Lund University

Department of Economics

What are the trade effects of environmental provisions in preferential trade agreements?

Rebecca Malmqvist Thorsell

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Supervisor: Maria Persson

Abstract

The climate crisis in one of the major challenges of our time. The role of trade in this context is a contested issue, both good and bad effects are plausible. One important question in this context is whether it is possible to increase the chance that trade does not have a negative impact on the environment by including environmental provisions in trade agreements. While this might be possible, it also risks negatively impacting trade, which in itself has important effects such as economic growth and poverty reduction. The limited previous literature suggests that environmental provisions have a negative effect on trade, but there as several possible issues with the empirical strategy used in these previous studies. To begin with, the previous study uses a theoretically inappropriate estimator, the model used introduces endogeneity, and the model is restrictive and does not allow environmental provisions to have varying effects across sectors. In my thesis, I propose an improved strategy that uses an appropriate estimator (PPML), specifies the model so that the risk of endogeneity is reduced, and lastly improves the fit of the model by controlling for the sectoral level of emissions, as well as allowing dirtier sectors to see a stronger effect than clean sectors. When using this improved empirical strategy, there is no longer a significant effect on trade from environmental provisions. I therefore conclude, contrary to the small previous literature, that there is no robust evidence that environmental provisions negatively affect trade.

Keywords: Environmental Provisions, Preferential Trade Agreements, Gravity Model, Climate Change, Trade

List of Abbreviations

EP – Environmental Provision

EU – European Union

FDI – Foreign Direct Investment

GATS - General Agreement on Trade in Services

GATT – General Agreement on Tariffs and Trade

GDP – Gross Domestic Product

MEA – Multilateral Environmental Agreement

NTI – Non-Trade Issue

OECD – Organisation for Economic Co-operation and Development

OLS – Ordinary Least Squares

PPML – Poission Pseudo-Maximum Likelihood

PTA – Preferential Trade Agreement

SADC – Southern African Development Community

TREND – TRend and ENvironment Database

UN – United Nations

WTO – World Trade Organization

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1. Introduction

In order to avoid a severe environmental catastrophe, global warming needs to be kept under 1,5*C (Calvin et. al., 2023). For this to be possible, countries need to come together to ensure lower carbon emissions. The issue in facilitating the green transition lays partly in the trade and environment nexus wherein trade could have both positive and negative effects on the climate. According to the environmental Kuznets curve economic growth leads to environmental degradation at low levels of income (Leal & Marques, 2022). The gains-from-trade hypothesis on the other hand hypothesises that the increase in income that results from trade also causes an increase in demand for environmental goods (Frankel & Rose, 2005). It could be possible to mitigate the potential negative environmental effects of trade by including environmental provisions in preferential trade agreements (PTAs[1]). There is a risk that this might negatively impact trade, which also has positive economic effects for example increased growth and poverty reduction. Some mean that environmental regulation impedes firm productivity, lowering trade (Ex: Chan et. al., 2013; Ryan, 2012), whereas another theory states that stringent regulation leads to innovation therefore increased productivity (Porter 1991; Porter & van der Linde, 1995).

The aim of this thesis is to investigate the trade effects of including environmental provisions in PTAs, specifically on exports from developing countries to developed countries. Few previous studies have been conducted on the subject, and with what I will show to be unsuitable econometric methods. The need for more information on the issue is therefore great, especially as environmental concerns should be included in all types of policy according to the Agenda 2030. In light of this, in this thesis I set out to answer the question: "What are the trade effects of including environmental provisions in preferential trade agreements between developing and developed countries?".

There is little previous empirical literature on environmental provisions in PTAs. Two previous studies ask the same question as this thesis, with opposing results. Berger et. al. (2020) estimate the gravity model with OLS and find that the increase in trade caused by the

[1] Preferential trade agreement (PTA) is used interchangably with the terms regional trade agreement (RTA), and free trade agreement (FTA), but is a more fitting term for the phenomenon and will thus be the preffered term in this thesis. The reason it is a better fit is that the trade agreements need not be neither regional nor entail free trade, since they can be between countries in different regions of the world, and must not necessarily bring about free trade but merely a freer trade than before.

existence of a PTA is smaller when environmental provisions are included. This result was for trade between countries of different levels of income but is especially pronounced for exports from developing countries to developed countries. One of the issues with their study is the use of OLS over PPML, since the PPML is more suitable due to the heteroskedasticity of the trade data and existence of zero values. The model they use also introduces endogeneity due to missing variable bias, more specifically the omission of carbon emissions of different sectors, as well as the inclusion of control variables which are correlated with the number of environmental provisions. The last issue is that the model is restrictive and does not allow for environmental provisions to have a varying effect across sectors. Brandi et. al. (2020) on the other hand do use data disaggregated at the sector level to answer the same question. Regardless of whether they use the OLS or the PPML estimator they receive they result that environmental provisions do not impact the level of trade, suggesting the importance of including sector level trade. The issue with the model used by Brandi et. al. (2020) is, similarly to Berger et. al. (2020), the inclusion of control variables which cause endogeneity. Both studies to include two control variables, namely PTA as a dummy variable and a measure of the depth of the PTA which are correlated with the existence of environmental provisions in PTAs.

To test the trade effects of environmental provisions I construct a gravity model with the number of environmental provisions as explanatory variable, as well as a model that also includes sectoral carbon emissions. Before that I begin by reconstructing the model used by Berger et. al. (2020) in order to see whether the sample affects the results, estimating it with both the OLS and PPML to also see if choice of estimator has an effect. In the first of my own models, I drop the two control variables used in the studies by Berger et. al. (2020) and Brandi et. al. (2020) since they are correlated with the existence of environmental provisions, thus introducing endogeneity to the estimation. I estimate it with PPML since it accounts for heteroskedasticity, which is common in trade data. In order to properly account for the sector level variation in pollution which affects how much costs increase for firms I also construct a third model which includes sector level pollution as an explanatory variable. By dropping the control variables, using the PPML estimator rather than the OLS, and including sector level emissions my contribution to the literature is a better suited method for estimating the trade effects of environmental provisions. Using this improved method I conclude that environmental provisions do not have an impact on exports from developing countries to

developed countries, which has important policy implications since environmental provisions could thus be included in PTAs with no adverse economic consequences.

The connection between trade and the environment is especially important for developing countries. Trade has a positive effect on a country's growth and productivity (Winters, 2000). Trade liberalisation ensures lower tariffs which have been shown to lead to developing countries increasing their exports (Dollar & Kraay, 2004). It is therefore especially important for developing countries to find a solution that allows for continued economic growth and simultaneous climate change mitigation, since they are the countries most affected by environmental issues. Because the issue is pronounced in developing countries, I use developing countries as exporters and developed countries as importers.

In terms of the expected trade effects of environmental provision some argue that environmental provisions can mitigate the environmental impact of trade, whereas others see it as a type of covert protectionism. This fear is mostly voiced by developing countries, and environmental provisions are thus thought of as a way to level the playing field between developed countries, which already have stringent domestic environmental regulation, and developing countries without the same regulations (Bechtel et. al. 2012; Lechner, 2016). Another group see the inclusion of environmental provisions as only a way of virtue signalling (Berger et. al., 2017).

This paper begins with an overview of environmental provisions in PTAs (chapter 2) with an inquiry into whether they are allowed, which levels of binding they can take on, and the different types. After that a there will be an overview of the history of environmental provisions, as well as how the landscape currently looks. Chapter 3 contains a review of the previous literature on the subject. Thereafter follows the theory of what effect environmental provisions should have on trade (chapter 4). In chapter 5 the empirical strategy used to answer the research question in described. The results of the regressions are then presented in chapter 6 together with a discussion on the implications of the results, with additional robustness tests in 6.2. Chapter 7 concludes the study and suggests further research subjects.

2. Environmental provisions in preferential trade agreements

In this chapter an overview of environmental provisions in PTAs will be given. At first whether or not environmental provisions are allowed is examined, then the different levels of binding that environmental provisions can take on is described. After that the different types of environmental provisions are outlined. At last there will be an overview of the history of environmental provisions, as well as how the landscape currently looks.

2.1 What are environmental provisions and how do they work?

In order to address environmental concerns that occur when countries enter a free trade agreement of some type, they might choose to include environmental provisions. As described in the introductory chapter, provisions are stipulations added to legal agreements, which in some cases must be upheld for the agreement to be valid. This depends on the level of binding of the provisions, which I will describe in greater detail.

Environmental provisions are heterogeneous in both scope and the language used. Despite this, the two most common types of environmental provisions are those that allow for environmental exceptions, and including environmental considerations in the preambular material (Draper et al., 2017). There are also differences in the language used, but typical for most environmental provisions is the fact that they are typically best endeavour clauses (Draper et. al., 2017; WTO, 2021), meaning that they do not necessitate the parties of the PTA to follow the provisions, but rather only attempt to do so to the best of their ability.

2.1.1 The WTO legal context: Are environmental provisions allowed?

Since preferential trade agreements are, as the name suggest, trade agreements they and their provisions fall under the jurisdiction of the WTO. Put simply the WTO allows environmental regulations as long as they do not contradict any of the non-discrimination principles, or are veiled attempts at protectionism (WTO, 2024b). The general trend in the WTO has been towards allowing for more environmental concerns. In the early days of GATT there were essentially no mentions of the environment, whereas with the establishing of the WTO with the Marrakesh agreement in 1994 came mentions of the environment in the preamble (WTO, 2024a). This meant that sustainability was written into the founding text of the WTO.

