusted R^2	0.3693	0.3696	0.3691	0.4456	0.4450	0.4441
Note:						*p**p***p<0.01

4. Data Imputation

The data set was relatively complete. Only for the variables Polity2, openness to trade and manufacturing more than 10% of values were missing. Missing values showed characteristics of missing at random (MAR). Therefore, missing data points could be imputed. The imputation method used is predictive mean matching. The prevailing theory suggest to run 3-5 imputations (Heymans and Eekhout 2019). 5 datasets were imputed and pooled into the missing values. The density plots show that imputed data follows the same distribution as the original dataset. The results are very similar to the results obtained in our main analysis. This gives a good indication on robustness of the results. The significant drop in R^2 indicates an overfitting of values, reducing the distances to the mean for an OLS regression.

Figure 8: Proportion of missingness for the data

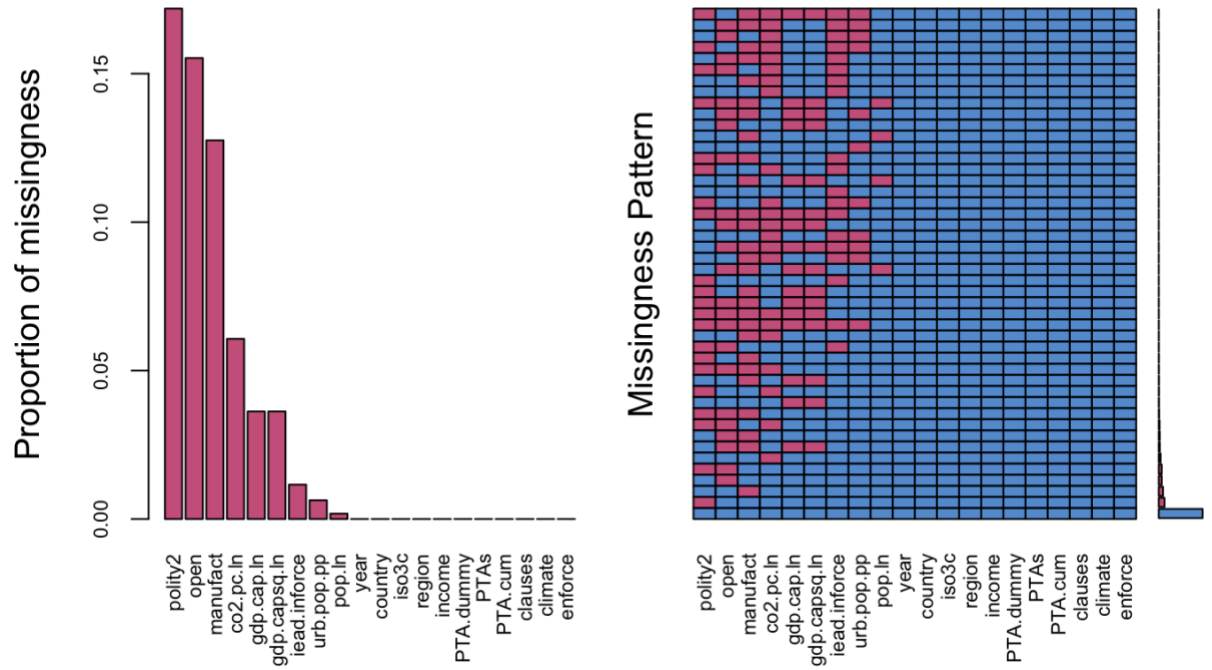

Figure 9: Density plots for imputed data (1/2)

