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Do PTAs with environmental provisions reduce emissions? Assessing the effectiveness of climate-related provisions?

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Abstract

The aim of this paper is to assess the effectiveness on climate change mitigation of the climate-related commitments contained in PTAs. Because of a lack of availability of detailed data on PTAs, the academic literature on the role of PTAs with environmental provisions (PTAwEP) in global climate governance remains limited. A novel and detailed database identifying nearly 300 different types of environmental provisions from more than 680 PTAs since 1947 allows us to establish per country and per year the number of PTAs by distinguishing PTAs with climate-related provisions (PTAwCP) and PTAs with provisions related to other environmental issues. Using panel data covering 165 countries over the period 1995 to 2012, controlling for endogeneity issues, our main result shows that PTAwCP statistically reduce the level of CO_2, CH_4 and N_2O. This suggests that governments seem to comply with the climate-related commitments they made in the PTAs, what potentially helps tackling global warming. Moreover, findings show that to be effective in terms of mitigating climate change, a PTAwEP should contain climate-related commitments.

Keywords: Preferential trade agreements, Climate-related provisions, Environmental policy, Greenhouse gases, Global warming, Climate change.
JEL: F13, F18, Q51, Q54.

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1. Introduction

The world trade system has seen an increase in the number of preferential trade agreements (PTAs) since the end of the Uruguay Round in the mid-1990s. While there were 124 before 1995, the number of PTAs has increased rapidly reaching a total number of notifications of 646 at the end of 2016 (Sorgho, 2018). The most common PTAs are concluded in order to reduce (or eliminate) tariffs, quotas and other trade restrictions on items traded between the members. Recent PTAs, in addition to the wide-ranging economic and commercial rules, incorporate a full-length chapter entirely devoted to environmental protection, with precise and enforceable obligations on various environmental issues (Morin et al. 2017).

Many PTAs include obligations not to lower environmental standards, the right to regulate for the benefit of the environment, addressing climate change issues, and the commitment to implement multilateral environmental agreements (MEAs). Nonetheless, the effectiveness of these PTAs to mitigate climate change remains a subject of controversial debate. Some environmentalists are concerned that PTAs will weaken national environmental standards. They see environmental provisions (EPs) as mere "fig leafs" that are included in modern PTAs in order to make them less controversial in the eyes of the public and legislators (Berger et al., 2017). For other critics, PTAwEP represent an instrument of "green protectionism" to keep cheaper products from developing countries out of the market. For others, the inclusion of EPs offers a potential for environmental protection, making these agreements more compatible with environment and climate policies (Berger et al., 2017). For example, PTAwEP can play a role in articulating new environmental norms (Morin et al., 2017) and diffusing environmental policies across borders (Jinnah and Lindsay, 2016). PTAwEP also can help to address trade-related aspects of climate change mitigation, such as the export of low-emission technologies,

border-tax adjustments on polluting production processes, fossil fuel subsidies, and trade in carbon credits (Morin and Jinnah, 2018). Through EPs, PTAs can help to spread cleaner techniques to improve production standards and reduce GHG emissions. Thus, certain authors support the idea that PTAwEP can potentially contribute to climate governance (e.g., OECD, 2007; Whalley, 2011; Leal-Arcas, 2013; Gehring et al., 2013; van Asselt, 2017). This idea is based on the fact that when a given country is linked to an increasing number of countries through PTAwEP, this country could face greater pressure coming from other parties of the PTAwEP to comply with environmental regulations (Martinez-Zarzoso, 2018). However, the effectiveness of a PTA on climate governance depends on whether provisions contained in the agreement address the problem of climate change.

The research on the contribution of PTAs to global climate governance remains yet underexplored (Morin and Jinnah, 2018). Indeed, to the best of our knowledge, few empirical studies have investigated the environmental effects of trade policy using PTAs instead of trade openness.[1] While numerous other papers have studied environmental effects of trade policy in

[1] Using the trade openness as a proxy for trade liberalization, papers have studied the environmental effects of trade policy (e.g., Antweiller et al., 2001; Cole and Elliot, 2003; Frankel and Rose, 2005; Managi et al., 2009).

the literature,[2] because of the problem of lack of detailed data on PTAs, only four papers[3] (Ghosh and Yamarik, 2006; Baghdadi et al., 2013; Zhou et al., 2017; and Martinez-Zarzoso and Oueslaty, 2018) have investigated the effects of PTAwEP on pollution levels or environmental outcomes.

Ghosh and Yamarik (2006) proposed an empirical model linking trade, growth and PTAs, and estimated that PTAs can have a direct and an indirect effect (through increasing trade and growth) on the environment. The main limitations of Ghosh and Yamarik (2006) are that they use of single-year data (that does not allow to include the dynamics or to control for unobserved factors that are country-specific and time-invariant) and the fact that they do not deal with how PTAs take into account environmental issues. They do not make the distinction between different types of PTAs, those PTAs with EPs and those without EPs.[4] Having omitted this

[2] Since Grossman and Krueger (1991), the first paper decomposing the total impact of trade on the environment, several studies (e.g., Brunel and Levinson, 2016; Grether et al., 2009; Levinson, 2009; Managi et al., 2009; Frankel and Rose, 2005; Copeland and Taylor, 2005; Cole and Elliot, 2003; Antweiler et al., 2001) have investigated the impact of trade on environmental quality. The linkages between trade and environment are multiple and complex. The academic literature identifies three channels of transmission of the effects through which trade-led PTAs (liberalizing trade) may affect the environmental quality. As summarized by Sorgho et al. (2018), "the trade impacts on environment through (1) a scale effect: increased economic activity from trade liberalization leads ceteris paribus to increased emissions; (2) a composition effect: trade liberalization may lead to changed specialization patterns across countries and sectors with different emission intensities, which can trigger changes in emissions; (3) a technique effect: through increased income and technology transfer, trade can lead to cleaner production technologies". For the recent discussion and a literature review on the subject, see Cherniwchan et al. (2017).

[3] Other papers (e.g., Yu et al., 2011; Stern, 2007; Logsdon and Husted, 2000; Grossman and Krueger, 1991) have investigated the environmental effects (e.g., energy consumption) of a specific trade agreement (e.g., the North American Free Trade Agreement - NAFTA) at country level (e.g., United states or Mexico).

[4] Apart from Carrapatoso (2008), Ferrara et al. (2009), Cai et al. (2013), Baghdadi et al. (2013) and Zhou et al. (2017), most studies on the environment-impact of PTAs do not distinguish PTAs with EPs from PTAs without EPs. Although Carrapatoso (2008), Ferrara et al. (2009), and Cai et al. (2013) do not investigate whether PTAwEP facilitate improvements to the environment, but rather view the trade-related patterns of PTAwEP. Thus, these

distinction could explain the mitigated results Ghosh and Yamarik found regarding the effect of PTAs on the environment.

Later papers refined and extended the modelling strategy established in Ghosh and Yamarik (2006) by considering not only trade and GDP growth as endogenous variables, but also membership in PTAs (e.g. Martinez-Zarzoso and Oueslaty, 2018). Distinguishing PTAs with environmental provisions (PTAwEP) from PTAs without, these papers found that there exists a direct positive effect of PTAwEP on the environment. Focusing on CO_2 emissions, Baghdadi et al. (2013) find that PTAwEP not only reduce domestically CO_2 emissions, but also lead to a convergence of CO_2 emissions across pairs of countries. Conversely, they found that PTAs without EPs do not affect emissions.[5] Zhou et al. (2017) examine the effect of PTAs with and without EPs on the concentration of PM2.5, arguing that this is a better indicator of pollution than gross CO_2 emissions. They find that PTAs without environmental provisions are associated with worse air quality in terms of PM2.5 concentrations, while PTAs with environmental provisions are likely to lead to lower levels of PM2.5 concentrations. Controlling for national environmental regulations[6] – which was not done in Baghdadi et al. (2013) and Zhou et al. (2017) – as well as controlling for scale, composition and technique effects, Martinez-Zarzoso and Oueslaty (2018) found that countries that have ratified RTAs with EPs show lower levels of PM2.5 concentrations. Also, the PM2.5 concentrations in the pairs of countries that belong

papers find that larger countries tend to form environmentally friendly trade agreements in order to collaborate on trade-related environmental issues and minimize their impact on trade.

[5] Also, Martinez-Zarzoso and Oueslaty (2016) found that membership in PTAs with EPs is in general associated with higher environmental quality in absolute terms, whereas no significant results are found for PTAs without EPs.

[6] The indicator is a composite country specific measure of environmental policy stringency (ESPI) calculated by OECD, covering only 24 OECD countries plus the 6 BRIICS for the period 1990–2012. Also, since ESPI indicator is only available for the small sample of countries, it is almost unchanged over time. Thus, it's not added in our analysis.

to an RTA with EPs tend to converge for the country sample. In addition to PM2.5, Martínez-Zarzoso (2018) also found similar results for other pollutants such as SO_2, NO_x and CO_2.

Thus, the direct effect of PTAs is explained by the fact that EPs in trade agreements will encourage members to apply and enforce more stringent environmental regulations and these should in turn enhance environmental quality (Martinez-Zarzoso, 2018). But, this direct effect is an average effect for all PTAwEP while EPs included in PTAs are very heterogeneous: some PTAs include EPs that are relative to various areas of environment (such as biodiversity, desertification, hazardous waste, forestry, GHG emissions, or ozone depletion) and others only mention the environment in the investment chapters (see OECD, 2007). Some PTAs include climate-related provisions clearly dedicated to address climate change and in, particular, the mitigation of GHG emissions. This raises the question of whether all PTAwEP have an impact on GHG emissions reduction or whether the effect of PTAwEP on GHG emissions is due to climate-related provisions (CP). Because of a lack of detailed data on PTAs, this question has not yet been studied in previous papers on the role of PTAs with environmental provisions in global climate governance.

A novel and detailed database ("TRade and ENvironment Database" – TREND) identifying nearly 300 different types of environmental provisions from more than 680 PTAs since 1947 allows us to establish per country and per year the number of PTAwEP containing (or not) climate-related provisions that have been signed. Thus, we distinguish two types of PTAwEP: (i) trade agreements with climate-related provisions (PTAwCP) and (ii) trade agreements with provisions related to other environmental issues. That allow us to assess whether there is a causal relation between countries' climate-related commitments through PTAs they sign and their GHG emissions. Due to the nature of data, we cannot assess the impact of the different-types of environmental provisions (into PTAs) in addressing climate change. Also, our paper

does not assess the impact of trade-led PTAs on environmental quality (e.g., Nemati et al., 2016; and Lovely and Popp, 2011).[7]

Our main result is that PTAwCP statistically reduce the level of per-capita GHG emissions (CO_2, CH_4 and N_2O). Moreover, the results show that it is rather the climate-related provisions (CPs) in PTAwEP that positively affect the environmental quality. Once purged from effect of climate-related provisions, the impact of PTAwEP have an inconclusive effect with regard to the reduction of GHG emissions. This evidence suggests that to be effective in terms of mitigating climate change, PTAwEP should contain climate-related commitments.

The rest of the paper is structured as follows. The section 2 discuses the heterogeneous nature of environmental provisions contained in PTA. The section 3 presents our empirical framework while section 4 describes and analyses the data used for study. The results and robustness check are presented in section 5. The last part of the paper (section 6) provides a conclusion of the study.