One of the foundational principles of the WTO is non-discrimination, which is in turn divided into two principles namely *most favoured nation* and *national treatment*. National treatment means that a country is not allowed to treat foreign goods worse than like products or directly competitive domestically produced goods (GATT 1994a, Article III). The principle of national treatment can be at odds with environmental regulation. One reason for this is due to what is considered a like product[2] (Falkner & Jaspers, 2012, p.5). Most favoured nation means that WTO members must treat all WTO members as well as they treat their most favoured trading partner (GATT 1994a, Article I). Even though a PTA gives better trading conditions to its members, it is allowed by the WTO (GATT 1994b, Article XXIV).

Article XX of GATT outlines exceptions to the principles of non-discrimination. This means that as long as the regulations adhere to the exceptions outlined in the article, they are allowed to have an impact on trade. The two most important exceptions are found in article XX(b) and (g), which state that regulations are allowed if they are aimed at protecting human, plant, and animal health, or alternatively if they are meant to protect exhaustible natural resources (WTO, 2024b). In terms of rules, two agreements are also important for environmental regulation, namely the TBT agreement and the SPS agreement. TBT stands for technical barriers to trade and sets rules for technical regulations and standards are allowed to be used. It states that they are allowed to be used to protect human health and the environment, but also that they should have as little trade distorting properties as possible (Falkner & Jaspers, 2012). The SPS agreement deals with sanitary and phytosanitary measures, which are measures that concern human, animal, and plant life and health. These measures are allowed as long as they are not discriminatory and do not constitute hidden protectionism. Both agreements promote the harmonisation of environmental rules through international

[2] The reason for this is that WTO rules do not include the production process in what is considered a like product, which means that countries that might want to regulate trade of a product due to its environmentally harmful production practice cannot do so. There have been two cases brought before the Appellate Body of the WTO. The first was the case Tuna-Dolphin which saw the US ban tuna imports from countries that used fishing practices harmful to dolphin. This ban was found to be inconsistent with WTO rules since the qualms the US had were regarding the production process (Falkner & Jaspers, 2012, p. 12-13). Since then the case of Shrimp-Turtles has caused a paradigm shift in the WTO. Again the US banned imports of a good (shrimp) from countries that did not use fishing methods which protected turtles. The *reason* for the ban was found to be legitimate, whereas *how* it was implemented was found to be discriminatory. The ruling thus marked a watershed as for whether or not the production process is allowed to be grounds for trade restrictions (Falkner & Jaspers, 2012, p. 14-15).

agreements in the shape of multilateral environmental agreements (Falkner and Jaspers, 2012).

Since many environmental provisions in PTAs reiterate commitments made in MEAs (multilateral environmental agreements), it is also important to examine the relationship between the WTO and MEAs. In short, the WTO encourages environmental regulation through MEAs since streamlining them help avoid the regulation becoming discriminatory. Both the TBT and the SPS agreement encourage the harmonisation of environmental regulations through MEAs[3].

2.1.2 How binding are environmental provisions?

Environmental provisions can take on many different levels of binding. While the specifics of how they work is more of an issue of legal understanding than economics, it is nonetheless important to go through since the stringency of environmental regulation can affect the trade outcomes. Therefore, I will give an overview of the different levels of binding, and some of the more common types of environmental provisions that exist.

Table 1. Level of binding of environmental provisions

Least binding				Most binding
Affirming commitments made elsewhere	Best endeavour clauses	Collaboratory environmental provisions	Unspecified environmental goals	Commitment to specific environmental goals

The least binding environmental provisions are those that simply promise to follow commitments made in some other context, for example promises to follow through on multilateral environmental agreements. Since they are already signed before the PTA was entered, this does not constitute any level of binding for the PTA itself. The second least binding provisions are "best endeavour clauses". A best endeavour clause means that the party subject to the clause should do their best to fulfill the actions stipulated in the clause under the circumstances, for example to "encourage clean energy" (United Nations

[3] The relationship between MEAs and the multilateral trading system is not completely settled though. One of the questions discussed is how the WTO should respond when one country references international environmental agreements that they themselves have ratified, but another country has not, and this second country's trade is affected by the agreement (WTO, 2024).

Environment Programme (UNEP) & International Institute for Sustainable Development (IISD), 2024a). These are not binding due to the ambiguity of the language. The first type of provision which is formally binding are those in which the parties (countries) promise to collaborate and share vital information regarding environmental issues. While this is technically binding, it is not in practice due to the difficulty in ensuring it is upheld. Another type of provision which is technically binding but not in practice are commitments to reach unspecified environmental goals. For example, promises to combat illegal fishing practices. The reason these are only technically binding is that they are often formulated very vaguely, which makes it nearly impossible to find that another country has gone again their promises. Lastly, the most binding type of environmental provisions are those which make the countries commit to actions or policies specified in advance. These might be brought up in dispute settlement, if such arrangements exist between the countries, and are binding (UNEP & IISD, 2024a). Over time, environmental provisions have gone from higher levels of binding to less. More specifically, from unspecified yet binding commitments, to those with lower levels of binding.

One example of a type of environmental provision that can take on many different levels of binding are those which specify the relationship to MEAs. In terms of level of binding, those provisions which aim to affirm the countries' commitment to MEAs are least binding since they only affirm choices made elsewhere, whereas those which aim to implement environmental regulation from MEAs into domestic laws constitute higher levels of binding since they can be subject to enforcement mechanism in the PTA.

2.1.3 Types of environmental provisions

There are many different types of environmental provisions, all of which can be of different levels of binding. While they are several hundred individual provisions, most of them fit into six categories which will be described here.

Table 2: Types of environmental provisions

Mentions in the preamble	Domestic regulation	Relationship to MEAs	Cooperative provisions	Environmental exceptions	Other commitments
-Signaling intent -Interpreting other parts of	-Maintain current legislation -Enact stronger	-Clarify relationship between PTA and MEA	-Capacity enhancement -Information sharing	-Sanitary and phytosanitary measures -Technical	-Environmental goods -Removing harmful

the agreement	future legislation	-Implement specific MEAs -Reaffirm commitment to MEAs -Implement domestic laws	-Cooperation on shared issues -Harmonsation of environmental regulation	Barriers to Trade	subsidies -Corporate Social Responsibility

One example of a type of environmental provision is the mention of environmental concerns in the preamble to the PTA. Mentions of environmental issues in the preamble is important both for signaling the intent of the agreement, as well as for interpreting other parts of the content of the agreement[4] (UNEP & IISD, 2024b). This type of provision is used more and more in PTAs. The mentions in the preamble to a PTA can either be in the shape of recognizing the interdependence of environmental, social, and economic goals in order to foster sustainable development, or a list of ambitions to be achieved through the PTA (UNEP & IISD, 2024b).

The second type of environmental provisions are those which include promises regarding the countries' own domestic environmental regulation. This can further be divided into two separate types namely those meant to ensure that countries uphold their current environmental legislation and do not deviate from this to increase trade, and those aimed at creating stronger domestic environmental legislation in the future. Neither of these two subdivisions of environmental provisions are especially common, but are part of certain recent PTAs. The Panama – Taiwan FTA is one example of a PTA which includes an environmental provision stipulating that they may not make exceptions to their domestic environmental laws in favour of trade (Panama – Taiwan FTA, Article 10.15), and the US – Morocco FTA is an example of one which includes a provision to ensure that the respective countries adopt greater domestic environmental regulation in the future (US – Morocco FTA, Article 17.1) (UNEP & IISD, 2024c).

A third type of environmental provision is that which specifies the countries' relationships or commitments to specific multilateral environmental agreements (MEA). This type of

[4] In the case of Shrimp - Turtles for example, the Appellate Body of the WTO used references to sustainable development in the preamble of the Marrakesh Agreement, which established the WTO, to decide that the US was in their right to not allow imports of shrimps which had been fished with methods dangerous to turtles (Falkner & Jaspers, 2012). Even though this case was between member countries of the WTO and not of a PTA, the principle that the content of a preamble can be used in a legal context holds.

environmental provision can take on many different levels of binding depending on how it is formulated. It can either be meant to elucidate the relationship between the MEA and the PTA, commitments to implement specific MEAs, reaffirm the countries' commitment to the various undertakings of the MEA, and lastly to implement domestic laws in line with the undertakings of the MEAs. How common this type of provision is depends greatly on the exact wording of it, which means it is difficult to parse the occurrence of them in PTAs (UNEP & IISD, 2024d).

The next type of environmental provision is called *cooperative provisions*. The four subdivisions of this type of provision are capacity enhancement, information sharing, cooperation on shared issues, and lastly harmonisation of environmental regulation. For capacity building to be efficient a sufficient budget and appropriate institutions are needed. This sub-type of environmental provision is most common between developed and developing countries. Information sharing can be important for strengthening each country's knowledge on environmental topics but is yet again dependent on the existence of appropriate institutions, budget, as well as political will. This type of environmental provision is rather common and is for example part of the economic partnership agreement[5] between the European Union (EU) and the Southern African Development Community (SADC). Cooperation on shared issues can entail cooperation on any environmental issues, and not only on environmental issues related to trade. The issues addressed in these types of environmental provisions may regard for example polluted waterways that both countries share, or issues with air pollution that affects both countries. Lastly, working towards harmonious environmental regulation is very rare and only part of a few PTAs which already foster great integration, namely the EU and NAFTA[6]. This work can entail common assessments of the state of the environment, or increased trade in clean goods. The NAFTA includes an environmental provision which mandates that firms in the private sector must report their pollution, and this is now standard practice in all three member countries (UNEP & IISD, 2024e).

