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This version: November 2023.

Abstract:

This study examines the impact of trade agreements and their specific provisions on the decline of marine fisheries resources. Using global data on the status of fish stocks and a comprehensive dataset of environmental provisions from trade agreements signed between 1947 and 2018, the impact of signing a free trade agreement and of the presence of fishery-related provisions on the status of fish stocks is estimated. To address potential endogeneity problems associated with fisheries-related provisions, we use a difference-in-differences (DID) propensity score matching method. Our results show that while trade agreements tend to have a negative impact on the status of fish stocks, the inclusion of fisheries-related provisions offsets this negative impact among signatory countries. However, our results indicate that these provisions do not encourage the adoption of better resource management practices but rather tend to reduce trade opportunities.

Keywords: Trade agreements, environmental provisions, natural resources, fisheries.

JEL codes: F18, Q22.

1. Introduction

Fisheries are increasingly being recognized for their essential contribution to global food security and nutrition in the twenty-first century (FAO (2022)). However, marine fishery resources are declining. In 2017, 94% of the world's marine fish stocks were maximally exploited or overfished, and the proportion of fish stocks that remained within biologically sustainable levels declined from 90% in 1974 to 64.6% in 2019 (FAO (2020)). This decline threatens the equitable and sustainable food security of a growing world population. Moreover, it has implications beyond collapsed populations, for marine ecosystems and biodiversity (Pauly et al. (1998)).

Many policies have been implemented to mitigate the decline of fishery resources. Among the available instruments, trade policies (Fugazza and Ok (2019); Costello et al. (2021)) and environmental provisions contained in trade agreements could be credible complementary tools for addressing this nontrade issue.[1] Indeed, because fishery products are largely traded (Asche et al. (2015)), trade policy exerts a wide influence on the sector (FAO (2020)). In addition, trade agreements contain an increasing number of provisions addressing a wide range of nontrade issues (Mattoo, Rocha, and Ruta (2020)) including environmental issues. The purpose of environmental provisions is usually the promotion of environmental cooperation and the provision of a level-playing field (Francois et al. (2022)). In our context, fishery-related provisions aim to mitigate the possible negative impacts of trade liberalization on fishery resources and marine ecosystems.

In some instances, environmental provisions have been shown to be effective in achieving their stated objectives. Provisions tend to mitigate the negative effects of trade liberalization on greenhouse gas emissions (Baghdadi, Martinez-Zarzoso, and Zitouna (2013); Apergis and Payne (2020)), air pollution (Zhou, Tian, and Zhou (2017); Martínez-Zarzoso and Oueslati (2018); Brandi et al. (2020)), and

[1] These include quantity-based policies -- such as marine protected areas (Edgar et al. (2014)), fisheries management practices and quotas (Costello, Gaines, and Lynham (2008)), seasonal closures (Bostedt et al. (2020)) -- and price-based policies, such as fishery taxes (Clark (2006)) and subsidies (Bayramoglu, Copeland, and Jacques (2018); Costello et al. (2021)).

deforestation (Abman, Lundberg, and Ruta (2021)). For fisheries and marine biodiversity, however, no such evidence has been provided[2].

This paper addresses the following question: are the fishery-related provisions contained in trade agreements an effective tool for the mitigation of trade-related marine biodiversity loss and decline of marine fisheries resources? We answer this question by providing a quantitative assessment of the impact of fishery-related provisions on the status of fish stocks and by investigating the mechanisms through which this impact occurs. We examine whether the inclusion of fishery-related provisions in a trade agreement exerts the expected positive impact on fish stock status in the signatory countries.

We use the marine trophic level (Pauly et al. (1998)) to measure the status of fish stocks on a global scale. The marine trophic level measures the average trophic level of catches in each area (whether a country or an Exclusive Economic Zone). Crucially, this measure captures not only catches but also the dynamics of the ecosystem. This measure was identified by the Conference of the Parties to the Convention on Biological Diversity (2004) as an indicator of functional biodiversity, and it is used also in economic analyses (e.g., Chesnokova and McWhinnie (2019)). For the specific content of trade agreements, we rely on the Trade and Environment Database (TREND) (Morin, Dür, and Lechner (2018)) (726 agreements from 1947 to 2018) which is the most comprehensive dataset on environmental provisions in RTAs (Brandi et al. (2020)). From this dataset, we identify the set of trade agreements containing a fishery-related provision (FRP) (175 agreements).