2. Heterogeneity of PTAwEP

A detailed analysis of the database TREND reveals nearly 300 different types of environmental provisions contained PTAs. From the more than 688 PTAs listed between 1947 and 2016, we

[7] The academic literature suggests that free-trade deals have an impact on the emission of pollutants. For example, an economic integration can increase the access to environmentally friendly technologies, and lead to earlier adoption of these technologies. Firms are more likely to increase their pollution abatement efforts because of the reduced prices resulting from an import tariff cut induced by trade liberalization (Nemati et al., 2016). However, the environmental effect of a free trade agreement depends on the agreement type. Assessing their impact on world GHG emissions, Lovely and Popp (2011) find that PTAs among only developed or only developing countries can be beneficial for the environment quality while this is not the case when PTAs cover both developing and developed countries.

identify 222 agreements that include at least one provision relating to the environment (so-called PTAwEP). However, environmental provisions (EPs) included in PTAs are very heterogeneous: some PTAs include EPs that are very detailed while others only include general objectives. As in Morin and Jinnah (2018), we can group EPs into eight categories referring to a specific environmental issue: biodiversity[8], water, waste, fisheries, forest, dessert, ozone, and climate change. Among these 222 PTAwEP, only 98 agreements (14% of PTAwEP) contain provisions addressing the question of climate change. However, the rate of PTAs with climate-related provisions (PTAwCP) has remarkably increased since 2010, even if it still remains small compared to the number of PTAwEP.

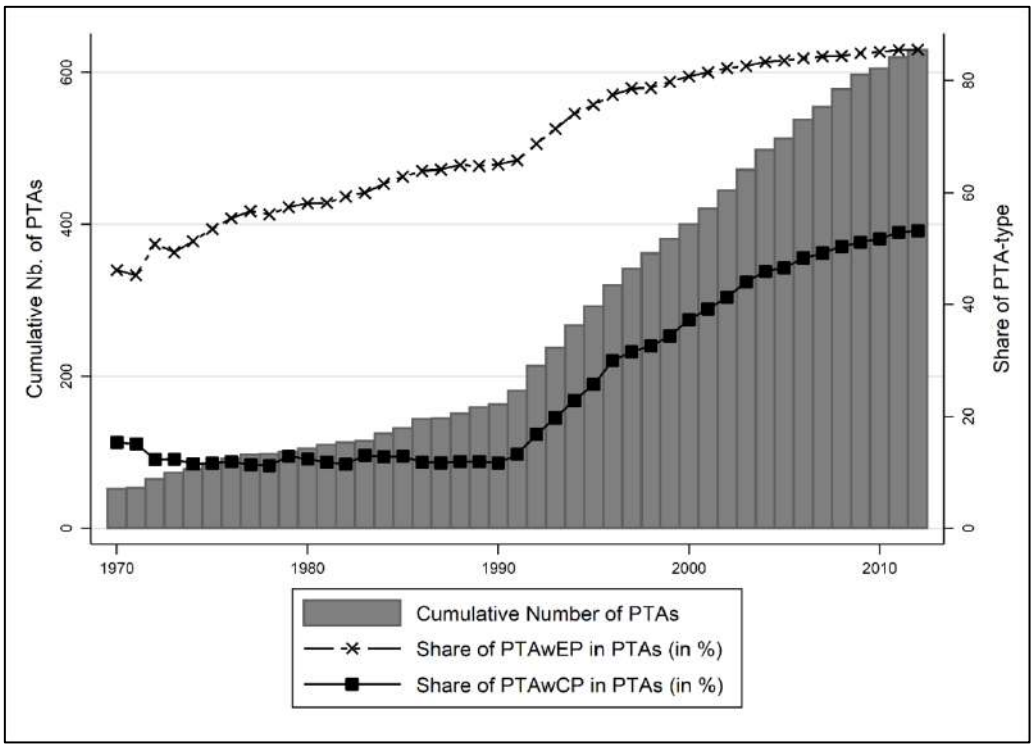
As Figure 1 shows since 1970, the share of PTAs negotiated on a bilateral and regional basis that have comprehensive environmental-related components has increased. In 1970, more than 50 per cent of all PTAs already contained environmental provisions (EPs). In 2012, the number of PTAs with EPs (PTAwEP) represented more than 85 per cent of all PTAs. Some PTAs include climate-related provisions to address climate change. The inclusion of provisions in PTAs addressing specifically climate issues was quite limited until 1990.[9] Before this date, the number of PTAs with climate-related provisions (PTAwCP) was about 18 per cent of total of PTAs. Since 1990, the number of PTAwCP has increased rapidly. It represents now about 55 per cent of total of PTAs.

[8] Biodiversity provisions include provisions related to endangered species, invasive species, migratory species, protected areas, genetic resources, biosafety and genetically modified organisms (Morin and Jinnah, 2018).

[9] Maybe a coincidence, 1990 is the date of the first report of the IPCC (Intergovernmental Panel on Climate Change) – an international scientific body set up in 1985 – that points out that human activities emit pollutants that significantly increase the concentration in the atmosphere of greenhouse gases (carbon dioxide, methane, chlorofluorocarbons, nitrous oxide) and enhance the natural greenhouse effect.

Given this evolution, the main interest of our paper is to take into account the heterogeneity of PTAwEP. Unlike previous papers, our paper assesses the impact of climate-related provisions (included in PTAs) on climate change mitigation through the reduction of GHG emissions including CO_2, CH_4 and N_2O, responsible for global warming which is a major element of climate change.[10] In doing so, we investigates whether the effect of PTAwEP on GHG emissions (found in previous studies) is due to the specific commitments of countries on climate change. Thus, our study distinguishes PTAs with climate change provisions (PTAwCP) from other PTAwEP.

Figure 1. Overview of Preferential trade agreements (PTAs)

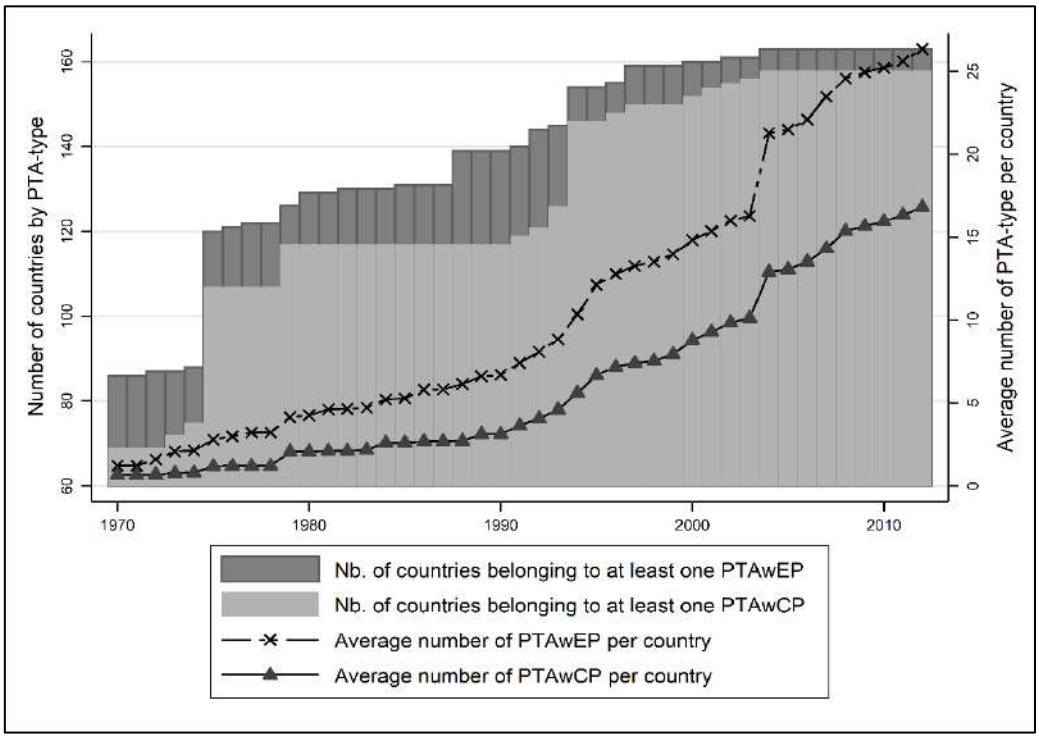


Source: Authors, created with data from "TRade and ENvironment Database" – TREND.
Note: PTAwEP means PTAs with environmental provisions; PTAwCP means PTAs with climate-related provisions.

[10] As Sorgho et al. (2018), we do not include in the study Fluorinated gases (F-gases) as Chlorofluorocarbons (CFC), Sulfurhexafluoride (SF_6), Hydrofluorocarbons (HFC) and Perfluorocarbons (PFC). These environment-harmful substances (F-gases) are almost totally prohibited since the entry in force of Montreal Protocol in 1989.

Figure 2 shows the evolution of the interest of countries in environmental issues. It shows an increasing number of countries belonging to agreements that include at least one climate change provision. This shows that many countries become aware of the climate issue. While until 1995 this was less than 5 PTAwCP, since 2008, on average, a country belongs at least to 15 PTAwCP.

Figure 2. A distribution of PTAwEP and PTAwCP



Source: Authors, created with data from "TRade and ENvironment Database" – TREND.

Considering the various environmental areas addressed by PTAs through EPs, PTAwCP are more specific and efficient to address the problem of climate change. These climate commitments included in PTAs are those that affect environmental quality once they have been implemented into national legislation. Governments have incentives (or will be constrained) to comply with commitments made in PTAwCP to which they are a Party. There is evidence of a positive and significant direct link between a country signing PTAs with many comprehensive EPs and a country introducing more environmental legislation domestically (see Brandi et al.,

2019; George and Yamaguchi, 2018).[11] In our data, several PTAwCP address explicitly the climate change issues with clauses even more specific and restrictive than those found in MEAs. For example, more than 50 PTAwCP include innovative climate provisions more specific and enforceable than the Kyoto Protocol and the Paris Agreement. This suggests a potential causal relationship between signing PTAwCP and GHG emissions: these gases would be reduced because countries implement international commitments on environmental issues into domestic legislation.

3. Modelling Framework

3.1. Empirical Model

The objective of this paper is to determine whether PTA-commitments on climate change issues have had an impact on the environmental quality through a reduction of emissions of the main greenhouse gases (GHG): emissions of CO_2, CH_4, and N_2O. We adopt an environmental quality model. As well-discussed in the empirical literature on "trade policy and environment", we control for scale, technique and composition effects in order to assess the effect of PTAwCP on emissions of GHG. Our model includes the usual determinants of emissions such as population density, per capita GDP and trade openness (e.g., Martinez-Zarzoso and Oueslaty, 2018; Zhou et al., 2017; Cherniwcha et al., 2017; Baghdadi et al., 2013; Managi et al., 2009; Frankel and Rose, 2005; Copeland and Taylor, 2005). It is a dynamic panel data model incorporating the

[11] In particular, George and Yamaguchi (2018) find that the United States and the European Union have made significant steps towards setting what may be regarded as a benchmark for monitoring and reporting on the implementation of environmental provisions in PTAs.

temporal dependency of the dependent variable on the past (noted by Em_{it-1}^{g}). Our model includes climate-related commitments as follows:

$$\log\left(Em_{it}^{g}\right)=\begin{bmatrix}\alpha_0+\alpha_1\log\left(Em_{it-1}^{g}\right)+\alpha_2\log\left(Popdens_{it}\right)+\alpha_3\log\left(Open_{it}\right)\\+\alpha_4\log\left(GDPcap_{it}\right)+\alpha_5 Reg_{it}^{pta}+FE_t+\varepsilon_{it}\end{bmatrix} \quad (1)$$

where Em_{it}^{g} denotes the per-capita emissions of each pollutant-type "g" (either CO_2, CH_4, or N_2O) from country *i* at the period *t*. Our dependent variable is measured in kilograms of emissions "g" per capita. The variable ($Open_{it}$), which proxies trade openness (i.e., trade intensity), is defined as the sum of trade (exports + imports) over GDP. This variable helps to capture the potential direct effect of trade openness on the environmental quality. Its effect could be positive or negative on environmental quality. The other control variables are $\left(Popdens_{it}\right)$ for population density measuring the number of inhabitants per square kilometers (Km^2) in country *i* in year *t*, $\left(GDPcap_{it}\right)$ for GDP per capita at constant US dollars in country *i* in year *t*. The variable $\left(Popdens_{it}\right)$ is used as a proxy for the scale effect. We add country fixed effects and time fixed effects (FE_t) to capture the linear time-trend effects (temporal events independent of countries). The term ε_{it} is the error term consists of an individual country effect ℓ_i and a random disturbance τ_{it} ($\varepsilon_{it}=\ell_i+\tau_{it}$).