Other examples of environmental provisions include those aimed at increasing trade in environmental goods and services, ones meant to reduce subsidies on environmentally harmful goods and services, and lastly provisions encouraging corporate social responsibility

[5] EPA – a type of PTA.
[6] North American Free Trade Agreement, an FTA between Canada, México, and the United States of America.

in environmental issues. Increasing trade in environmental goods and services is usually done by decreasing tariffs and eliminating other barriers to trade on goods of this type. A mandate which would require countries to remove or lower tariffs on environmental goods was part of the Doha round of negotiations within the WTO. This never came into fruition but certain PTAs have included provisions on the issue, for example Asia-Pacific Economic Cooperation (APEC) which reached an agreement to reduce tariffs on environmental goods to a maximum of 5% in 2012 (UNEP & IISD, 2024f). A similar agreement to eradicate tariffs on over 100 environmental goods was part of the PTA between New Zealand and Taiwan. Other than those two, most similar provisions have been relatively unimportant in size and scope. Provisions which promise to reduce subsidies on environmentally harmful goods are very rare, and the only real instance in which it has been done is the Trans-Pacific Partnership. It included a binding provision that mandated that subsidies for harmful fishing practices be eradicated. On the other hand, provisions on corporate social responsibility are not binding, but increasingly common. They stipulate that the countries or regions in the PTA should encourage firms to take responsibility in environmental issues in some capacity (UNEP & IISD, 2024f). This is included in several PTAs which the EU is part of, for example in the Trans-Atlantic Trade and Investment Partnership, and in a PTA between the EU and Vietnam.

Lastly, there is one very important type of environmental provision or regulation that also exists within the WTO, namely *environmental exceptions*. These outline when it is allowed to make exceptions to the rules of the WTO in favour of the environment. Article XX(b) of GATT cover sanitary- and phytosanitary measures, meaning animal and plant health, and thus states that it is allowed to deviate from other GATT rules in order to protect the health of said animals and plants. Article XX(g) on the other hand covers exceptions “relating to the conservation of exhaustible natural resources” (WTO, n.d.). The articles are either included in their entirety in PTAs, or references to them are made in order to allow for countries to make exceptions for the sake of the environment. They are part of most modern PTAs, but often with additional clarifications. There are for example no references to the environment in the original articles, and while the Appellate Body of the WTO has on numerous occasions ruled in favour of the interpretation of the articles as pertaining to the environment some countries chose to specify it in the environmental provision. In the case of article XX(g), it is not mentioned whether the exception applies to living organisms or the atmosphere, but the Appellate Body has ruled in favour of this interpretation on several occasions. Despite these

rulings countries still chose to include references to living organisms and the atmosphere to clarify which exceptions are passable by the rules of the PTA.

There is a need for enforcement or dispute settlement mechanisms within the PTA in order for certain environmental provisions to work in practice. Therefore, environmental provisions go hand in hand with dispute settlement and consultation provisions to PTAs. These provisions outline how the parties in the PTA should go about when they believe any of the other parties in the PTA has not lived up to the environmental provisions. There are two different variants of these provisions, ones meant to be used by states when they believe some other state has acted incorrectly, and institutions meant to be used by the public to raise issues regarding the environment. The reason most countries fail to live up to the conditions outlined in the PTA is not intentionally to thwart the incentives and give themselves better trading conditions, but rather that they do not have the capacity to implement what they should. As such consultation provisions where countries can meet and discuss issues, and provision which allow the public to raise issues are better than dispute settlement provisions (UNEP & IISD, 2024f).

2.2 Overview of existing environmental provisions.

The dataset used for background in this thesis is the TREND (Trade and Environment Database) dataset (Morin et. al., 2018), which is the dataset also used for the analysis. It is the most detailed and comprehensive dataset on environmental provisions in PTAs that exists both in terms of number of PTAs and provisions included. It assesses the environmental provisions of 775 preferential trade agreements, and has coded 305 separate types of environmental provisions between the years of 1947 and 2018 (Morin et al, 2018, p. 122). What is considered an environmental provision is not an objective science, which means that the numbers of environmental provisions in each PTA is dependent on interpretation. Congruence between different coders can be measured with the Cohen's kappa index[7]. Morin et. al. (2018) calculated this index and found that the coding in the TREND dataset received a score of 0,77 between the different coders (Morin et al, 2018, p. 126). Everything above 0,6 is considered substantial agreement (Landis & Koch, 1977). The TREND dataset was also cross-checked with the dataset of Lechner (2016), and received a score of 0,66 (Morin et al,

[7] Cohen's kappa is a way to measure congruence between a number of independent people who rate or code a nominal occurrence into categories first introduced by Cohen (1960). It is more reliable than using the percentage of agreement as Cohen's kappa also takes into consideration the fact that congruence may happen by chance.

2018, p. 126). Since the level of congruence is substantial according to the Cohen kappa index the dataset can be used in the analysis.

There is considerable variation in the number of environmental provisions included in PTAs depending on the development level of the countries in the agreement, when the agreement was signed, and geographical differences. Certain countries or regions, for example the EU, also include many more environmental provisions than the global average in their PTAs.

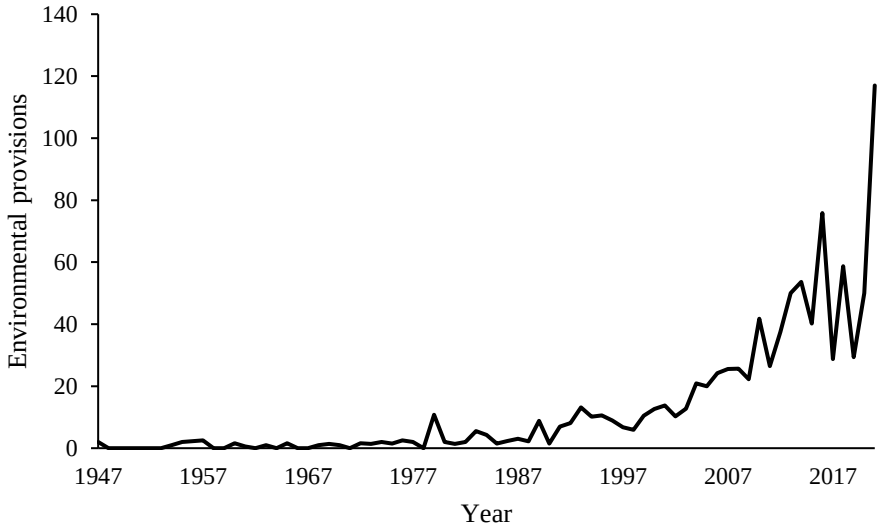

Figure 1: The average number of environmental provisions in a new PTA signed in a given year.
Source: Own compilation based on TREND (Morin et. al., 2018).

The occurrence of environmental provisions hade increased greatly over time. Before the 1970s there were virtually no mentions of the environment in trade agreements, but ever since the 1990s more and more PTAs include them. The average in the year 1970 was about one environmental provision per PTA (Morin et. al., 2018). Since then it has gone from an average of 8 in the 1990s, to a an average of 19 EPs per PTA in the 2000s, and finally to 44 EPs per PTA in the 2010s (OECD, 2023). The trend over time is especially strong in north-south trade agreements, meaning agreements between developed countries and developing countries (Morin et. al., 2018, p. 127). It is not only the number of environmental provisions included that has changed over time though, the nature of the provisions has also changed. Early agreements mostly reiterated the environmental rules and exceptions already permitted by the WTO, whereas newer agreements include more ambitious provisions (WTO, 2023).

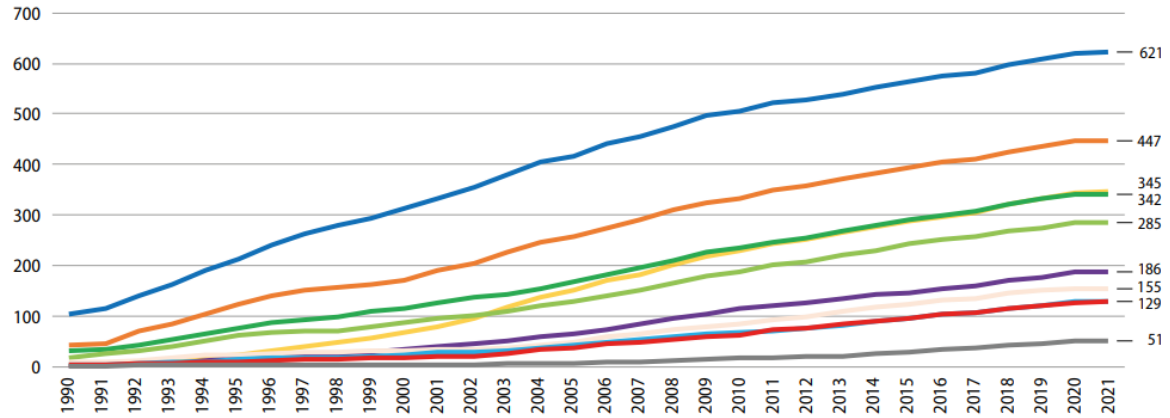

Figure 2: Cumulative number of PTAs with environmental provisions by category, 1990-2021
Source: OECD, 2023, p. 8

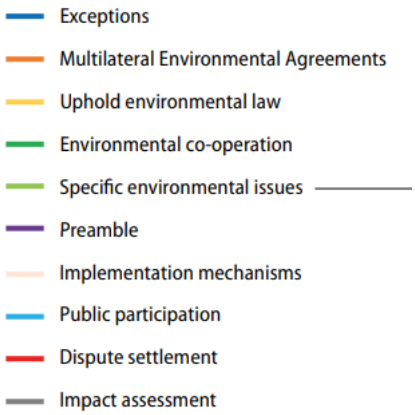

Figure 3: Key to interpret the graph in figure 2.
Source: OECD, 2023, p. 8

The most common types of environmental provisions in the dataset are still environmental exceptions, being part of over 80% of all PTAs. The second most common type is provisions that clarify the relationship to MEAs (58% of all PTAs), and in third place comes provisions that promise to uphold domestic environmental laws with a presence in 45% of PTAs. These types of provisions became more common throughout the 1990s. Since the 2000s other types have also started to become more common. These include provisions that outline implementation mechanisms (20% of all PTAs) and dispute settlement mechanisms (17% of all PTAs) (OECD, 2023, p. 6-8).