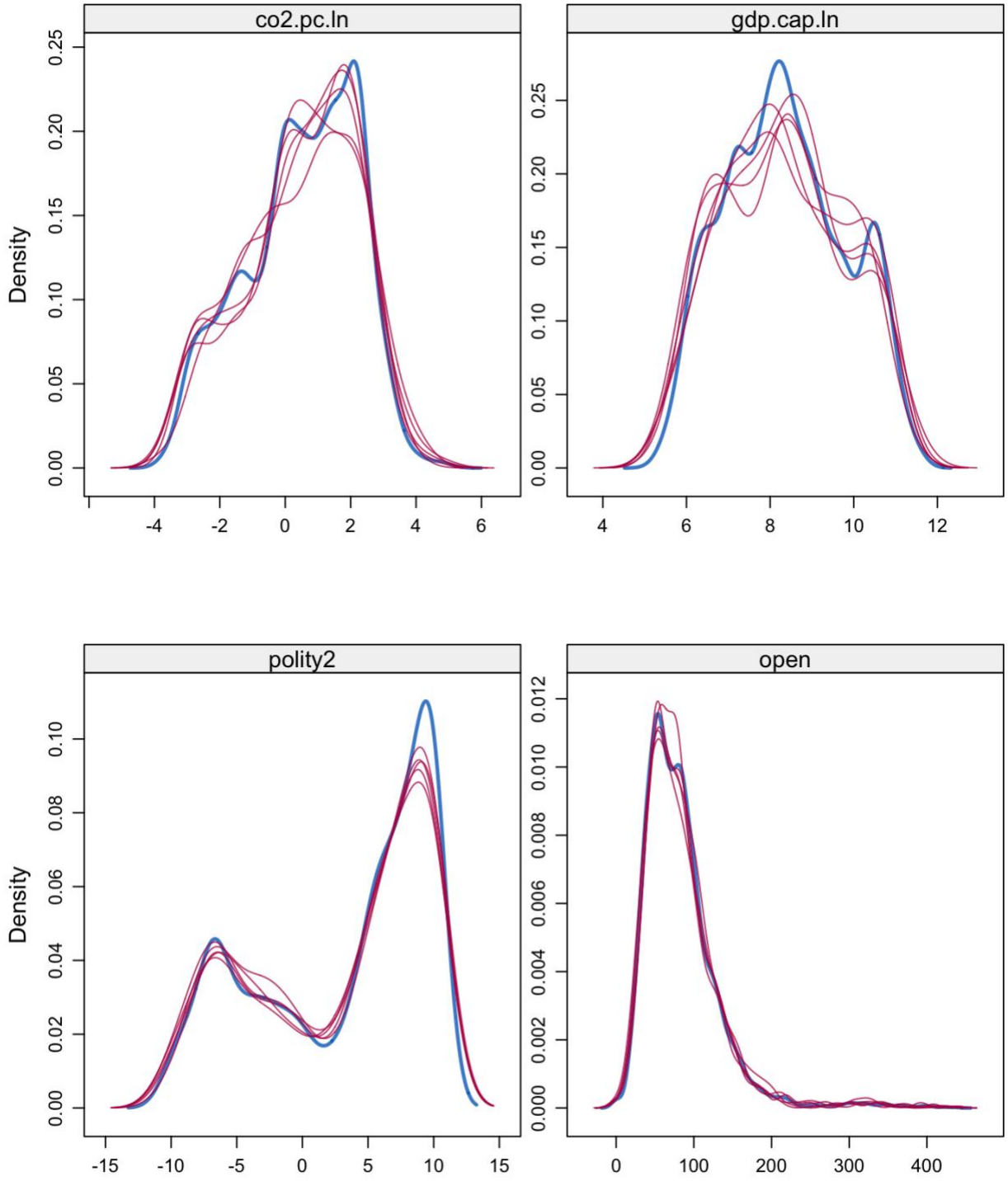

Figure 10: Density plots for imputed data (2/2)