According to previous studies, the coefficient of Em_{it-1}^{g} is intuitively expected to have a positive sign (e.g. Martinez-Zarzoso and Oueslaty, 2018; Managi et al., 2009). The coefficients for "per-capita GDP" and "trade openness", measuring their impact on CO_2 emissions, are also expected to be positive (e.g. Baghdadi et al., 2013). Indeed, the literature intuitively assumes that the more a country is populous, economically rich, and/or commercially open, the more it pollutes

(in absolute term). However, a high concentration (of inhabitants) per km² can lead to some form of economy of scale in terms of pollutant emissions. Accordingly, a country with a high population density can have a low emission per capita.

Through stringent environmental regulations, a country could have lower emissions despite its comparative advantage in capital-intensive goods (i.e., having a high capital-labor ratio). The domestic productive units would be constrained by the strict environmental standards (implemented by country) and adopt new more environment-friendly technologies and practices.

The variable Reg_{it}^{pta} represents the environment-related commitments embodied by the PTAwEP (or specifically climate-related commitments into PTAwCP) signed by a country *i* in year *t*. By including climate-related provisions in almost all PTAs it signs, a government signals its strong interest for climate change issues. Indeed, there is a positive relationship between international obligations on specific environmental issue areas and domestic environmental legislation in the same issue areas (see Brandi et al., 2019; George and Yamaguchi, 2018). To avoid paying environmental compliance costs (when international commitments on environment/climate will be incorporated into domestic law), companies can anticipate by adopting environment-friendly technologies and practices. Thus, PTAwCP could benefit the environmental quality by lowering pollutants' emissions (i.e., an indirect negative relationship between PTAwCP and GHG emissions). This negative effect on emissions is captured by the coefficient associated to Reg_{it}^{pta}.

Instead of a simple dummy[12] indicating a PTAwEP (or PTAwCP), we define our variable of interest (Reg_{it}^{pta}) as the number of PTAwEP (or the number of PTAwCP). We consider multi-commitments through different PTAs (involving various partners) as a proxy measuring the willingness of a country to deal with climate change issues. Thus, we introduce the number of PTAwEP (or the number of PTAwCP) into the estimating equation (1) above.[13] Taking the number of PTAwCP, rather than a dummy reflecting whether or not a country has a PTAwCP, allows to address the selection bias problem of PTAs. All countries are included in the analysis.

3.2. Pre-treatment for the endogeneity problem

As emphasized by the literature, the variables "GDP" and "trade openness" may be endogenously determined with environmental regulation (e.g., Martinez-Zarzoso and Oueslaty, 2018; Zhou et al., 2017; Baghdadi et al., 2013; Managi et al., 2009; Frankel and Rose, 2005).[14] Moreover, certain covariates like trade (trade openness) and production (GDP) may be simultaneously contributing to regulatory stringency (an explanatory variable) and our dependent variable "pollutants' emissions" (Brunel and Levinson, 2016). Consequently, we first instrument these variables by using a set of instrumental variables. We adopt an income equation (see equation 3) taken from the growth literature to instrument the variable "GDP" for each country (the predicted values of GDP). For the "trade openness", we run a gravity model

[12] Previous studies on the environment-impact of PTAs (e.g. Baghdadi et al., 2013) design the variable of interest as a dummy variable taking a value of 1 if country is involved in a PTA in the considered year, and zero otherwise.

[13] Using for our variable of interest a dummy variable (indicating whether country belongs to a PTA) would not be suitable in our case. In general, a PTA dummy depends on pairs of countries, while in this study the data is by country.

[14] The correlation matrix in Table A1 suggests that all explanatory variables in equation (1) are not exogenous; e.g., "per-capita GDP", and "trade openness" are highly correlated with our interest variable (e.g., Nb. of PTAwCP).

with pair-wise trade. The predicted values of aggregated bilateral trade (all trade) is used to calculate the openness for a given country (see equation 4). This instrumentation approach seeks to deal with both endogeneity and simultaneity problems pointed out above (e.g. Milllinet and Roy, 2016).

We use the predicted values of "income" (GDP_{it}) (i.e., the predicted values of GDP instead of its observed values) and "trade openness" ($Open_{it}$) (i.e., the predicted values of trade openness instead of its observed values) as instrumented variables in the equation (1).

In the equation (3), inspired from the growth-literature, we run an OLS model to regress an *income equation* on all trade $(Trade_{it})$, investments (Inv_{it}) calculated as the stock of inward foreign direct investments (FDIs), population (Pop_{it}) and human capital (Sch_{it}) approximated by the rate of school enrolment. With an error term (υ_{it}), the *income equation* is:

$$\log(GDP_{it}) = \left[\omega_0 + \omega_1 \log(Trade_{it}) + \omega_2 \log(Inv_{it}) + \omega_3 \log(Pop_{it}) + \omega_4 \log(Sch_{it}) + FE_t + \upsilon_{it}\right] \quad (3)$$

The variable $Trade_{it}$ represents the yearly sum of exports *plus* imports for a country *i* at time *t*, as follows: $Trade_{it} = \sum_j Export_{ijt} + \sum_j Imports_{ijt}$ (where $\sum_j Exports_{ijt}$ and $\sum_j Imports_{ijt}$ are respectively the total exports and the total imports, at period *t.* After the estimation of equation (3), we predict values of GDP for each country at year *t* (noted GDP_{it}).[15]

[15] As the predicted values of GDP directly obtained from the OLS estimation (3) are in logarithmic form, we transform them by taking their exponential in order to have the predicted values needed.

Following the literature, we adopt a gravity approach to create an instrumental variable for "trade openness" (e.g., Baghdadi et al., 2013; Frankel and Romer, 1999). We implement a PPML[16] gravity model that explains bilateral trade between two trading partners by their size (GDP and population) and distances between them (physical distance and dummy variables indicating common borders and linguistic link status).

$$T_{ijt} = \begin{bmatrix} \eta_0 + \eta_1 \log\left(dist_{ij}\right) + \eta_2 \log\left(GDP_{it}\right) + \eta_3 \log\left(GDP_{jt}\right) + \\ \eta_4 \log\left(Pop_{it}\right) + \eta_5 \log\left(Pop_{jt}\right) + \eta_6 CB_{ij} + \eta_7 CL_{ij} + FE_t + \pi_{ijt} \end{bmatrix} \quad (4)$$

Here, T_{ijt} denotes the bilateral trade (exports *plus* imports) of two trading partners *i* and *j* at the period *t.* The productions (GDP_{it} and GDP_{jt}) and the populations (Pop_{it} and Pop_{jt}) are respectively referred to countries *i* and *j*; and $dist_{ij}$ is the physical distance between them. In additional, the dummy variables: CB_{ij} takes the value of 1 if both countries *i* and *j* share a common border and 0 otherwise; and CL_{ij} takes the value of 1 if both countries *i* and *j* share a common language and 0 otherwise. We also include temporal fixed effects $\left(FE_t\right)$ to control for the time trend. The term (π_{ijt}) is an error term. After predicting values of bilateral trade $\widehat{T}_{ijt}$ from equation (4), we aggregate them to obtain a prediction for total trade ($\widehat{T}_{it}$) for each country at year *t*, as follows: $\widehat{T}_{it} = \sum \widehat{T}_{ijt}$ (where terms $\sum \widehat{T}_{ijt}$ is the sum of predicted bilateral trade, at period *t*). Then, we use the values of $\widehat{T}_{it}$ to calculate the "trade openness" ($Open_{it}$) for each

[16] Silva and Tenreyro (2006) suggest the PPML estimator in order to deal with the presence of heteroscedasticity and take into account the problem of zero (generally) observed in trade data. Moreover, in our case, contrast to the OLS model, the PPML gravity model gives directly the predicted values needed because the dependent variable is in level (not in logarithmic form).

country *i* at year *t* by dividing them by the predicted value of GDP, i.e. (GDP_{it}) from equation (3).

The results from equations (3) and (4) are reported in Appendix A. As reported in Tables A2 and A3 for equations (3) and (4) respectively, all estimated coefficients are statistically significant with the expected sign (with respect to the existing literature).

4. Data description

For this study, we construct a dataset from various sources. Table 1 shows the summary statistics for the covariates used. Our dataset covers the period 1995–2012 for 165 countries (for the list of countries, see the Appendix C). Data on trade are from the UN COMTRADE database.[17] Data on pollutants' emissions (CO_2, N_2O, and CH_4) are obtained from the European Commission.[18]

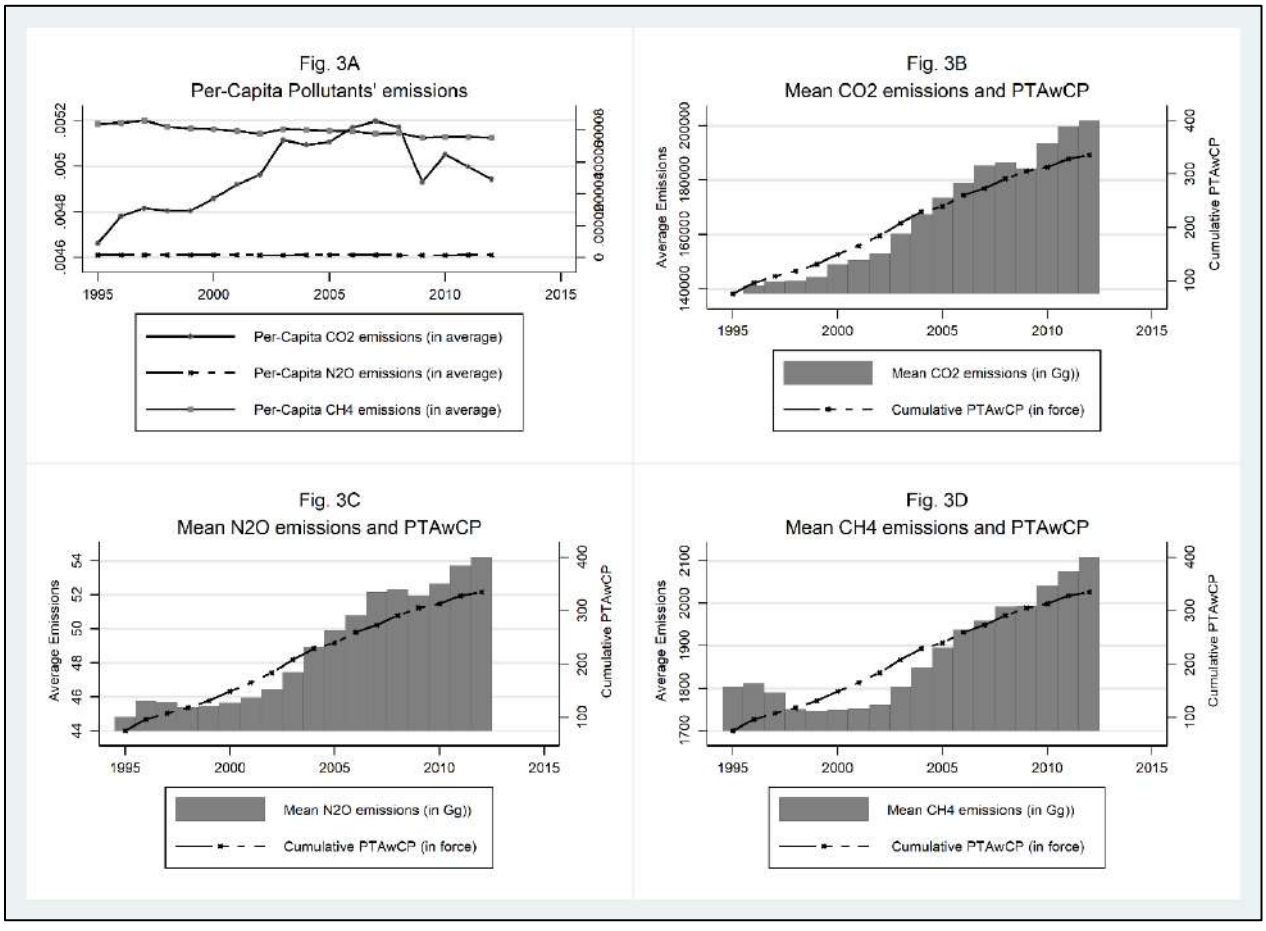
Figure 3 shows that the pollution per capita is more stable for N_2O than the per-capita emissions in CO_2 and CH_4 (see Fig. 3A). However, we can note a decrease of per-capita emissions for CH_4 since 1997. The per-capita pollution for CO_2 started to decrease from 2008 after a regular increase until 2007. Between 1995 and 2000, the average emission (per country) was relatively stable despite the large number of PTAwCP.