Environmental provisions are prominent in PTAs between developed and developing countries. The average number of environmental provisions in such PTAs is 32, whereas the average for PTAs between developed countries is 12, and the average in PTAs between developing countries is 8. There are more outliers in PTAs between developing countries

though, for example the PTA between Nicaragua and Taiwan includes 80 different types of environmental provisions. Specific types of environmental provisions are also more common in PTAs between developing countries than in PTAs which include developed countries. Examples of these include protection of the knowledge of biodiversity found in indigenous communities, and needing permission to access genetic resources (Morin et. al., 2018, p. 128). This trend has also changed in recent years. Historically, environmental provisions have mostly been part of PTAs which include developed countries with already strict domestic environmental regulations (Draper et. al., 2017; Brandi & Morin, 2022; Berger et. al., 2020). In recent years there have been an increase in the average number of environmental provisions in PTAs between developing countries as well (Lechner & Spilker, 2021). Other factors which seem to affect the number of environmental provisions included in PTAs are whether countries are democratic, if they face import competition or not, and whether or not they exhibit behaviour that shows care for environmental issues (Morin et. al., 2018, p. 122).

Certain specific countries or regions include much greater amounts of environmental provisions in their PTAs than the average country. The United States in the country with the highest average amount of environmental provisions included in PTAs to which they are party, with an average number of 66 different environmental issues covered in their provisions. Neither Canada nor the European Union is far behind, with an average of 57 and 54 environmental provisions included respectively. Asian countries have been noticeably later than the rest of the world to include environmental provisions, but Hong Kong is an outlier with an average of 47 environmental provisions in their PTAs (Morin et. al., 2018, p. 128).

3. Previous literature

The literature on the trade effects of environmental provisions in PTAs is very limited as much of the research focuses on the environmental impact. Only two previous studies to explain the effect on exports have been conducted, that I know of, and a third on the effects on FDI.

The study which most closely corresponds to the method and research question asked in this thesis is by Berger, Brandi, Morin, and Schwab (2020). Making use of the gravity model to estimate the trade effects of environmental provisions, they find that the increase in trade caused by the existence of a PTA is rendered smaller when environmental provisions are

included. Simply put, that environmental provisions decrease trade, and that PTAs increase trade. The larger the number of environmental provisions in the PTA, the greater the decrease in trade. The effect was a 0,2% decrease in trade for each additional environmental provision. The trade effect was especially prevalent in trade flows from developing to developed countries, while virtually non-existent in trade flows between developed countries, from developed countries to developing, and between developing countries (Berger, 2020, p. 10). To get this result, they made use of the OLS[8]. They add a dummy variable regarding the existence of a PTA as a control variable, and a second control variable to control for the depth of the PTA. This has no impact on the analysis itself and risks introducing endogeneity to the model due to correlation between the existence of a PTA and environmental provisions since without a PTA there can be no provisions. Because of this I forgo both control variables in my estimation. Instead of using the variables typically included in the gravity model (distance, GDP, and dummy variables for whether the countries share a border, language, and whether or not one country is a former colony of the other) they include fixed effects which is preferable since it captures otherwise unobserved heterogeneity. The same will be done in this thesis.

Another article which has examined the trade effect of environmental provisions in PTAs is by Brandi, Schwab, Berger, and Morin (2020). The study uses a sectoral level analysis to examine whether environmental provisions in PTAs can increase trade in green goods and decrease trade in polluting goods. The result is that trade in green goods increases from liberal environmental provisions, and that trade restricting provisions decrease trade in polluting goods. Liberal environmental provisions means that they are aimed at increasing trade in goods which remedy environmental degradation. What is considered a green, neutral or polluting good is decided by different factors. Which sectors are polluting was decided by the sectors in the economy with the highest pollution abatement costs. The green goods were taken from a list created by the OECD, and lastly neutral goods are all other goods. The study makes use of the gravity model to analyse their question, with the composition of exports as the dependent variable, the number of environmental provisions as the explanatory variable, and control variables for the existence of a PTA and the depth of the PTA. As explained in the

[8] They also performed one robustness test with the PPML estimator, which showed no significant trade effect of environmental provisions. Unlike the linear regression, the results are not statistically significant when using the non-linear estimator (the PPML estimator). The use of a linear estimator rather than the PPML is motivated by the authors as being due the efficiency of the PPML has been questioned by for example Pfaffermayr (2019). They did also perform efficiency tests themselves and found the opposite result, namely that the efficiency was higher for the PPML estimator.

previous paragraph I will forgo both control variables in order to not introduce endogeneity. Also similarly to the study by Berger et. Al. (2020), they use fixed effects instead of the traditional gravity model variables. An additional aspect that Berger et. Al. (2020) did not take into consideration is sector level variation, which is included through the different types of goods. The study used both the linear estimator, and performed robustness tests using the PPML estimator, both of which gave the same results. In addition to the main question the study also examined the effect on trade as a whole (not just in the composition of goods), and found that environmental provisions did not have a statistically significant effect. They did however find that restrictive environmental provisions do lead to a 0,4% decrease in exports of polluting good for each restrictive environmental provision included, and that trade in green goods increases with 0,4% for each liberal environmental provision included in a PTA (Brandi et. al., 2020, p. 7).

Lechner (2018) also used a sectoral level analysis, albeit to examine the effect of environmental provisions on FDI. Lechner examines the effect on foreign direct investment (FDI) of the inclusion of non-trade issues (NTIs) in PTAs. The two NTIs she examines are environmental measures and labour protection. She proposes two hypotheses, that these NTIs increase FDI, and that they decrease FDI. While these hypotheses may seem to be in opposition, the explanation is that the heterogeneity of firms causes some firms to lose from NTIs being included, while some gain, depending on their ecological footprint (if environmental issues is the NTI being examined/introduced) (Lechner, 2018). The results of the analysis are those which were hypothesised by Lechner, namely that firms with a low ecological footprint will increase their foreign direct investment when environmental issues are included in PTAs, while firms with high ecological footprint will decrease their foreign direct investments (Lechner, 2018).

The results of the two first studies showed different results for the same research question. Berger et. al. (2020) found that including environmental provisions decreased trade, whereas Brandi et. al. (2020) did not get a statistically significant effect despite using the same dataset for environmental provisions. The difference between the two studies is the use of sector level analysis, which is done by Brandi et. al. (2020). Berger et. al. (2020) got the result that environmental provisions impact trade when estimating with OLS, but not with PPML, whereas Brandi et. al. (2020) found no effect regardless of estimator. This means that an additional study which also examines the explanatory variables the first to may have missed is

needed. This is what I aim to do in this thesis. The two first studies both used the gravity model and the TREND dataset for the data on environmental provisions in PTAs. The models used to examine the questions both included control variables that risk introducing endogeneity due to their correlation with the existence of environmental provisions. In order to asses the legitimacy of including the control variables I will begin by recreating the model used by Berger et. al. (2020). Later I will construct a new gravity model without the control variables to contrast the results. The third study, that is Lechner (2018), included an explanatory variable which was meant to capture industry sensitivity (pollution levels, skill levels of workers, and labour endowment) to environmental and labour standards. Neither the study by Berger et. al. (2020) or by Brandi et. al. (2020) included sector level emissions in their models despite being an important variable to include since excluding it introduces missing variable bias, leading to endogeneity. I will therefore include it in my thesis.

4. Theoretical considerations: What are the expected effects on trade?

In order to assess the effect on trade, it is necessary to examine the effect that environmental regulation has on firms. By evaluating the effect on the firm-level, the total effect on trade can also be gauged. Dechezleprêtre and Sato (2017) examine the effect of environmental regulation on firm competitiveness, for which they use many different measures, for example trade, productivity, employment, industry location, and innovation. As a first order effect environmental regulation can affect both the average and marginal cost of production for firms, as well as the entry cost (Dechezleprêtre & Sato, 2017; Iraldo et al, 2011). The average and marginal cost of production is affected due to abatement costs caused by the environmental regulation necessitating changes in production to comply with the new rules, i.e. to reduce the environmental impact of the firm. Examples of abatement options available for firms are reducing the scale of production, using less environmentally taxing materials or fuels, and lastly installing abatements such as post combustion scrubbers (Goulder & Parry, 2008, p. 154). The changes in average and marginal cost can arise from two different types of costs, namely *direct* and *indirect* costs. Direct costs are those incurred by firms in the production of their good or service, for example labour and material costs. In the European power market for example, material costs increased between 5% and 8% as a result of European Union Emissions Trading System regulations on carbon emissions (Chan, Li & Zhang, 2013). The regulations caused higher prices on power sources which emit greater

levels of carbon dioxide, which makes this a direct cost for the power industry. While direct costs are the result of processes involved in creating a product that a firm sells, indirect costs on the other hand are additional costs outside of those directly related to the creation of a product. This can be taxes, maintenance, or material costs for materials not directly used in the production of a good for example the cost of computers for the workers at the company. An indirect cost caused by environmental regulation for European firms might therefore be higher costs due to electricity being more expensive as a result of regulations on carbon emissions. The entry cost may also be affected by environmental regulation. Firms may receive higher compliance costs because of intense testing and certifications needed to be allowed entry into a new industry. One example of this is the cement industry in the US. Ryan (2012) found that the 1990 amendments to the Clean Air Act caused a significant increase in the sunk cost of entry, more exactly an average increase of between 5 million USD to 10 million USD. To summarise, environmental regulations cause abatement and compliance costs for firms, which can lead to an increase in their average, marginal, and sunk entry costs. These are the first order effects of environmental regulation. There are also second and third order effects through which regulation can impact trade.