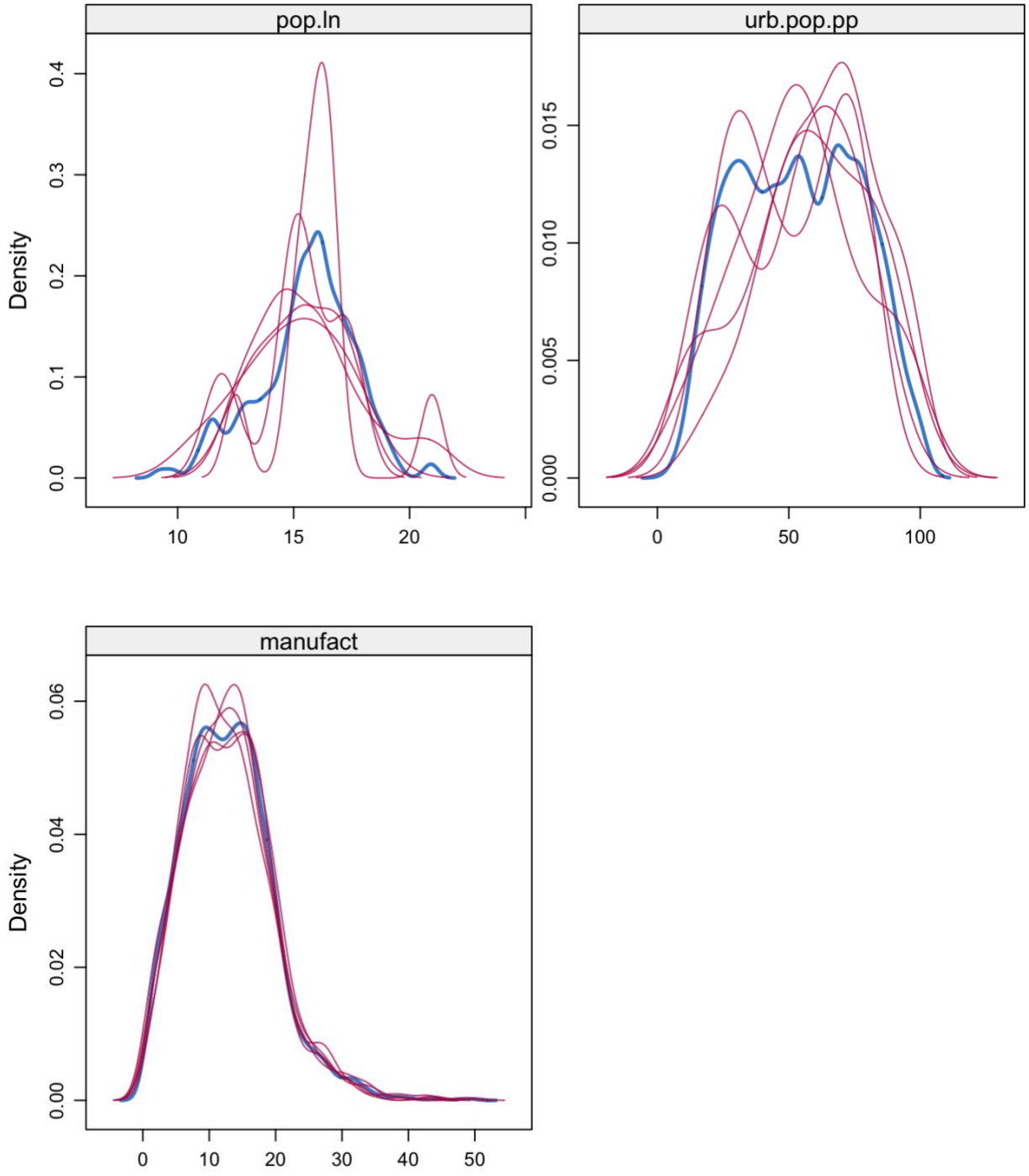

Table 15: Regression with imputed data for the PTA level

	Dependent variable:			
	co2.pc.ln			
	(1)	(2)	(3)	(4)
PTA.dummy	0.0164			-0.0109
	(0.0186)			(0.0243)
PTAs		0.0101		0.0101
		(0.0084)		(0.0110)
PTA.cum			-0.0135***	
			(0.0016)	
gdp.cap.ln	0.1381***	0.1380***	0.1418***	0.4757***
	(0.0176)	(0.0176)	(0.0175)	(0.0316)
pop.ln	-0.1146**	-0.1143**	-0.2738***	-0.0324
	(0.0560)	(0.0559)	(0.0585)	(0.0662)
urb.pop.pp	0.0222***	0.0222***	0.0207***	0.0172***
	(0.0019)	(0.0019)	(0.0019)	(0.0021)
open	0.00004	0.00003	0.0003	0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
manufact	0.0025	0.0025	0.0026	0.0042**
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
iea.inforce	-0.0010***	-0.0010***	-0.0002	-0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
polity2	0.0030	0.0030	0.0016	0.0032
	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Observations	5,520	5,520	5,520	5,320
R^2	0.0465	0.0466	0.0597	0.0750
Adjusted R^2	0.0069	0.0070	0.0207	0.0349
Note:				*p**p***p<0.01
				Year and Country fixed effects included in all columns

Table 16: Regression with imputed data for ENVPROV, CLIMRPOV, ENFORCE

	Dependent variable:					
	co2.pc.ln					
	(1)	(2)	(3)	(4)	(5)	(6)
ENVPROV	-0.0005***	-0.0012***				
	(0.0002)	(0.0002)				
CLIMPROV			-0.0065**	-0.0145***		
			(0.0031)	(0.0040)		
ENFORCE					-0.0325***	-0.0455***
					(0.0102)	(0.0112)
PTAs		0.0477***		0.0349***		0.0258***
		(0.0111)		(0.0108)		(0.0092)
gdp.cap.ln	0.1392***	0.4715***	0.1391***	0.1387***	0.1386***	0.1377***
	(0.0176)	(0.0315)	(0.0176)	(0.0176)	(0.0176)	(0.0176)
pop.ln	-0.1379**	-0.0970	-0.1313**	-0.1465***	-0.1369**	-0.1423**
	(0.0564)	(0.0671)	(0.0564)	(0.0566)	(0.0563)	(0.0563)
urb.pop.pp	0.0219***	0.0165***	0.0219***	0.0216***	0.0219***	0.0218***
	(0.0019)	(0.0021)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
open	0.0001	0.0005**	0.0001	0.0001	0.0001	0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
manufact	0.0026	0.0041**	0.0026	0.0025	0.0026	0.0024
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
iea.inforce	-0.0009***	-0.0009***	-0.0009***	-0.0009***	-0.0009***	-0.0009***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
polity2	0.0031	0.0031	0.0031	0.0029	0.0030	0.0029
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Observations	5,520	5,320	5,520	5,520	5,520	5,520
R^2	0.0481	0.0802	0.0471	0.0490	0.0482	0.0496
Adjusted R^2	0.0085	0.0403	0.0076	0.0093	0.0087	0.0099

Note: *p**p***p<0.01

Year and Country fixed effects included in all columns