[17] World Bank database: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators [Accessed June 05, 2018].

[18] European Commission, Joint Research Centre (EC-JRC)/Netherlands Environmental Assessment Agency (PBL). Emissions Database for Global Atmospheric Research (EDGAR), release EDGAR v4.3.2 (1970 - 2012) of March 2016: http://edgar.jrc.ec.europa.eu [Accessed June 05, 2018].

From 2000, the average emission of pollutants has particularly accelerated; the average emissions of CO_2 (see Fig. 3B), and that of N_2O (see Fig. 3C) have increased proportionally to the number of PTAwCP, while the evolution of the average emissions of CH_4 (see Fig. 3D) is less than proportional to the number of PTAwCP. However, the overview of Figure 3 does not give a conclusive picture of the causal relationship between countries' GHG emissions and the number of PTAwCP they have signed. Indeed, from these figures, we cannot conclude to any pattern in GHG emissions associated to climate-related commitments into PTAs made by countries.

Figure 3. Evolution of Pollutants' emissions and PTAwCP



Source: Authors, created using data from "TRade and ENvironment Database" – TREND, and Emissions Database for Global Atmospheric Research (EDGAR).

Table 1. Descriptive statistics

	Obs.	Mean	S.D	Min	Max
Emissions of CO_2 in gigagrams (Gg)	2970	166337.4	686148.9	13.79101	9918456
Emissions of CH_4 in gigagrams (Gg)	2970	1878.82	5462.892	0.070019	66296.83
Emissions of N_2O in gigagrams (Gg)	2970	48.84334	156.3949	0.001684	1762.989
Nb. of PTAs with C.C. Prov. (PTAwCP)	2970	11.60438	12.68798	0	62
Total import (yearly)	2970	376483.9	3852653	0	1.78e+08
Total export (yearly)	2970	383011	4102908	0	1.88e+08
Stock FDI - at current prices (in millions of $US)	2970	67770.03	251437.1	0.26	3915538
Pop. in age 15+ with secondary schooling (in %)	2970	23.92534	15.49427	0.68	71.8
Area in square kilometers (Km^2)	2970	780958.7	2048573	316	1.71e+07
Population	2970	3.77e+07	1.35e+08	17255	1.35e+09
GDP in US dollars	2914	2.76e+11	1.13e+12	7.66e+07	1.62e+13
Bilateral distance (in Km)	2970	7234.95	4185.477	213.1258	19475.95
Dummy for sharing a common official language	2970	0.135017	0.341799	0	1
Dummy for sharing a common border (contiguity)	2970	0.020875	0.142991	0	1

Source: Data are from Emissions Database for Global Atmospheric Research (EDGAR), UNCTAD's database, World Development Indicators (World Bank), TRade and ENvironment Database (TREND), *Centre d'Études Prospectives et d'Informations Internationales* (CEPII).

The data on gross national product (GDP), land area, population, school enrollment[19] comes from World Development Indicators.[20] Data on foreign direct investments (FDIs) are from the UNCTAD's database.[21] The other gravity data, such as bilateral distance, common language and contiguity dummies come from the *Centre d'Études Prospectives et d'Informations Internationales* (CEPII). Data on trade agreements with climate-related provisions (PTAwCP) come from the TRade and ENvironment Database (TREND). This PTA-database encodes information on the environmental provisions (including the climate-related provisions) contained in 688 PTAs signed between 1947 and 2016. Our definition of PTAwCP follows the

[19] This educational attainment data is computed following Barro R. and Lee J.-W. (2013). These authors compute an average index of education ranging from 0 to 1, where 1 represents 16 education-years.

[20] All values are in 2005 constant US Dollar.

[21] See UNCTAD Stat: http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=fr [Accessed June 05, 2018].

study of Morin and Jinnah (2018) which manually code the climate-related provisions contained in PTAs from TREND. For a list of these climate-related provisions in PTAs, see Appendix B.

5. Estimation strategy and results

As defined in the equation (1), the implementation of our environmental model requires the "dynamic" panel data techniques rather than the "static" panel data methods (e.g., GLS estimation, OLS estimation, and fixed-effects estimation). Even if the static panel data models are robust under heteroskedastic disturbances (Davidson and MacKinnon, 2004), none of them has acceptable properties when a dynamic structure is introduced in the model as in our case.[22]

Because of the potential issue of endogeneity and reverse causality[23] of the PTA variable, it is difficult to isolate the environmental effects of PTAwCP. As in Martinez-Zarzoso and Oueslaty (2018), in order to address the issue of endogeneity and reverse causality of the PTA variable, we estimate by the dynamic Generalized Method of Moments (GMM) for panel data (Arellano and Bond 1991; Blundell and Bond 1998).[24] As a robustness check, we estimate a panel data model – as suggested by Baier and Bergstrand (2007) – to control for the endogeneity of the

[22] Including a lagged dependent variable as a regressor in the equation (1) violates strict exogeneity, because of its correlation with the idiosyncratic error. Thus, as the strict exogeneity assumption is violated, commonly use of "static" panel data estimators are inconsistent; these estimators require strict exogeneity. Moreover, the instrumental variables (IV) estimation proposed by Anderson and Hsiao (1982) as a solution (when the strict exogeneity assumption is violated) has been found asymptotically inefficient by Arellano and Bond (1991) who propose a more efficient estimation procedure (using moment conditions in which lags of the dependent variable and first differences of the exogenous variables are instruments for the first-differenced equation).

[23] In other words, if we know that the accumulation of PTAwEP may lead to better environmental quality, a country that seeks to improve environmental quality may also be keen to enter into negotiations of PTAwEP.

[24] The difference GMM estimator uses moment conditions from the estimated first differences of the error term. While the system GMM estimator utilizes an additional set of level moment conditions as well as the difference moment conditions to estimate dynamic panel data. In our case, the system GMM estimator is not necessary.

PTA variable in the environmental-impact model (equation 1), while using the instrumental method will enable us to address the endogeneity of the income and trade variables (see section 2).

When using panel data, the unobserved country-specific component is eliminated by taking the first differences of the left- and right-hand-side variables and the endogeneity issue is solved by using the lagged values of the levels of the endogenous variables as instruments (Martinez-Zarzoso, 2018). Thus, the estimating equation (1) is transformed as follows:

$$\Delta \log\left(Em_{it}^{g}\right) = \begin{bmatrix} \alpha_0 + \alpha_1 \Delta \log\left(Em_{it-1}^{g}\right) + \alpha_2 \Delta \log\left(Popdens_{it}\right) + \alpha_3 \Delta \log\left(Open_{it}\right) \\ + \alpha_4 \Delta \log\left(GDPcap_{it}\right) + \alpha_5 \Delta Reg_{it}^{pta} + \Delta FE_t + \varepsilon_{it} \end{bmatrix} \quad (5)$$

where Δ defines the first difference of the corresponding variable. $Open_{it}$ indicates the predicted value of variable of "trade openness". $GDPcap_{it}$ is predicted value of per-capita GDP. The other variables in the equation have already been described above for equation (1).

There are two situations where the difference GMM model does not provide good estimators: when model errors are heteroskedastic (see Windmeijer, 2005) and when using time invariant regressors (see Blundell and Bond, 1998).[25] Both problems do not matter in our case. Moreover, once difference GMM results are obtained, the validity of the model must be checked: test for serial correlation in the first-differenced residuals and test for the validity of the overidentifying restrictions. In our case, the explanatory variables such as "per-capita GDP" and "trade

[25] When model errors are heteroskedastic, Windmeijer (2005) proposes to correct it by implementing the two-step GMM estimator (using thus a first-step estimation to obtain the covariance matrix of estimation error). In the case of time-invariant regressors in the model, the econometric literature proposes to use the system GMM estimator rather than the difference GMM estimator (see Arellano and Bover, 1995; Blundell and Bond, 1998).

openness" that are potentially endogenous have first been instrumented before estimating equation (5).

The validity of specific instruments can be tested in the GMM framework by using the Hansen test of over-identifying restrictions.[26] In our analysis, we consider as endogenous variables the lagged dependent variable and the variables related to a PTA with EPs/CPs and the instruments used are the second lagged values of the levels of the respective variables and density of country. The GMM results from equation (5) are reported in Table (2) and FGLS results from equation (1) are shown in Table (3) as robustness test. Results are reported for the following three specifications:

- Specification (1): investigating the environmental-effects of PTAwEP;
- Specification (2): investigating the environmental-effects of PTAwCP;
- Specification (3): investigating both effects of PTAwEP (without CP) and PTAwCP.

Specification (1) replicates results from previous studies, while specifications (2) and (3) are our main contribution to literature. The two last specifications seek to show that PTAwEP are heterogeneous with regard to their impact on climate change issues: certain PTAwEP contain general environmental provisions while others are more specific with provisions addressing the problem of climate change. To do that, we split PTAwEP in PTAwEP containing climate-related provisions (noted PTAwCP) and PTAwEP without CP (noted PTAw/oCP). We then isolate the impact of PTAwCP on GHG emissions (specification 2) and test its sensitivity by conjointly running PTAwCP and PTAw/oCP (specification 3) in the same equation.

[26] Hansen test: under the null hypothesis (H0), the instruments used to address the endogeneity of some regressors are valid instruments. When the associated probability value is lower than 0.05, the null hypothesis (H0) is rejected.

Before discussing the results regarding our variable of interest (climate-related provisions), we check the validity of GMM estimations. As reported in Tables 2, results on AR-tests (i.e., the non-significance on the hypothesis of no second-order autocorrelation) show that there is no serial correlation in the error term and our GMM estimations are valid. Thus, residuals are uncorrelated with instruments taking the number of PTAwCP as the measure of climate-related commitments in PTAs. Moreover, the results on Hansen test are all insignificant; the null hypothesis (H0) can not be rejected. Thus, the instruments used to address the endogeneity of PTA variable are valid. Overall, these results confirm that the use a dynamic model for our study is justified.