Second order effects may entail changes in the volume of production, the prices that consumers face, investments into production, and investments into abatement and compliance with regulations (Dechezleprêtre & Sato, 2017). In turn, these cause third order effects along several different dimensions, for example domestic economic consequences, technology and innovation outcomes, international economic consequences, and lastly environmental effects. The third order effects on the international economy are for example on trade and investment location, whereas the environmental effects can take the shape of changing levels of pollution, as well as pollution leakage in line with the pollution haven hypothesis. The pollution haven hypothesis states that trade liberalisation leads to polluting firm relocating from countries with stringent environmental policies to countries with lax policies (Copeland & Taylor, 1994). The effects do not only happen in this order though, and third order effects can in turn affect production or costs for firms. This chain of events explains how environmental regulation affects firm, which in turn creates a trade effect, which is what is examined in this thesis.

The effect of environmental regulation depends on which economic view to use. In neoclassical theory environmental regulation would be interpreted as a fix to a negative externality, which also has negative consequences on the market itself. By this view the

affected firms would have higher production costs, and have to devote time and resources to comply with the regulation, in turn creating additional costs for the firm. This leads to changes in market composition with affected firms losing market share, change the composition of their production, and relocate to areas with less stringent regulation (Iraldo et. al., 2011). Since PTAs with environmental provisions even out the gap in regulation between two countries, this is not very likely to happen as a result of environmental provisions. A revisionist view may instead be in line with the Porter hypothesis. The hypothesis states that firm competitiveness and environmental protection do not have to be opposed to one another, and that strict environmental regulation can instead lead to innovation (Porter 1991; Porter & van de Linde, 1995). Porter and van der Linde (1995) go even further and state that the regulation may lead to innovation which increases productivity so much that the costs of complying with the regulation are completely offset by the increased productivity. The higher productivity would lead to greater market share and increased exports. In the case of environmental provisions this would mean that trade (measured in exports from developing countries to developed countries) would increase as the number of environmental provisions included in the PTA increased. The Porter hypothesis essentially paints the opposite picture to the pollution haven hypothesis in the sense that the pollution haven hypothesis assumes that any reduction in pollution in a country with stringent environmental regulation would simply move the polluting production to a country with less stringent environmental regulation, whereas the Porter hypothesis states that pollution actually does decrease.

The connection between production costs and trade is the following. Lower production costs mean greater marginal productivity, which increases the firms' competitiveness and market share (Dechezleprêtre & Sato, 2017, p. 197), which in turn means greater opportunities to export since only the most productive firms are able to export due to the fixed cost associated with exporting (Melitz, 2003). Since environmental regulations increase costs for firms, they will also lead to lower levels of exports (Dechezleprêtre & Sato, 2017, p. 197). This theory is formulated from domestic environmental regulation, but may also be applied to the case of environmental provisions in PTAs since the effect should still be the same, namely that trade should decrease compared to PTAs without environmental provisions. To sum up, if environmental provisions are added to PTAs, all else equal, they will cause a decrease in trade due to an increase in costs for firms.

While all else equal may be a theoretically appealing assumption to make, it does not apply empirically since firms of different sectors have different levels of carbon emissions. Therefore, more exactly how and to what degree environmental regulation affects firms depends on the sector of the firm, as well as the specifics of the environmental regulation itself. How stringent it is, and the design of the regulation will affect the impact it has on firms. The abatement cost depends on the type of environmental regulation used, taxes on emissions for example are estimated to have a 40%-95% lower abatement cost than regulation which sets a firm cap on emissions (Tietenbeg, 2006 cited in Goulder & Parry, 2008), and in the case of gasoline specifically taxes are 65% cheaper in terms of cost than more stringent regulation (Austin & Dinan, 2005 cited in Goulder & Parry, 2008). The cost advantage that incentive-based regulation has over other types of regulation such as technology mandates and performance standards is does not apply in all cases though. When firms are homogenous a technology mandate may work as well as a tax (Goulder, 1999 cited in Goulder & Parry, 2008). Different types of regulation also bring about varying levels of uncertainty. If the goal is to reduce emissions to a certain level, then taxes lead to uncertainty regarding what the final level of emissions will be. Creating a cap on the amount of emissions on the other hand leads to uncertainty regarding what the price in the market will be (Goulder & Parry, 2008, p. 162-163). The most common types of environmental provisions are those which allow for environmental exceptions, and the inclusion of environmental considerations in the preamble to the PTA (Draper et. al., 2017). Most environmental provisions are best endavour clauses, meaning that the parties of the PTA only need to attempt to live up to the provision to the best of their ability (Draper et. al., 2017; World Trade Organization (WTO), 2021). Due to the ambiguity and non-stringency of environmental regulation the hypothesis in this thesis is that environmental provisions will not have an effect on the amount of exports from developing countries to developed countries.

As for the variation in effect on a sectoral level, it depends greatly on the level of pollution of the different sectors. Sectors with high levels of pollution have been found to have higher abatement costs compared to sectors with low levels of emissions. The pulp and paper, steel, and oil refining industries are all sectors with high levels of pollution, and in 2005 in the USA firms in these sectors spent an average of 1% of their yield on ensuring their compliance with environmental regulations, whereas the average for firms in the manufacturing sector was 0,4% of the yearly turnover (Ferris & McGartland, 2014 cited in Dechezleprêtre & Sato, 2017). This means that it is necessary to examine the trade effect of environmental provisions

on a sectoral level, and to include the pollution of each sector in the analysis since it otherwise risks introducing endogeneity to the model due to missing variable bias. Since no previous study, that I know of, has taken into account differences in sector emissions I will do so in this thesis and thus add to the research on the topic on environmental provisions in PTAs.

5. Empirical strategy

The gravity model will be used to discern whether there is a connection between the inclusion of EPs in PTAs and the amount of trade. The model works by establishing a "natural" amount of trade, which would exist in a world without outside influence on trade flows. By contrasting actual trade flows with the ones from this fake world, I can assess whether environmental provisions influence trade. I do not expect environmental provisions to have an impact on trade. I will begin by recreating the regression and model used in Berger et. al. 2020, which examined the question whether environmental provisions affect trade. I will then use a non-linear estimator instead. In a later stage, I will also allow environmental provisions to have varying effects over sectors depending on how much carbon dioxide each sector emits. The gravity model is used in all these regressions, in order to establish a baseline level of trade, and then compare this to the actual level of trade.

5.1 Regression model

Initially, the gravity model was the result of Tinbergen's work (1962), who realised that bilateral trade flows could be deduced from the size of the countries' economies as well as their distance. The size was measured in the GDP of both countries, for example denoted by Y_i and Y_j, while distance had an inverse relationship with trade and could be denoted by D_{ij} (Santos Silva & Tenreyro, 2006, p. 642). Sometimes the size was also measured in the size of the countries' respective populations, denoted N_i and N_j. If we denote the dependent variable, that is the amount of bilateral trade, M_{ij} this enables us to write the original gravity model using the following specification: $M_{ijk} = \alpha Y_i^{\beta}\ Y_j^{\gamma}\ N_i^{\varepsilon}\ N_j^{\epsilon}\ D_{ij}^{\mu}\ U_{ij}$ where U_{ij} is the error term (Anderson, 1979, p. 106).

For a long time, a lack of theoretical underpinnings persisted, but the model was used extensively in empirical research. Early work on the model's theoretical strength includes Anderson (1979) as well as Bergstrand (1985). The model has been considered to have a

solid theoretical foundation since around the early two thousands, when Anderson and van Wincoop (2003), among other, published a paper which cemented the model's theoretical basis. The model has ever since been widely used in research of bilateral international trade (Yotov et al, 2016, p. 12-13).

To begin with, I replicate the model used by Berger et. al. (2020), which takes the following form:

$$\ln Y_{ijt} = \beta_1 * EP_{ijt} + \beta_2 * PTA_{ijt} + \alpha_{ij} + \alpha_{it} + \alpha_{jt} + \varepsilon_{ijt} \quad (1)$$

Y_{ijt} is the amount of exports from country i to country j in a certain year t. Since the logarithm is taken of Y_{ijt} the coefficients are to be interpreted as percentage change in trade for each unit of change in the explanatory variables. The variable EP_{ijt} is a continuous variable which measures the number of environmental provisions between two countries i (exporter) and j (importer) for each year. Berger et. al. (2020) used both PTA_{ijt} and $DEPTH_{ijt}$ as control variables. PTA_{ijt} is a dummy variable which takes the value 1 if a PTA existed between the countries in year t, and $DEPTH_{ijt}$ is an index that shows the depth of the PTA. Due to the limited scope of this thesis the $DEPTH$ variable is not included in the model, but is an issue to consider in future research. If there are several PTAs in place between two countries in a given year, only the PTA with the largest number of environmental provisions is included in the estimation. Berger et. al. use a linear estimator for their main equation and log the dependent variable Y_{ijt}. Their chosen model is the gravity model. They find that countries that do have a PTA between them also trade more, and that environmental provisions make this increase smaller. The result that PTAs increase trade is supported by both theory and other empirical studies (Egger et. al., 2011).

Berger et. al. (2020) use OLS to estimate the model, which is theoretically inappropriate for two reasons. First, OLS assumes homoskedasticity which is an issue since trade data is typically heteroskedastic, leading to biased estimates. PPML on the other hand is robust to heteroskedasticity. And secondly OLS requires the log being taken of data, which is not possible when there are zero-values in the data. Zero-values are common in trade data, and since the PPML does not require any transformations to be done it can handle zero-values. I

will begin by estimating their model with OLS, and then perform a robustness test where I estimate it using PPML.

Whether or not a PTA exists between two countries is included in the form of a dummy control variable. This is the second explanatory variable. Regardless of whether or not several PTAs exist between the countries, it will take the value 1 if any number of PTAs exist between the two countries. According to both theoretical and empirical studies, PTAs can lead to an increase in trade between the member countries (Egger, 2011, p. 114, 140). The increase in trade is the result of, amongst other things, a reduction in tariffs. It is thus expected that this variable will have a positive coefficient for the existence of a PTA. Berger et. al. hypothesized that environmental provisions in PTAs will decrease the amount of trade in a country dyad, while the existence of a PTA will increase the amount of trade compared to a situation without one. This means that while the EPs are likely to make the increase in trade from the existence of a PTA smaller, the trade volume will still be bigger than without any PTA whatsoever. Taking into consideration the non-stringency and low level of binding of most environmental provisions, I instead hypothesize that environmental provisions will not have a negative effect on trade.

Since both PTA_{ijt} and $DEPTH_{ijt}$ are correlated with the number of environmental provisions, they risk introducing endogeneity to the model. The reason that PTA_{ijt} is correlated with EP_{ijt} is that without a PTA there could be no environmental provisions. For this reason, I only include observations where $PTA_{ijt} = 1$ in my sample. $DEPTH_{ijt}$ on the other hand is correlated with the number of environmental provisions since a PTA is considered deep if it includes non-trade issues, for example environmental provisions. I will therefore also omit the $DEPTH_{ijt}$ variable from my own model. Not including either PTA_{ijt} or $DEPTH_{ijt}$ is, to my knowledge, a new approach to the question of whether environmental provisions increase trade. I therefore construct the following model, independent of Berger et. al. (2020):

$$Y_{ijt} = \exp\left(\alpha_{ij} + \alpha_{it} + \alpha_{jt}\right) EP_{ijt}^{\beta_1} \varepsilon_{ijt} \qquad (2)$$

The dependent variable is yet again Y_{ijt}, which represents the amount of exports from a developing country i, to a developed country j in a certain year t. All exporters are developing countries since they are the ones which have the largest amounts of carbon

emissions, which will be important later in the essay when I will also use carbon emissions as an explanatory variable. In order to be able to discern whether environmental provisions have an effect on the amount of exports, it is thus preferable to use developing countries as the exporters, and developed countries as the importers. Which countries are considered developing countries and which are developed was based on the classification by the UN from 2018 (United Nations, 2018).

The explanatory variable is EP_{ijt}, which is the the number of environmental provisions between two countries. Since it is a continuous variable, the natural logarithm was taken of it. As in the model used by Berger et. al. (2020), if several PTAs exist between the countries, only the PTA with the largest number of environmental provisions will be counted. This is done since many provisions overlap in some way, and to thus ensure that what is essentially the same provision is not counted several times. Berger et. al. (2020) reason that additional PTAs with environmental provisions will not actually affect trade volumes, since it already existed previously. Assuming all else equal this variable would be expected to take on negative values for higher values due to the provisions imposing stricter conditions before trade is allowed, as well as frictional costs which occur due to firms needing to adapt to rules. On the other hand, different sectors have different levels of carbon emissions, and many environmental provisions are ambiguous and non-stringent. Therefore I expect this variable to not have any effect on trade. Since the variable is log-transformed, a one percent increase in environmental provisions would mean a percentage increase in trade the same size of the coefficient.

Instead of using the traditional gravity model variables, fixed effects will be used. Typically, a gravity model includes the size of both countries in the importer-exporter dyad measured in GDP as well as GDP per capita, and the distance between the countries. It also includes a set of dummy variables meant to capture additional bilateral trade costs, namely whether the countries share a border, language, or a colonial past. In this thesis, fixed effects will be used instead. I use the same fixed effects in my preferred model as Berger et. al. (2020). The different sets of fixed effects capture different factors which might otherwise influence trade and lead to omitted variable bias. The bilateral fixed effects, α_{ij}, capture everything that is constant over time for a certain country pair, but varies between country pairs. This includes for example distance, a shared history, and a shared language, all of which are variables

typically included in the traditional gravity model. The perk of using bilateral fixed effects is that not only these effects are captured, but also everything else that might vary between country pairs but stay constant over time. This could be that something as simple as one country consuming a lot of TV-shows produced in the other country. The export-time fixed effect α_{it} on the other hand, captures everything that varies for the exporter over time, but that is not dependent on who the trading partner is. An important example is GDP, which as stated before is one of the variables included in traditional gravity models. The importer-time fixed effect (α_{jt}) captures the same effects but for the importer instead. By including both α_{it} and α_{jt} the time effects are also captured. This means that trends across time are captured, and ensures that chocks such as pandemics, wars, and natural disasters do not interfere with the analysis. In short, it is better to use fixed effects since they not only capture what the traditional variables capture, but also unobserved heterogeneity. Unobserved heterogeneity might otherwise cause omitted variable bias and endogeneity. One example of unobserved heterogeneity is multilateral resistance, defined by Anderson and Van Wincoop (2003) as the average relative trade costs for a country to all of its trading partners. Anderson and van Wincoop go on to explain that the original empirical model did not properly take into account additional trade costs not related to only relative distance. Using fixed effects greatly mitigates the problem of omitted variables, meaning one of the sources of endogeneity is dealt with.

Fixed effects should be used rather than random effects for two reasons, one being theoretical and the other being empirical. Theoretically, it can be assumed that the endogeneity needed to be corrected is the result of unaccounted for variables. Since random effects mean that the effect is not dependent on any other variable, this would not solve the issue. The empirical reason is that studies have been conducted using the Hausmann test, and they found that the fixed effects suit the data better, meaning the assumptions for random effects were not met (Baier, 2007, p. 84, 86).

I will also construct another model, which includes additional explanatory variables as well as extends the analysis to the sector level. The new explanatory variable is $CO_{2_{ijts}}$, which represents the amount of carbon dioxide emitted from the trade between exporter i to importer j in year t in sector s. The variable is log-transformed. The reason I also include this model is to examine whether dirtier sectors' trade is more or less affected by EPs than clean sectors.

Furthermore, the coefficient for CO_2 tells us about whether there is more or less trade depending on the emission level. The way I have chosen to measure environmental damage is through carbon emissions, even though environmental provisions include a wide range of environmental considerations. Therefore, in order to see whether environmental provisions do decrease carbon emissions, I look to different sectors and the different levels of emissions these have. To my knowledge this study is the first to use sector level emissions to analyse the question of the trade effects of environmental provisions in PTAs. The model is the following:

$$Y_{ijts} = \exp(\alpha_{ij} + \alpha_{it} + \alpha_{jt} + \alpha_s)\,(lnCO_{2_{ijts}}^{\beta_1} + \beta_2 CO_{2_{DIRTY}} EP_{ijt} + \beta_3 CO_{2_{CLEAN}} EP_{ijt} + \varepsilon_{ijts}) \quad (3)$$

Similar to my first preferred model, this model also includes EP_{ijt} as an explanatory variable, but here it is interacted with the amount of carbon emissions. The new explanatory variable variable in this model is the amount of greenhouse gases emitted by the different sectors in both the exporting and the importing country. This is included both in and of itself, as well as together with EP_{ijts}. Logically, environmental provisions should matter more when carbon emissions are high. This is the reason I have split emissions into two different categories, $CO_{2_{DIRTY}}$ and $CO_{2_{CLEAN}}$, in order to interact them with environmental provisions. If this is not included, there will be omitted variable bias since the amounts of sectoral carbon dioxide will not be picked up by any of the fixed effects.

Fixed effects are also used in this second regression model. Yet again, they are used in order to account for unobserved heterogeneity, which could cause bias and endogeneity. The addition of the sector fixed effects α_s captures that which varies between sectors but is constant for country pairs and over time, such as higher demand or supply in some sectors than others.

Typically the logarithm is taken of the dependent variable as well as all continuous explanatory ones in the gravity model in order to be able to interpret the results in percentages and to be able to use the OLS estimator. Because of many zeroes, using the OLS is not suitable. In order to be able to discern between zeroes and missing values, another estimator must be used, namely the PPML estimator (Poisson pseudo maximum likelihood) (Westerlund and Wilhelmsson, 2011 ; Santos Silva and Tenreyro, 2006). Using PPML is also

more theoretically appropriate since it is robust to heteroskedasticity, meaning that the risk that bias is introduced due to heteroskedasticity in the error term is reduced.

5.2 Estimation issues

A major issue in the use of the gravity model is endogeneity. There are several possible sources of this, for example omitted variables in the form of multilateral resistance. Omitted variables make for unobserved heterogeneity (Baier & Bergstrand, 2007), which means that there are unobserved variables affecting the amount of exports from country i to country j. These omitted variables thus cause endogeneity since there is a correlation between the independent variables and the error term (Baier & Bergstrand, 2007). Unobserved heterogeneity can be the GDP of a country, shocks that happen over time, or whether countries share a common history. By including the fixed effects discussed in *5.1 Regression model*, this is accounted for. Unobserved heterogeneity is also discussed by Egger et. al. (2011), who explain that endogeneity is present in the existence of PTAs. They propose the use of the Poisson Pseudo Maximum Likelihood (PPML) model in estimating the regression model, since it can account for endogeneity in binary variables, and PTA_{ijt} is a dummy variable. The solution I have chosen to this issue is to instead only include observations when the variable equals 1, that is when a PTA is present since this is when countries may have environmental provisions in the first place, which is the real variable of interest.