With respect to the control variables, the lagged emissions terms for all specifications are statistically significant with a positive sign and their values are less than one. As concluded by Managi et al. (2009), these results imply that changes in explanatory variables, such as "trade openness" or "per-capita GDP", at a specific point in time would also influence emissions after the current period. The estimated coefficients on "trade openness" and "per-capita GDP" have the expected sign, even if some of them are non-significant.

Thus, a higher per-capita income (higher GDP per capita) is estimated as having a positive impact on the GHG emissions. The estimated coefficient on the "population density" is significant for all specifications suggesting that a country with a higher concentration of inhabitants per square kilometer (Km^2) has lower GHG emissions. The positive estimated coefficient on "trade openness" indicates that a large openness for country tends to increase its GHG emissions. The results confirm that the economically richer the country, the more it tends to pollute. However, the non-significance effect on "trade openness" can be linked to the fact that a participation to PTAwEP or PTAwCP is potentially harmful for free trade.

As concluded by previous studies (e.g. Martinez-Zarzoso and Oueslaty, 2018; Zhou et al., 2017; Baghdadi et al., 2013), our results indicate that pollutants emissions (N_2O, CO_2 and CH_4) are reduced for countries that belong to PTAs with EPs (specification 1 in Table 2).[27] We find that each additional PTA with EPs decreases the mean of per-capita emissions by around 1.3% (for CO_2), by around 0.7% (for CH_4), and by around 1.6% (for N_2O), whereas PTA without EP show positive and significant coefficients (except for CH_4).[28] However, these effects of PTAwEP seem to hide the direct effects of specific PTAs such as PTAwCP as shown in the following analysis.

All the estimated coefficients for the variable "environmental commitments" related to climate change have a negative sign and are highly significant for specifications (2) and (3). Accordingly, we can conclude that multi-commitments on climate change through the signing of several PTAwCP helps the mitigation of emissions responsible for greenhouse gases (GHG). The estimated coefficients on PTA without EP remain similar to those obtained in specification (1), except for CH_4 (in specification 3) where the coefficient is negative and not significant.[29]

In specification (2) in Table 2, the estimated coefficient on PTAwCP displays -0.0181 (for CO_2 emissions), -0.0108 (for CH_4 emissions), and -0.0211 (for N_2O emissions). Thus, these results indicate that signing an additional PTAwCP by a country reduces, on average, its per-capita

[27] Baghdadi et al. (2013) found that CO_2 emissions are around 0.3% lower for countries that have RTAs with EPs, whereas the effect is not statistically significant for countries with RTAs without EPs. Martinez-Zarzoso, (2018) found that an additional PTA with EPs can decrease CO_2 emissions by 0.4% for countries that have RTAs with EPs.

[28] Since our variable of interest is a count variable, the interpretation is slightly different from that of an elasticity. An increase of one unit of this variable increases (decreases in case of a negative coefficient) the dependent variable by beta*100.

[29] Recall that our study data cover the period from 1995 to 2012, and more than 80% of all PTAs contain environmental provisions (PTAwEP).

emissions by around 1.8% (about 36.9 metric tons), 1.1% (about 24.2 metric tons), and 2.1% (about 21.1 metric tons) respectively for CO_2, CH_4 and N_2O.[30] Comparatively, it is not surprising that the magnitude of the effect of PTAwCP (containing more specific provisions) are higher than that of PTAwEP (that can include simple declarations of good intentions).

In specification (3), we include both PTAwEP and PTAwCP in same equation. The associated coefficient on PTAwCP remains negative and significant, and its amplitude is similar to that obtained in specification (2). However, the effect of PTAwEP without CP (noted PTAw/oCP) is inconclusive. The estimated coefficient on PTAw/oCP is positive and not significant for CO_2 emissions, but significant for CH_4 emissions, while it is negative but not significant for N_2O emissions. The mixed effect of PTAw/oCP on GHG emissions could be due to the heterogeneity of environmental provisions (EPs) that range from declarations of good intentions on environment to environmental provisions that are not necessarily relevant for GHG mitigation.

[30] Since, by converting, 1 gigagrams (Gg) = 1 billion grams = 1000 metric tons.

Table 2. Results of GMM estimates - Causal effect of PTAwCP on Pollutants' emissions

	Specification (1)			Specification (2)			Specification (3)		
	CO_2 em.	**CH_4 em.**	**N_2O em.**	**CO2 em.**	**CH_4 em.**	**N_2O em.**	**CO_2 em.**	**CH_4 em.**	**N_2O em.**
Lag of per-capita emissions	0.3464*** (0.0657)	0.5465*** (0.0572)	0.1693*** (0.0486)	0.3367*** (0.0677)	0.5305*** (0.0596)	0.1496*** (0.0571)	0.3347*** (0.0693)	0.5048*** (0.0593)	0.1516** (0.0617)
Trade openness (instrumented)	0.0113 (0.0108)	0.0121 (0.0080)	0.0202** (0.0081)	0.0107 (0.0121)	0.0124 (0.0087)	0.0161** (0.0082)	0.0102 (0.0119)	0.0130 (0.0082)	0.0163* (0.0087)
Number of PTAw/oEP	0.1278*** (0.0451)	0.0508 (0.0345)	0.1782*** (0.0427)	0.0923** (0.0356)	0.0473 (0.0287)	0.1190*** (0.0348)	0.0767 (0.0522)	-0.0137 (0.0372)	0.1351** (0.0592)
Number of PTAwEP	-0.0129*** (0.0031)	-0.0066*** (0.0021)	-0.0162*** (0.0036)	–	–	–	–	–	–
Number of PTAw/oCP	–	–	–	–	–	–	0.0043 (0.0125)	0.0178** (0.0072)	-0.0037 (0.0158)
Number of PTAwCP	–	–	–	**-0.0181*** (0.0042)**	**-0.0108*** (0.0028)**	**-0.0211*** (0.0047)**	**-0.0193*** (0.0060)**	**-0.0153*** (0.0035)**	**-0.0203*** (0.0065)**
Pop. density (inhabitants/km²)	-0.2259* (0.1303)	-0.2591*** (0.0958)	-0.3679*** (0.1106)	-0.2788** (0.1272)	-0.2971*** (0.1054)	-0.4340*** (0.1093)	-0.2914** (0.1251)	-0.3399*** (0.1132)	-0.4229*** (0.1257)
Per-capita GDP (instrumented)	0.0070 (0.0141)	0.0098 (0.0111)	0.0451*** (0.0138)	0.0006 (0.0142)	0.0048 (0.0110)	0.0278** (0.0141)	0.0009 (0.0142)	0.0059 (0.0112)	0.0283* (0.0153)
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.653	0.762	0.254	0.608	0.733	0.265	0.599	0.699	0.259
Nb. of observations	2,609	2,609	2,609	2,609	2,609	2,609	2,609	2,609	2,609
Nb. of countries	164	164	164	164	164	164	164	164	164
AR(1)	-4.41***	-4.54***	-2.98***	-4.21***	-4.28***	-2.66***	-4.13***	-4.15***	-2.52***
AR(2)	-0.54	0.22	-1.33	-0.49	0.22	-1.20	-0.48	0.22	-1.23
Hansen Test (Prob)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Standard errors, in parentheses, are robust to heteroskedasticity and arbitrary patterns of autocorrelation within individuals. The symbols (***), (**) and (*) to coefficients means that latter are respectively significant at the 1% level, 5% level and 10% level. The variables: "trade openness" and "per-capita GDP" are instrumented for using their "predicted" values. Time fixed-effects are not reported. PTAwEP means trade agreement with environmental provisions. PTAwCP means trade agreement with climate-related provisions. PTAw/oEP means PTA without environmental provisions. PTAw/oCP means PTAwEP without climate-related provisions. Variable of interest: PTAwCP as PTA - PTAw/oEP - PTAw/oCP = PTAwEP - PTAw/oCP (with PTAwEP = PTA - PTAw/oEP).

PTA with climate-related provisions (PTAwCP) target better the reduction of gases responsible to climate change. In our data, more than half of PTAwEP are PTAwCP. Thus, having purged the direct effect of PTAwCP on GHG emissions, the coefficient of PTA without CP (PTAw/oCP) is not significant (except for CH_4). The positive and significant coefficient for CH_4 would mean that effect of PTAw/oCP could be harmful on environment quality as a PTA without EP. Therefore, their impact on the environment should be modulated through trade or income.

As a robustness check, we run equation (1) using panel data techniques (FGLS) as suggested by Baier and Bergstrand (2007). The FGLS results shown in Table 3 follow the three different specifications described above. Except for the coefficient on PTAw/oEP for CO_2 emissions (negative and significant)[31], the results in Table 3 are similar to Table 2. FGLS estimates also support the idea that climate-related commitments through PTAwCP led to a reduction of per-capita emissions of GHG. For specification (2) in Table 3, the estimated coefficient on our interest variable (PTAwCP) is -0.0071 (for CO_2 emissions), -0.0070 (for CH_4 emissions) and -0.0112 (for N_2O emissions). For all GHG, it is negative and statistically significant. These results remain significantly stable when we conjointly run PTAwCP and PTAw/oCP in same equation (specification 3). This means that signing an additional PTAwCP significantly decreases (on average) the level of per-capita GHG emissions by about 1.4% for CO_2 emissions, 0.7% for CH_4 emissions and 1.7% for N_2O emissions (specification 3).

[31] The negative and statistically significant coefficients of PTAw/oEP could be due to the fact that we are not able to control for domestic environmental regulations (Martínez-Zarzoso and Oueslati, 2018: 761).

Table 3. Results of FGLS estimates - Causal effect of PTAwCP on Pollutants' emissions

	Specification (1)			Specification (2)			Specification (3)		
	CO_2 em.	**CH_4 em.**	**N_2O em.**	**CO2 em.**	**CH_4 em.**	**N_2O em.**	**CO_2 em.**	**CH_4 em.**	**N_2O em.**
Trade openness (instrumented)	0.0124** (0.0056)	0.0206*** (0.0053)	0.0097*** (0.0034)	0.0123** (0.0052)	0.0205*** (0.0053)	0.0098*** (0.0030)	0.0128*** (0.0047)	0.0208*** (0.0056)	0.0102*** (0.0025)
Number of PTAw/oEP	0.0004 (0.0207)	-0.0046 (0.0169)	0.0625*** (0.0178)	0.0101 (0.0176)	0.0032 (0.0154)	0.0651*** (0.0153)	-0.0334* (0.0192)	-0.0241 (0.0154)	0.0277* (0.0154)
Number of PTAwEP	-0.0027* (0.0016)	-0.0008 (0.0014)	-0.0055*** (0.0016)	–	–	–	–	–	–
Number of PTAw/oCP	–	–	–	–	–	–	0.0156*** (0.0045)	0.0098** (0.0040)	0.0134*** (0.0044)
Number of PTAwCP	–	–	–	**-0.0071*** (0.0027)**	**-0.0030 (0.0024)**	**-0.0112*** (0.0025)**	**-0.0142*** (0.0037)**	**-0.0074** (0.0036)**	**-0.0172*** (0.0036)**
Pop. density (inhabitants/km²)	-0.3258** (0.1366)	-0.3795** (0.1614)	-0.3353*** (0.0997)	-0.3776*** (0.1356)	-0.4062** (0.1624)	-0.3997*** (0.0956)	-0.4424*** (0.1371)	-0.4469*** (0.1644)	-0.4555*** (0.0971)
Per-capita GDP (instrumented)	0.0347* (0.0181)	0.0344* (0.0180)	0.0303** (0.0131)	0.0327* (0.0182)	0.0335* (0.0179)	0.0277** (0.0126)	0.0294 (0.0184)	0.0314* (0.0177)	0.0249** (0.0121)
Constant	-6.238*** (0.3504)	-8.392*** (0.4208)	-13.452*** (0.2330)	-6.087*** (0.3499)	-8.313*** (0.4235)	-13.268*** (0.2231)	-5.919*** (0.3575)	-8.207*** (0.4284)	-13.124*** (0.2291)
Fixed-effects: Country and Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.991	0.980	0.977	0.991	0.981	0.978	0.991	0.981	0.978
Nb. of observations	2,934	2,934	2,934	2,934	2,934	2,934	2,934	2,934	2,934
Nb. of countries	164	164	164	164	164	164	164	164	164

Notes: Standard errors, in parentheses, are robust to heteroskedasticity and arbitrary patterns of autocorrelation within individuals. The symbols (***), (**) and (*) to coefficients means that latter are respectively significant at the 1% level, 5% level and 10% level. The variables: "trade openness" and "per-capita GDP" are instrumented for using their "predicted" values. Time and country fixed-effects are not reported. PTAwEP means trade agreement with environmental provisions. PTAwCP means trade agreement with climate-related provisions. PTAw/oEP means PTA without environmental provisions. PTAw/oCP means PTAwEP without climate-related provisions. Variable of interest: PTAwCP as PTA - PTAw/oEP - PTAw/oCP = PTAwEP - PTAw/oCP (with PTAwEP = PTA - PTAw/oEP).