Another issue is that of zero-values in trade data. This causes relatively severe downward bias in estimates of trade effects if ignored when deciding which estimator to use (Egger et. al., 2011, p. 115). In order to be able to include these zeroes in the estimate, the regression model cannot be estimated using ordinary least squares (OLS), which is the method typically used, since it requires the model to be log-linearised. This would mean that the zeroes would show up in the model as ln(0), which is undefined, and they would thus be thrown out, which introduces bias in the model (Westerlund & Wilhelmsson, 2011, p. 648). It also causes the model to be less efficient, as well as introduces inconsistency of estimates (Egger et. al., 2011, p. 118). It is thus better to estimate the model using the original multiplicate form, which means the OLS cannot be used. Another reason why the OLS cannot be used it due to the assumption of homoscedasticity of variance. Since trade data is typically heteroskedastic, it is preferable to use a different estimator (Egger et. al., 2011, p. 118).

The issues of heteroskedasticity in the data and zero-values can be remedied using the Poisson Pseudo Maximum Likelihood (PPML) estimator. With the use of PPML, it is possible to estimate the model in its original multiplicative form, meaning the issue of zero entries is resolved (Westerlund & Wilhelmsson, 2011, p. 642). Using this method and robust standard errors with panel data, which used in this thesis, also takes care of any potential heteroskedasticity, at the same time as it takes care of bias caused by heterogeneity between countries (Westerlund & Wilhelmsson, 2011, p. 642).

5.3 Data and sample

Table 3. Descriptive statistics for the data used in the preferred model with differentiated emissions

VARIABLES	Minimum	Median	Mean	Maximum	Observations
Exports	0,0011428	1525,376	78780,95	110000000	213006
Environmental provisions	0	0	5,078691	146	203976
Carbon	0	0,001	0,0353248	18,983	213006

The dependent variables Y_{ijt} and Y_{ijts} both come from the same dataset, wherein the disaggregated data was simply added together for use in the first model, and kept disaggregated in the second. Trade is measured as the amount of exports from one country to another, in thousands of US dollars. The data comes from the OECD iLibrary database, from the Bilateral Trade Database by Industry and End-Use (BTDIxE). It shows trade in goods, broken down by industry. The data I use is the amount of exports from one country to another. The average amount of exports for trade in a sector in a country pair, in a certain year is about 78780 thousand US dollars (table 3).

In order to find countries that exist in all datasets, the countries I have used are 22 different exporters, which are all developing countries, and 38 developed countries as importers. A full list of the countries is provided in the appendix. The categorization of countries into developing or developed groups was done using the United Nations 2018 classification (United Nations, 2018). The reason for only using developing countries as exporters and developed as importers is due to the fact that developed countries oftentimes already have

extensive environmental regulations, which means environmental provisions in PTAs are likely to not have any large effect. Developing countries on the other hand usually have less domestic environmental regulation, meaning that environmental provisions could have an effect.

The two explanatory variables I use in my own models are environmental provisions and carbon emissions. Environmental provisions are counted only for the PTA with the greatest number of them between two countries. As seen in table 3, both the minimum and median is 0, whereas the mean is about 5 EPs per PTA. The maximum is 146, which suggests that there are a few PTAs with plenty of EPs which increase the mean. The data on environmental provisions comes from the the Trade and Environment Database, called TREND analytics (Morin et. al., 2018). It contains information on many different levels of obligation regarding the environmental provisions, everything from mere goals to legal obligations. In this thesis, no difference is made between the different levels of obligation. Instead, only the amount of EPs between a country dyad are counted, and even if the same EPs is part of several PTAs between the same countries, it is only counted once.

Similar to the data on trade, the carbon emissions data comes from the OECD iLibrary. It measures carbon emissions in millions of tons, and ranges from the year 1995 to 2018, hence why that period was chosen for the analysis. The chosen measure was "Domestic CO2 emissions embodied in gross exports" which shows the amount of carbon dioxide that was emitted with the production and export of goods in a certain industry. The average amount emitted on a sector level was about 0,035 million tons (table 3).

6. Empirical results

6.1 Baseline results

Table 4. Results from the three main regressions

VARIABLES	(1) Replication of Berger et. al. (2020) - OLS	(2) Preferred model[9] - PPML	(3) Preferred model, differentiated emissions[10] -

[9] Only observations when $PTA = 1$.
[10] Only observations when $PTA = 1$.

			PPML
Environmental provisions	0.0238 (0.0165)	-0.00364 (0.0143)	-0.00245 (0.0283)
PTA	0.293*** (0.0510)	Not included	Not included
Carbon	Not included	Not included	0.745*** (0.00799)
Interaction (Dirty and EPs)	Not included	Not included	-0.035** (0.01143)
Interaction (Clean and EPs)	Not included	Not included	0.001954 (0.00188)
Constant	10.32*** (0.0296)	16.99*** (0.0122)	14.82*** (0.0262)
Observations	9,308	5,264	112,274
R-squared	0.928	0,9927	0,848
Exporter-importer FE	Yes	Yes	Yes
Exporter-time FE	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To begin with, I estimated the same model (minus the $DEPTH$ variable) as Berger et. al. (2020) used, also using OLS. My results differ from theirs in that I have no statistically significant effect for the variable EP (table 4, column 1). This result is however in line with Brandi et. al. (2020), as well as what I hypothesised would be the result due to non-stringency and lack of binding of environmental provisions. The result suggests that the creation of a PTA with environmental provisions will lead to a similar increase in trade as a PTA without environmental provisions does. Similarly to Berger et. al. (2020), I find a positive and statistically significant effect of the existence of a PTA, only the effect I find is more than twice as large (0,293 compared to 0,127). Their result remains the same when they only use developing countries as exporters and developed countries as importers, which points towards this not being the reason for the difference in results. In fact, when they split countries into

these two groups and tried them in additional different roles (developed-developed, developed-developing, developing-developing), only developing-developed had statistically significant effects for environmental provisions.

The fact that my results are in line with Brandi et. al. (2020) but not Berger et. al. (2020) could point toward the sample being important for the effects. Berger et al (2020) studied the time period 1986-2016, Brandi et. al. (2020) studied the years between 1984 and 2016, whereas this essay uses the time period 1995-2018. It could be that there is a difference in the types and level of binding of the environmental provisions which could affect the amount of trade. If they are less binding or less stringent this would mean that countries are able to keep exports at similar levels to before.

In order to not introduce endogeneity to the estimations, I excluded the PTA variable in both of my preferred models, both of which were estimated using the PPML estimator. No statistically significant effect was found for environmental provisions in the model without sector level emissions. The preferred model which also included carbon emissions as an explanatory variable, found a statistically significant effect for this variable. All else equal, there is in this sample more trade in sectors with a lot of emissions, than in clean sectors. High levels of carbon emissions coinciding with large amounts of exports from developing countries to developed countries is consistent with carbon leakage and the pollution haven hypothesis. Carbon leakage means that developed countries buy environmentally damaging goods from abroad rather than producing them at home due to there being less environmental regulation in developing countries, and the goods thus being cheaper (Nielsen et. al., 2021).

There was a statistically significant effect found for the interaction effect between high levels of carbon emissions and environmental provisions. This is in line with the hypothesis that environmental provisions would have a greater negative effect in highly polluting industries. There was no significant effect in clean sectors.

6.2 Robustness analysis

Table 5. Robustness tests: fixed effects

VARIABLES	Preferred model,	Preferred model,	Preferred model,	Preferred model,	Preferred model,

	differentiated emissions but with only exporter-time FE	differentiated emissions but with only importer-time FE	differentiated emissions but with only exporter-importer FE	differentiated emissions but with exporter-time and importer-time FE	differentiated emissions for reference
EPs	-0.0800***	-0.351***	0.168***	-0.0679***	-0.00245
	(0.0202)	(0.0343)	(0.0117)	(0.0232)	(0.0283)
Carbon emissions	0.866***	0.718***	0.755***	0.805***	0.745***
	(0.00635)	(0.0116)	(0.00948)	(0.00733)	(0.00799)
Interaction Dirty and EPs	0.00272***	0.0129***	-0.00386***	0.00297***	-0.035**
	(0.000931)	(0.00128)	(0.00115)	(0.00105)	(0.01143)
Interaction Clean and EPs	-0.0000815	Omitted	Omitted	Omitted	0.001954
	(0.0006336)				(0.00188)
Constant	14.89***	14.69***	14.69***	14.87***	14.82***
	(0.0254)	(0.0420)	(0.0238)	(0.0261)	(0.0262)
Observations	112291	112292	112275	112291	112274
Exporter-time FE	Yes	No	No	Yes	Yes
Importer-time FE	No	Yes	No	Yes	Yes
Exporter-importer FE	No	No	Yes	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In order to further examine reasons for the results, I performed several robustness tests. In all three cases when only some sort of time fixed effect was included (either exporter-time, importer-time, or both), all environmental provisions, carbon emissions, and carbon emissions in dirty sectors interacted with environmental provisions all had statistically significant effects on exports (see table 5). All three variables also had the same sign for the effects for the regressions with exporter-time fixed effects, importer-time fixed effects, and exporter-time and importer-time fixed effects. There was a negative effect for environmental provisions, positive for carbon emissions, and positive for the interaction term between the two. Since these regressions do not account for the exporter-importer fixed effects there is a large risk of omitted variable bias and endogeneity. The regression which only used exporter-importer

time effects received the result that environmental provisions and carbon emissions increase trade, but a negative effect for the interaction between dirty sectors and environmental provisions.