In addition, since using predictions for GDP and trade openness can affect the standard errors, we bootstrap the estimations. The GMM bootstrapped results reported in appendix (Table A4) are also similar to Table 2. Likewise, the FGLS bootstrapped results (Table A5) confirm the results in Table 3. In sum, these results suggest the robustness of our benchmark estimates in Table 2.

Using detailed data on the different types of PTA, our results in Tables 2 and 3 show that the negative effect of PTAwEP on GHG emissions (concluded by previous studies) are driven by the specific CPs contained in these PTAs (see specifications 2 and 3). Thus, our findings provide the first evidence that signing a PTAwCP can play an important role in climate governance by committing countries to continue efforts in emissions abatement. Consequently, any PTAwEP does not necessarily have a direct positive impact on the environmental quality, in particular on the reduction of GHG emissions. On the other hand, signing PTAs with (ambitious) provisions related to climate protection may lead a country to toughen its national regulation related to climate change issues. This change of domestic legislation towards more climate-friendly regulation affects (or modifies) the behavior of economic actors (producers and consumers) which in the long-run can substantially mitigate the level of GHG emissions of the country.

6. Concluding remarks

This paper investigates whether climate-related commitments made by countries by signing PTAwCP contribute to climate change mitigation. Concretely, we assess their effectiveness in terms of reducing main GHG per capita emissions including CO_2, CH_4 and N_2O, responsible for global warming, which a major element of climate change. Moreover, it answers to question of whether all PTAwEP have an impact on GHG emissions reduction or whether the effect of

PTAwEP on GHG emissions is due to climate-related provisions (CP). Because of a lack of detailed data on PTAs, this question has not yet been studied in previous papers on the role of PTAs with environmental provisions in global climate governance.

To do that, we run a simplified model for environmental quality. In order to assess the effect of PTAwCP on emissions of GHG, we control for scale, technique and composition effects and deal with the endogeneity of income and trade variables by using instruments. Using data on 165 countries from 1995 to 2012, our main results show that PTAwCP statistically reduce the level of GHG emissions. This suggests that governments seem to comply with the climate-related commitments they made in the PTAs, what potentially helps tackling global warming.

By signing an additional PTAwCP, a country can reduce, on average, its per-capita emissions by around 1.8% (about 36.9 metric tons), 1.1% (about 24.2 metric tons), and 2.1% (about 21.1 metric tons) respectively for CO_2, CH_4 and N_2O. Moreover, our results show that any PTAwEP does not necessarily have a direct positive impact on the environment, in particular on the reduction of GHG. It is the specific climate-related provisions in PTAs that affect directly environmental indicators (CO_2, CH_4 and N_2O). This evidence suggests that to be effective in terms of mitigating climate change, a PTAwEP should contain climate-related commitments.

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8. Appendix

Appendix A:

Table A1. Correlation Matrix

	CO2 per capita	CH4 per capita	N2O per capita	Trade openness	GDP per capita	Nb. of PTAwCP	Nb. of PTAwEP	Density
CO2 per capita	1							
CH4 per capita	0.718***	1						
N2O per capita	0.262***	0.215***	1					
Trade openness	0.162***	0.0823***	-0.00752	1				
GDP per capita	0.641***	0.292***	0.343***	0.103***	1			
Nb. of PTAwCP	0.179***	-0.0974***	0.240***	0.103***	0.539***	1		
Nb. of PTAwEP	0.198***	-0.0819***	0.273***	0.0863***	0.532***	0.977***	1	
Pop. Density	0.0883***	-0.0655***	-0.0479**	0.399***	0.149***	0.0176	0.00142	1

Note: *p<0.05; **p<0.01; *** p<0.001.

Table A2. Results for Income Equation (3)

Dependent variable: Income ("GDP")	
Country's trade (exports *plus* imports)	0.0239*** (0.0045)
Country's investment stock	0.6015*** (0.0124)
Country's population	0.4290*** (0.0132)
Country's human capital ratio	0.3397*** (0.0238)
Constant	12.887*** (0.1973)
Fixed-effects (time)	Yes
R-squared	0.89
Observations	1'816

Notes: Standard Errors (s.e.) are in parentheses. The symbol (***) to coefficients means that latter are significant at the 1% level. Time fixed-effects are not reported.

Table A3. Results of Gravity Equation (4)

Dependent variable: bilateral trade ("exports *plus* imports**")**	
Log of distance (between trading partners)	–0.7079*** (0.0245)
Log of population (exporter)	0.0979*** (0.0260)
Log population (importer)	0.0979*** (0.0260)
Log of GDP (exporter)	0.7941*** (0.0211)
Log of GDP (importer)	0.7941*** (0.0211)
Common language (between trading partners)	0.3288*** (0.0753)
Common border (between trading partners)	0.5132*** (0.0886)
Constant	-25.45718*** (0.6359)
Fixed-effects (time)	Yes
R-squared	0.82
Observations	487'080

Notes: Standard Errors (s.e.) are in parentheses. The symbol (***) to coefficients means that latter are significant at the 1% level. Time fixed-effects are not reported.

Table A4. Causal effect of PTAwCP on Pollutants' emissions (Bootstrapped GMM results)

	Specification (1)			Specification (2)			Specification (3)		
	CO_2 em.	**CH_4 em.**	**N_2O em.**	**CO2 em.**	**CH_4 em.**	**N_2O em.**	**CO_2 em.**	**CH_4 em.**	**N_2O em.**
Lag of per-capita emissions	0.3463*** (0.0001)	0.5466*** (0.0001)	0.1694*** (0.0002)	0.3367*** (0.0002)	0.5305*** (0.0001)	0.1499*** (0.0002)	0.3347*** (0.0002)	0.5048*** (0.0002)	0.1520*** (0.0002)
Trade openness (instrumented)	0.0123*** (0.0000)	0.0121*** (0.0000)	0.0176*** (0.0000)	0.0107*** (0.0000)	0.0124*** (0.0000)	0.0161*** (0.0000)	0.0102*** (0.0000)	0.0130*** (0.0000)	0.0164*** (0.0000)
Number of PTAw/oEP	0.1278*** (0.0002)	0.0508*** (0.0002)	0.1781*** (0.0003)	0.0923*** (0.0002)	0.0473*** (0.0002)	0.1189*** (0.0002)	0.0768*** (0.0005)	-0.0137*** (0.0002)	0.1352*** (0.0003)
Number of PTAwEP	-0.0129*** (0.0000)	-0.0066*** (0.0000)	-0.0161*** (0.0000)	--	--	--	--	--	--
Number of PTAEPw/oCP	--	--	--	--	--	--	0.0043*** (0.0001)	0.0178*** (0.0000)	-0.0037*** (0.0000)
Number of PTAwCP	--	--	--	**-0.0181*** (0.0000)**	**-0.0108*** (0.0000)**	**-0.0211*** (0.0000)**	**-0.0193*** (0.0000)**	**-0.0153*** (0.0000)**	**-0.0203*** (0.0000)**
Pop. density (inhabitants/km²)	-0.2254*** (0.0058)	-0.2588*** (0.0013)	-0.3653*** (0.0015)	-0.2781*** (0.0056)	-0.2969*** (0.0010)	-0.4311*** (0.0015)	-0.2908*** (0.0058)	-0.3399*** (0.0008)	-0.4197*** (0.0015)
Per-capita GDP (instrumented)	0.0016*** (0.0001	0.0071*** (0.0001)	0.0318*** (0.0001)	-0.0006*** (0.0001)	0.0048*** (0.0001)	0.0277*** (0.0001)	-0.0010*** (0.0001)	0.0059*** (0.0001)	0.0282*** (0.0001)
Time fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.6524	0.7673	0.2494	0.6085	0.7335	0.2654	0.6000	0.6987	0.2596
Nb. of observations	2609	2609	2609	2609	2609	2609	2609	2609	2609
Nb. of countries	164	164	164	164	164	164	164	164	164
AR(1)	-4.4102***	-4.5395***	-2.9775***	-4.2114***	-4.2789***	-2.6553***	-4.1315	-4.1518	-2.5221**
AR(2)	0.5376	0.2194	-1.3324	-0.4942	0.2215	-1.2035	-0.4824	0.2207	-1.2321
Hansen Test (Prob)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Notes: Standard errors (in parentheses) are bootstrapped. The symbols (***), (**) and (*) to coefficients means that latter are respectively significant at the 1% level, 5% level and 10% level. The variables: "trade openness" and "per-capita GDP" are instrumented for using their "predicted" values. Time fixed-effects are not reported. PTAwEP means trade agreement with environmental provisions. PTAwCP means trade agreement with climate-related provisions. PTAw/oEP means PTA without environmental provisions.

PTAw/oCP means PTAwEP without climate-related provisions. Variable of interest: PTAwCP as PTA - PTAw/oEP - PTAw/oCP = PTAwEP - PTAw/oCP (with PTAwEP = PTA - PTAw/oEP).

Table A5. Results of FGLS estimates - Causal effect of PTAwCP on Pollutants' emissions (Bootstrapped results)

	Specification (1)			**Specification (2)**			**Specification (3)**		
	CO_2 em.	**CH_4 em.**	**N_2O em.**	**CO2 em.**	**CH_4 em.**	**N_2O em.**	**CO_2 em.**	**CH_4 em.**	**N_2O em.**
Trade openness (instrumented)	0.0124*** (0.0000)	0.0206*** (0.0000)	0.0097*** (0.0000)	0.0123*** (0.0000)	0.0205*** (0.0000)	0.0098*** (0.0000)	0.0128*** (0.0000)	0.0208*** (0.0000)	0.0102*** (0.0000)
Number of PTAw/oEP	0.0004*** (0.0000)	-0.0046*** (0.0000)	0.0625*** (0.0000)	0.0101*** (0.0000)	0.0032*** (0.0000)	0.0651*** (0.0000)	-0.0334*** (0.0000)	-0.0241*** (0.0000)	0.0277*** (0.0000)
Number of PTAwEP	-0.0027*** (0.0000)	-0.0008*** (0.0000)	-0.0055*** (0.0000)	–	–	–	–	–	–
Number of PTAw/oCP	–	–	–	–	–	–	0.0156*** (0.0000)	0.0098*** (0.0000)	0.0134*** (0.0000)
Number of PTAwCP	–	–	–	**-0.0071*** (0.0000)**	**0.0030*** (0.0000)**	**-0.0112*** (0.0000)**	**-0.0142*** (0.0000)**	**-0.0074*** (0.0000)**	**-0.0172*** (0.0000)**
Pop. density (inhabitants/km²)	-0.3258*** (0.1366)	-0.3797*** (0.0001)	-0.3351*** (0.0002)	-0.3777*** (0.0000)	-0.4062*** (0.0001)	-0.3994*** (0.0002)	-0.4425*** (0.0000)	-0.4469*** (0.0001)	-0.4552*** (0.0000)
Per-capita GDP (instrumented)	0.0347*** (0.0000)	0.0344*** (0.0000)	0.0303*** (0.0000)	0.0327*** (0.0000)	0.0335*** (0.0000)	0.0277*** (0.0000)	0.0294*** (0.0000)	0.0314*** (0.0000)	0.0249*** (0.0000)
Constant	-6.238*** (0.000)	-8.392*** (0.0000)	-13.452*** (0.0000)	-6.087*** (0.0000)	-8.313*** (0.4235)	-13.268*** (0.0000)	-5.919*** (0.0000)	-8.207*** (0.0000)	-13.124*** (0.0000)
Fixed-effects: Country and Time	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.991	0.980	0.977	0.991	0.981	0.978	0.991	0.981	0.978
Nb. of observations	2,934	2,934	2,934	2,934	2,934	2,934	2,934	2,934	2,934
Nb. of countries	164	164	164	164	164	164	164	164	164

Notes: Standard errors (in parentheses) are bootstrapped. The symbols (***), (**) and (*) to coefficients means that latter are respectively significant at the 1% level, 5% level and 10% level. The variables: "trade openness" and "per-capita GDP" are instrumented for using their "predicted" values. Time and country fixed-effects are not reported.

PTAwEP means trade agreement with environmental provisions. PTAwCP means trade agreement with climate-related provisions. PTAw/oEP means PTA without environmental provisions. PTAw/oCP means PTAwEP without climate-related provisions. Variable of interest: PTAwCP as PTA - PTAw/oEP - PTAw/oCP = PTAwEP - PTAw/oCP (with PTAwEP = PTA - PTAw/oEP).

Appendix B:

Category of provisions related to Climate Governance

(1) PTA-Provisions directly related to climate change are referring to following items:

Promotion of renewable energy; Promotion of energy efficiency; Cooperation on climate governance; Reduction of GHG emissions; Adaptation to climate change; Ratification or implementation of Kyoto; Ratification or implementation of UNFCCC; Harmonization of climate regulation.

(2) PTA-Provisions indirectly related to climate change are referring to following items:

Exception for the conservation of resources; Cooperation on environmental matters; Should not lower environmental protection; Technical Assistance; Enforcement of environmental measures; Public awareness on the environment; Improvement of environmental protection; Trade in environmental goods; Exception to protection against expropriation; Air pollution; Participation in the adoption of environmental measures; Capacity building related to environment protection; Evidence-based environmental measures; Assistance related to natural disasters; Domestic impact assessment of environmental policies; Investment in environmental research; Monitoring the state of the environment; Differentiated responsibility principle.

Source: Provisions encoded in "TRade and ENvironment Database" – TREND.

Appendix C:

List of countries involved in the study

Albania	Congo	Iran	Myanmar	Suriname
Algeria	Costa Rica	Iraq	Namibia	Swaziland
Angola	Croatia	Ireland	Nepal	Sweden
Argentina	Cuba	Israel	Netherlands	Switzerland
Armenia	Cyprus	Italy	New Zealand	Syria
Australia	Czech	Ivory Coast	Nicaragua	Taiwan
Austria	Denmark	Jamaica	Niger	Tajikistan
Azerbaijan	Djibouti	Japan	Nigeria	Tanzania
Bahamas	Dominica	Jordan	Norway	Thailand
Bahrain	Dominican Rep.	Kazakhstan	Oman	Togo
Bangladesh	Egypt	Kenya	Pakistan	Trinidad and Tobago
Barbados	El Salvador	Korea	Palau	Tunisia
Belarus	Equatorial Guinea	Kuwait State	Panama	Turkey
Belgium	Eritrea	Kyrgyzstan	Paraguay	Turkmenistan
Belize	Estonia	Lao	Peru	Uganda
Benin	Ethiopia	Latvia	Philippines	Ukraine
Bhutan	Finland	Lebanon	Poland	United Arab Emirates
Bolivia	France	Lesotho	Portugal	United States of America
Bosnia and Herzegovina	Gabon	Liberia	Puerto Rico	Uruguay
Botswana	Gambia	Libya	Qatar	Uzbekistan
Brazil	Georgia	Lithuania	Romania	Venezuela
Brunei	Germany	Luxembourg	Russia	Vietnam
Bulgaria	Ghana	Macedonia	Rwanda	Yemen
Burkina Faso	Great Britain	Madagascar	Sao Tome and Principe	Zambia
Burundi	Greece	Malawi	Saudi Arabia	Zimbabwe
Cambodia	Grenada	Malaysia	Senegal	
Cameroon	Guatemala	Mali	Seychelles	
Canada	Guinea	Malta	Sierra Leone	
Cape Verde	Guinea-Bissau	Mauritania	Singapore	
Central African	Haiti	Mauritius	Slovakia	
Chad	Honduras	Mexico	Slovenia	
Chile	Hungary	Moldova	South Africa	
China	Iceland	Mongolia	Spain	
Colombia	India	Morocco	Sri Lanka	
Comoros	Indonesia	Mozambique	Sudan	

Appendix D:

List of PTAwEP - including climate change provisions (CCP)

Trade agreements with climate change provisions (CCP)	Date of Entry in force	Direct CCP	Indirect CCP
GATT	1947	0	1
France-Tunisia Customs Union Convention	1955	0	1
EC	1957	0	1
Yaoundé I	1963	0	1
Canada-US Automotive Products Trade Agreement (APTA)	1965	0	1
Australia-New Zealand Free Trade Agreement	1965	0	1
Yaoundé II	1969	0	1
EC-Turkey Additional Protocol	1970	0	1
Caribbean Community (CARICOM)	1973	0	1
Lomé I	1975	0	1
Australia-Papua New Guinea	1976	0	1
Lomé II	1979	1	1
Tokyo Codes	1979	0	1
Economic Community of Central African States (ECCAS-CEEAC)	1983	1	1
Australia-New Zealand (ANZCERTA)	1983	0	1
Lomé III	1984	1	1
Israel-US	1985	0	1
Canada-US	1988	0	1
Lomé IV	1989	1	1
EC-Hungary	1991	1	1
EC-Poland	1991	1	1
EC-San Marino	1991	0	1
African Economic Community	1991	1	1
Australia-Papua New Guinea	1991	0	1
Caribbean Community (CARICOM)-Venezuela	1992	0	1
Central European Free Trade Agreement (CEFTA)	1992	0	1
Czech-Slovak Republic EFTA	1992	0	1
Czech Republic-Slovakia	1992	0	1
EC Maastricht	1992	0	1
EFTA-Romania	1992	0	1
European Economic Area (EEA)	1992	1	1
Faroe Islands-Norway	1992	0	1
Faroe Islands-Switzerland	1992	0	1
Finland-Latvia	1992	0	1
North American Free Trade Agreement (NAFTA)	1992	0	1
Faroe Islands-Finland	1992	0	1
Bulgaria-EC	1993	1	1
Bulgaria-EFTA	1993	0	1
Common Market for Eastern and Southern Africa (COMESA)	1993	1	1
Czech Republic-EC	1993	0	1
Czech Republic-Slovenia	1993	0	1
EC-Romania	1993	1	1
EC-Slovakia	1993	1	1

Economic Community Of West African States (ECOWAS)	1993	1	0
Slovakia-Slovenia	1993	0	1
Central American Common Market (CACM) Protocol of Guatemala	1993	0	1
Bolivia-Mexico	1994	0	1
Caribbean Community (CARICOM)-Colombia	1994	0	1
Commonwealth of Independent States (CIS)	1994	0	1
Costa Rica-Mexico	1994	0	1
EC Maastricht (15) Enlargement	1994	0	1
Economic and Monetary Community of Central Africa (CEMAC)	1994	1	0
Group of Three	1994	0	1
Hungary-Slovenia	1994	0	1
Israel-PLO	1994	0	1
Kazakhstan-Ukraine	1994	0	1
Moldova-Romania	1994	0	1
Romania-Slovakia	1994	0	1
Ukraine-Uzbekistan	1994	0	1
WTO Agreements	1994	0	1
Bulgaria-Czech Republic	1995	0	1
Bulgaria-Slovakia	1995	0	1
Czech Republic-Lithuania	1995	0	1
EC-Estonia Europe Agreement	1995	1	1
EC-Israel Euro-Med Association Agreement	1995	1	1
EC-Latvia Europe Agreement	1995	1	1
EC-Lithuania Europe Agreement	1995	1	1
EC-Tunisia Euro-Med Association Agreement	1995	1	0
EC-Turkey	1995	0	1
EFTA-Estonia	1995	0	1
EFTA-Latvia	1995	0	1
EFTA-Lithuania	1995	0	1
EFTA-Slovenia	1995	0	1
Georgia-Ukraine	1995	0	1
Bolivia-MERCOSUR	1996	0	1
Bulgaria-Slovenia	1996	0	1
Canada-Chile	1996	0	1
Canada-Israel	1996	0	1
Chile-MERCOSUR	1996	0	1
Czech Republic-Estonia	1996	0	1
Czech Republic-Israel	1996	0	1
Czech Republic-Latvia	1996	0	1
EC-Morocco Euro-Med Association Agreement	1996	1	0
EC-Slovenia Europe Agreement	1996	1	1
Estonia-Slovakia	1996	0	1
Estonia-Slovenia	1996	0	1
Georgia-Turkmenistan	1996	0	1
Israel-Slovakia	1996	0	1
Kyrgyzstan-Uzbekistan	1996	0	1
Latvia-Slovakia	1996	0	1
Lithuania-Poland	1996	0	1

Lithuania-Slovakia	1996	0	1
Lithuania-Slovenia	1996	0	1
Macedonia-Slovenia	1996	0	1
Southern African Development Community (SADC)	1996	0	1
Croatia-Macedonia	1997	0	1
Croatia-Slovenia	1997	0	1
Czech Republic-Turkey	1997	0	1
EC-Jordan Euro-Med Association Agreement	1997	1	1
EFTA-Morocco	1997	0	1
Estonia-Faroe Islands	1997	0	1
Hungary-Israel	1997	0	1
Israel-Poland	1997	0	1
Latvia-Poland	1997	0	1
Mexico-Nicaragua	1997	0	1
Romania-Turkey	1997	0	1
Slovakia-Turkey	1997	0	1
Bulgaria-Turkey	1998	0	1
Central America-Dominican Republic	1998	0	1
Chile-Mexico	1998	0	1
Chile-Peru	1998	0	1
Estonia-Hungary	1998	0	1
Faroe Islands-Poland	1998	0	1
Hungary-Lithuania	1998	0	1
Israel-Slovenia	1998	0	1
Latvia-Turkey	1998	0	1
Slovenia-Turkey	1998	0	1
Bulgaria-Macedonia	1999	0	1
Central America-Chile	1999	0	1
Andean Community-Brazil	1999	0	1
Cuba-Uruguay	1999	0	1
Cuba-Venezuela	1999	0	1
EC-South Africa	1999	1	1
Eurasian Economic Community (EAEC)	1999	0	1
Guatemala-Mexico	1999	1	1
Hungary-Latvia	1999	0	1
Armenia-Kazakhstan	1999	0	1
Poland-Turkey	1999	0	1
Chile-Cuba	1999	0	1
EC-Switzerland Bilaterals I	1999	0	1
Bolivia-Cuba	2000	0	1
Bosnia/Herzegovina-Croatia	2000	0	1
Caribbean Community (CARICOM)-Cuba	2000	0	1
Colombia-Cuba	2000	0	1
Andean Countries-Argentina	2000	0	1
Cotonou Agreement	2000	1	1
Cuba-Ecuador	2000	0	1
Cuba-Mexico	2000	0	1
Cuba-Paraguay	2000	0	1