Similarly to the preferred model specification with sector level emissions, the positive effect of carbon emissions on trade is present for all models with different fixed effects. The coefficient took on fairly similar values (between 0,718 and 0,866). Yet again, this is consistent with the theory of carbon leakage.

Table 6. Robustness tests: fixed effects, continued

VARIABLES	Preferred model, differentiated emissions but with exporter-time and exporter-importer FE	Preferred model, differentiated emissions but with importer-time and exporter-importer FE	Preferred model, differentiated emissions for reference
EPs	-0.0185	0.0685**	-0.00245
	(0.0229)	(0.0297)	(0.0283)
Carbon emissions	0.744***	0.741***	0.745***
	(0.00797)	(0.00815)	(0.00799)
Interaction Dirty and EPs	0.000665	-0.00241**	-0.035**
	(0.00102)	(0.00121)	(0.01143)
Interaction Clean and EPs	Omitted	Omitted	0.001954
			(0.00188)
Constant	14.82***	14.78***	14.82***
	(0.0246)	(0.0280)	(0.0262)
Observations	112,274	112,275	112,274
Exporter-time FE	Yes	No	Yes
Importer-time FE	No	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

As can be seen in table 6, it is specifically when exporter-time fixed effects are included together with exporter-importer fixed effects that both environmental provisions and the interaction term lose their statistical significance. On the other hand when importer-time and exporter-importer fixed effects are used all three explanatory variables are statistically significant.

Table 7. Robustness tests: before and after financial crisis

VARIABLES	Preferred model, diferrentiated emissions before financial crisis	Preferred model, diferrentiated emissions, after financial crisis	Preferred model, diferrentiated emissions for reference
EPs	0.179***	0.02146	-0.00245
	(0.05028)	(0.01688)	(0.0283)
Carbon emissions	0.782***	0.765***	0.745***
	(0.03872)	(0.00769)	(0.00799)
Interaction Dirty and EPs	-0.164***	-0.0223*	-0.035**
	(0.04793)	(0.01204)	(0.01143)
Interaction Clean and EPs	Omitted	Omitted	0.001954
			(0.00188)
Constant	14.82***	15.14***	14.82***
	(0.0379)	(0.0195)	(0.0262)
Observations	57,581	53,663	112,274
Exporter-time FE	Yes	Yes	Yes
Importer-time FE	Yes	Yes	Yes
Exporter-importer FE	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In order to discern whether the 2008 financial crisis has any impact on the analysis, I ran two separate regressions, one with the years before 2008 and one from 2008 and onward. This showed statistically significant effects for environmental provisions, carbon emissions, and

the interaction between dirty sectors and environmental provisions. Environmental provisions had a positive effect on trade, which is in line with the Porter hypothesis that environmental regulation can lead to increased productivity and thus trade. The reason for the positive sign can also be that countries who already trade more, or have generally deeper PTAs also tend to include more environmental provisions. The interaction term for dirty sectors and environmental provisions on the other hand was negative, which tells us that trade decreases in dirty sectors when there are more environmental provisions. For the years after the crisis, no significant effect was found for environmental provisions by themselves. Carbon emissions had a similar affect to before the financial crisis, and the same applies for the interaction between emissions in dirty sectors and environmental provisions.

Table 8. Robustness tests: other estimators

VARIABLES	Replication of Berger et. al. (2020) estimated with PPML	Preferred model estimated with OLS	Preferred model, differentiated emissions estimated with OLS
Environmental provisions	0.000874 (0.00883)	0.0309** (0.015)	0.015456 (0.0220)
Carbon emissions	Not included	Not included	0.924018*** (0.0042)
PTA	-0.0274 (0.0362)	Not included	Not included
Interaction Dirty and EPs	Not included	Not included	0.00011 (0.00096)
Interaction Clean and EPs	Not included	Not included	Omitted
Constant	16.73*** (0.0314)	10.55792*** (0.011)	13.52349*** (0.023)
Observations	9308	17241	112274
R-squared	0.9955	0.9292	0.5920

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For a last round of robustness tests, all three main models were regressed using different estimators (see table 8). For the model that Berger et. al. (2020) used, choosing to estimate it with a non-linear estimator (PPML) instead of a linear resulted in the statistical significance of the PTA-variable disappearing. Estimating the preferred model without sectoral level emissions linearly caused the effect of environmental provisions to become statistically significant. For the preferred model with sector level emissions carbon emissions still had a statistically significant effect, only larger now. The interaction term between dirty sectors' emissions and environmental provisions lost its significance. This result points shows the importance of using the PPML, since it is a more appropriate estimator. Because of the difference in results depending on estimator, it can be concluded that choice of estimator is important for the results and subsequent analysis.

7. Summary and conclusions

The purpose of this thesis was to examine the trade effects of environmental provisions in preferential trade agreements. The gravity model was used to empirically assess the hypothesis that environmental provisions will not have an effect on exports from developing countries to developed countries due to the ambiguity and non-stringency of the provisions. The results were in line with the theory, and no trade effect was found.

In order to arrive at the results, I began by reconstructing the model used by Berger et. al. (2020) and found the same results as they did when I used the OLS estimator, namely significant negative trade effects. The results become statistically insignificant when I used the PPML, which is more appropriate due to the heteroskedasticity of the trade data, and zero-values. Using a better model thus yields different results and gives rise to a different conclusion. Further, Berger et. al. (2020) and Brandi et. al. (2020) both included control variables which introduce endogeneity, meaning that the results of both previous studies are likely to be biased and thus not reliable. By forgoing both control variables I greatly mitigate the risk of endogeneity. Thirdly, unlike previous studies I also included sector level emissions and allow effects to vary over sectors, which is needed since excluding emissions leads to omitted variable bias. This is the main contribution to the literature. Even when I construct this sector level model, I arrive at the result that environmental provisions in PTAs do not have a statistically significant effect on trade overall. The results are in congruence with the theory that less stringent environmental regulation is unlikely to have any adverse effects on

costs for firms, and by extension trade. However, I also find that environmental provision do have a trade effect in dirty sectors, which is also in line with theory that sectors with larger emissions are more affected by environmental regulation.

Using the same sector level model I also found that high levels of pollution did correlate with more exports from developing countries to developed, which is in line with the pollution haven hypothesis since developing countries have less stringent environmental regulations on average. The fact that the existence of a PTA with environmental provisions, meaning that both countries should now have a more similar level of stringency in their environmental regulation than before the environmental provisions, did not impact this result could be the result of the types of provisions included. This is in line with previous research and theory suggesting that the type and stringency of provisions in the PTA would impact what trade effects they have. Further research on this with more detailed analysis of the provisions themselves is needed to assess whether this is the case.

This paper contributes to the previous empirical research on environmental provisions in PTAs by finding a better suited model, namely one which excludes control variables that cause endogeneity, includes sector level carbon emissions, measures the trade effect on a sector level, and uses the PPML model to estimate. Since the results of this more appropriate model are different to those of different studies, it has important policy implications. Since environmental provisions were found to not have a negative effect on trade they could continue being used in PTAs to mitigate the possible environmental impact of trade, with no adverse effects on trade in clean sectors. It is necessary to study the environmental impact of the provisions in order to assess whether this is possible.

In terms of future research on the subject it would be relevant to examine the environmental effects on environmental provisions, to differentiate between different types of environmental provisions and their stringency, and it could also be relevant to measure the environmental damage of sector in more ways than only carbon emissions. It could be that sectors that harm the environment in ways other than with greenhouse gas emissions are still affected by environmental provisions, especially since many of the traditional provisions regard sanitary- and phytosanitary measures.

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Appendix

Appendix 1: Data and Sources

Variables	Sources and definitions
Environmental provisions	*Source:* Trade and Environment Database (TREND) *Definition:* The number of environmental provisions in a PTA between two countries in a given year. If several PTAs with environmental provisions exist only the PTA with the largest number of environmental provisions is counted.
Carbon emissions	*Source:* OECD iLibrary – OECD Inter-Country Input-Output (ICIO) Database and International Energy Agency (IEA) *Definition:* Domestic carbon dioxide emissions embodied in gross exports, measured in millions of metric tons.
Preferential Trade Agreement	*Source:* Trade and Environment Database (TREND) *Definition*: Dummy variable which takes value 1 if a PTA between two countries exists in a given year, otherwise 0.
Exports	*Source:* OECD iLibrary – Bilateral Trade Database by Industry and End-Use (BTDIxE) *Definition:* Exports in thousands of USD.

Appendix 2: List of exporters and importers

Exporters	Importers
Argentina	Australia
Brazil	Austria
Brunei Darussalam	Belgium
Cambodia	Bulgaria
Chile	Canada
Colombia	Croatia
Costa Rica	Cyprus
India	Czechia
Indonesia	Denmark
Kazakhstan	Estonia
Malaysia	Finland
Mexico	France
Morocco	Germany
Myanmar	Greece
Peru	Hungary
Philippine	Iceland
Saudi Arabia	Ireland
Singapore	Israel
South Africa	Italy
Thailand	Japan
Tunisia	Korea
Türkiye	Latvia
	Lithuania
	Luxembourg
	Malta
	Netherlands
	New Zealand
	Norway
	Poland
	Portugal
	Romania
	Slovak Republic
	Slovenia
	Spain
	Sweden
	Switzerland
	United Kingdom
	United States