Cuba-Peru	2000	0	1
EC-Mexico	2000	0	1
EFTA-Macedonia	2000	0	1
EFTA-Mexico	2000	0	1
Israel-Mexico	2000	0	1
Jordan-US	2000	0	1
Mexico-Northern Triangle	2000	0	1
New Zealand-Singapore	2000	0	1
United States-Vietnam	2000	0	1
Bosnia/Herzegovina-Slovenia	2001	0	1
Bulgaria-Estonia	2001	0	1
Bulgaria-Israel	2001	0	1
Bulgaria-Lithuania	2001	0	1
Canada-Costa Rica	2001	0	1
Caribbean Community (CARICOM) revised	2001	0	1
Croatia-EC	2001	0	1
Croatia-EFTA	2001	0	1
EC-Egypt Euro-Med Association Agreement	2001	1	1
EC-Macedonia-SAA	2001	1	1
EFTA-Jordan	2001	0	1
Gulf Cooperation Council (GCC)	2001	0	1
Israel-Romania	2001	0	1
Macedonia-Ukraine	2001	0	1
Pacific Island Countries Trade Agreement (PICTA)	2001	0	1
Tajikistan-Ukraine	2001	0	1
Albania-Macedonia	2002	0	1
Bosnia/Herzegovina-Macedonia	2002	0	1
Bosnia/Herzegovina-Moldova	2002	0	1
Bosnia/Herzegovina-Serbia/Montenegro	2002	0	1
Bosnia/Herzegovina-Turkey	2002	0	1
Brazil-Mexico	2002	0	1
Bulgaria-Latvia	2002	0	1
Algeria-EC Euro-Med Association Agreement	2002	1	1
Central America-Panama	2002	0	1
Chile-EC	2002	1	1
Croatia-Macedonia (amended)	2002	0	1
Croatia-Serbia-Montenegro	2002	0	1
EC-Lebanon Euro-Med Association Agreement	2002	1	1
EFTA-Singapore	2002	0	1
GUAM Organization for Democracy and Economic Development	2002	0	1
Armenia-Estonia	2002	0	1
Japan-Singapore	2002	0	1
Pakistan-Sri Lanka	2002	0	1
Albania-Croatia	2002	0	1
Albania-Kosovo	2003	0	1
Bosnia/Herzegovina-Bulgaria	2003	0	1
Albania-Moldova	2003	0	1
Bosnia/Herzegovina-Romania	2003	0	1

Albania-Romania	2003	0	1
Albania-Serbia	2003	0	1
Bulgaria-Serbia	2003	0	1
Afghanistan-India	2003	0	1
Chile-EFTA	2003	0	1
Chile-Korea	2003	0	1
Chile-US	2003	0	1
China-Hong Kong	2003	0	1
China-Macao	2003	0	1
Economic Cooperation Organization Trade Agreement (ECOTA)	2003	0	1
Macedonia-Romania	2003	0	1
Albania-Bosnia/Herzegovina	2003	0	1
Mexico-Uruguay	2003	0	1
Moldova-Serbia	2003	0	1
Moldova-Ukraine	2003	0	1
Panama-Taiwan	2003	0	1
Romania-Serbia	2003	0	1
Singapore-US	2003	1	1
Albania-Bulgaria	2003	0	1
Australia-Singapore	2003	0	1
Bulgaria-Moldova	2004	0	1
Caribbean Community (CARICOM)-Costa Rica	2004	0	1
Central American Free Trade Agreement (CAFTA)	2004	0	1
Central American Free Trade Agreement (CAFTA)-Dominican Republic	2004	0	1
Andean Countries-MERCOSUR	2004	0	1
Croatia-Moldova	2004	0	1
EFTA-Lebanon	2004	0	1
EFTA-Tunisia	2004	0	1
India-MERCOSUR	2004	0	1
Iran-Pakistan	2004	0	1
Japan-Mexico	2004	0	1
Jordan-Singapore	2004	0	1
Macedonia-Moldova	2004	0	1
MERCOSUR-Southern African Customs Union (SACU)	2004	0	1
Morocco-Turkey	2004	0	1
Morocco-US	2004	0	1
Association of Southeast Asian Nations-China	2004	0	1
India-MERCOSUR	2004	0	1
Australia-Thailand	2004	0	1
Australia-US	2004	1	1
Bahrain-US	2004	0	1
Chile-China	2005	0	1
EFTA-Korea	2005	0	1
Guatemala-Taiwan	2005	1	1
India-Singapore	2005	0	1
Japan-Malaysia	2005	0	1
Korea-Singapore	2005	0	1
Malawi-Mozambique	2005	0	1

MERCOSUR-Peru	2005	0	1
New Zealand-Thailand	2005	1	1
Trans Pacific Strategic EPA	2005	1	1
Belize-Guatemala	2006	0	1
Albania-Turkey	2006	0	1
Agreement Secretariat Environmental Matters FTA	2006	0	1
Central European Free Trade Agreement (CEFTA)	2006	0	1
Chile-Colombia	2006	1	1
Chile-India	2006	0	1
Chile-Panama	2006	0	1
China-Pakistan	2006	0	1
Colombia-US	2006	0	1
Cuba-Mercosur	2006	0	1
D8 PTA	2006	0	1
EFTA-Southern African Customs Union (SACU)	2006	0	1
Iran-Syria	2006	0	1
Japan-Philippines	2006	1	1
Nicaragua-Taiwan	2006	0	1
Oman-US	2006	0	1
Panama-Singapore	2006	0	1
Peru-US	2006	1	1
Chile-Peru	2006	0	1
Association of Southeast Asian Nations-Korea	2006	0	1
Malawi-Zimbabwe	2006	0	1
Brunei-Japan	2007	1	1
Chile-Japan	2007	0	1
Colombia-Northern Triangle	2007	0	1
EC-Montenegro-SAA	2007	1	1
EFTA-Egypt	2007	0	1
El Salvador-Honduras-Taiwan	2007	1	1
Indonesia-Japan	2007	1	1
Israel-Mercosur	2007	0	1
Japan-Thailand	2007	1	1
Korea-US	2007	1	1
Malaysia-Pakistan	2007	0	1
Mauritius-Pakistan	2007	0	1
Panama-US	2007	0	1
Bosnia/Herzegovina-EC-SAA	2008	1	1
Canada-Colombia	2008	0	1
Canada-EFTA	2008	0	1
Canada-Peru	2008	0	1
CARIFORUM-EC EPA	2008	1	1
Chile-Ecuador	2008	0	1
China-New Zealand	2008	0	1
China-Singapore	2008	1	1
Colombia-EFTA	2008	0	1
Cote d'Ivoire-EC EPA	2008	0	1
EC-Serbia-SAA	2008	1	1

Gulf Cooperation Council (GCC)-Singapore	2008	0	1
Japan-Vietnam	2008	1	1
Montenegro-Turkey	2008	0	1
Peru-Singapore	2008	0	1
Association of Southeast Asian Nations-Japan	2008	0	1
Australia-Chile	2008	0	1
MERCOSUR-Southern African Customs Union (SACU)	2008	0	1
Belarus-Serbia	2009	0	1
Canada-Jordan	2009	1	1
Chile-Turkey	2009	1	1
China-Peru	2009	1	1
EFTA-GCC	2009	0	1
EFTA-Serbia	2009	0	1
India-Korea	2009	1	1
Japan-Switzerland	2009	1	1
Malaysia-New Zealand	2009	1	1
Serbia-Turkey	2009	0	1
Association of Southeast Asian Nations Australia New Zealand FTA	2009	1	1
Association of Southeast Asian Nations-India	2009	0	1
Chile-Turkey	2009	1	1
Albania-EFTA	2009	0	1
Canada-Panama	2010	0	1
Chile-Malaysia	2010	1	1
China-Costa Rica	2010	1	1
Costa Rica-Singapore	2010	0	1
EC Korea	2010	1	1
EFTA-Peru	2010	0	1
EFTA-Ukraine	2010	0	1
Hong Kong-New Zealand	2010	0	1
EC (28) Enlargement	2011	1	1
Chile-Vietnam	2011	1	1
Commonwealth of Independent States	2011	0	1
Costa Rica-Peru	2011	0	1
EFTA Hong-Kong	2011	1	1
EFTA Montenegro	2011	1	1
Guatemala-Peru	2011	0	1
India-Japan	2011	1	1
India-Malaysia	2011	0	1
Japan-Peru	2011	1	1
Korea-Peru	2011	1	1
Mauritius-Turkey	2011	0	1
Montenegro-Ukraine	2011	0	1
Panama-Peru	2011	0	1
Central America-Mexico	2011	0	1
Australia-Malaysia	2012	1	1
Central America-EC	2012	1	1
Colombia-Peru-EC	2012	1	1
Korea-Turkey	2012	1	1

Chile-Hong Kong	2012	0	1
Panama-US Environment	2012	0	1
Korea-US Environment	2012	1	1
Canada-Honduras	2013	1	1
Chile-Thailand	2013	1	1
Colombia-Costa Rica	2013	0	1
Colombia-Israel	2013	0	1
Colombia-Korea	2013	1	1
Colombia-Panama	2013	1	1
New Zealand-Taiwan	2013	1	1
Bosnia/Herzogovina-EFTA	2013	1	1
China-Switzerland	2013	0	1
Central America EFTA	2013	1	1
Colombia-US Environment	2013	1	1
Australia-Japan	2014	0	1
Canada-Korea	2014	0	1
EC-Georgia	2014	1	1
EC-Moldova	2014	1	1
EC-Ukraine	2014	1	1
Mexico-Panama	2014	0	1
Agreement on Trade Facilitation	2014	0	1
China-Korea	2014	1	1
Australia-Korea	2014	1	1
Malaysia-Turkey	2014	1	1
Australia-China	2015	0	1
EC-Singapore	2015	1	1
Transpacific Partnership	2015	1	1
Korea-New Zealand	2015	1	1
Korea-Vietnam	2015	0	1
Belarus-Kazakhstan-Russia-Vietnam	2015	1	1
Honduras-Peru	2015	0	1
Japan-Mongolia	2015	1	1
EC-Kosovo-SAA	2015	1	1
Canada-EC (CETA)	2016	1	1
Canada-Ukraine	2016	0	1
EC-Vietnam	2016	1	1
EFTA-Philippines	2016	1	1

Notes: Direct CCP: PTA with Provisions directly related to climate change; Indirect CCP: PTA with Provisions indirectly related to climate change. These PTA encoding refer to provisions detailed in Appendix C. Thus (1) indicates that PTA includes Direct CCP or Indirect CCP; and (0) otherwise.

Source: TREND database.

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

Pascal

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