Our empirical strategy is based on the comparison of the marine trophic level of signatories of a trade agreement that includes an FRP with that of an agreement that does not include an FRP. The main empirical difficulty inherent in this strategy lies in the endogeneity of FRPs. As the inclusion of an FRP may be endogenous to the pre-agreement fish stock status of signatories, we mitigate this bias by estimating the impact of the provision on a matched sample in which both those agreements with and without an FRP can be compared. Methodologically, our study is similar to a recent article that focuses on the effectiveness of environmental provisions in preventing deforestation (Abman, Lundberg, and Ruta (2021)) which also uses this “matched difference-in-difference” strategy.

[2] In 2009, the trade value of seafood exceeded the combined trade value of sugar, maize, coffee, rice, and cocoa (Asche et al. (2015)). In 2018, 38% of total fisheries and aquaculture production was traded internationally (FAO (2020)).

Two main findings emerge from our analysis. First, we estimate that FRPs mitigate the negative impact of trade liberalization on the status of fish stocks. While trade agreements tend to deteriorate fish stock status, the presence of FRPs tends to compensate for the negative effect of trade liberalization. In terms of magnitude, we estimate that including an FRP in a trade agreement has a sizable effect on fish stock status, equivalent to the negative effect of trade liberalization. Our estimations show that trade agreements containing FRPs do not deteriorate fish stock status, in contrast to those without FRPs, which do. Most of the effect of FRPs on fish stock status occurs 5 to 8 years after the agreement is signed. This broad result holds when controlling for other domestic and international policies (marine protected areas, fishery quotas, number of international environmental agreements signed, etc.). Conversely, the "depth" of such provisions[3] does not seem to shape their effectiveness.

Second, this good news is somewhat tempered by examining the mechanisms through which this effect occurs. On the one hand, we estimate that FRPs reduce fish landings and fish exports. On the other hand, we do not find a significant effect of FRPs on fishing techniques (e.g., proportion of fish caught by trawling, which is particularly harmful to biodiversity). This suggests that provisions do not foster the adoption of better resource-management practices but rather serve to reduce trade opportunities.

All these results are robust to the use of alternative estimation strategies, alternative sets of provisions, alternative matching procedures, and other estimation issues.

Our article contributes to the literature in several ways. First, to the best of our knowledge, our article is the first to assess the effectiveness of environmental provisions on biodiversity, in particular on marine biodiversity. Our analysis also complements existing research that assesses the effectiveness of environmental provisions on natural resources (Abman, Lundberg, and Ruta (2021)) by considering another renewable resource other than forests, namely, fisheries, and by considering heterogeneous treatment effects. Our main outcome variable is original and rich, as it is both an indicator of sustainable fisheries and marine biodiversity.

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[3] i.e., their number, as an agreement may contain several different FRPs.

Second, our analysis contributes to the literature on the impact of trade on the sustainability of fishery resources. Theoretically, trade can lead to the overexploitation of renewable resources under open-access conditions (Brander and Taylor (1997a); Brander and Taylor (1997b); Brander and Taylor (1998); Rus (2012); Rus (2016); Takarada, Dong, and Ogawa (2013)) and even to the complete depletion of a resource (Gars and Spiro (2018)). Empirically, international trade and export opportunities increase the likelihood of fishery collapse (Eisenbarth (2022)), but better institutions and governance serve to shape this relationship (Erhardt (2018)). Our results confirm that export opportunities created by cooperative trade agreements and fish stock depletion are closely linked and correlate with each other.

Finally, our work has important policy implications. Our paper shows that the content of trade agreements is not sufficient for the alignment of trade-related objectives and environmental concerns. The environmental improvement for signatories in a trade agreement including environmental provisions occurs at the expense of trade opportunities, thus trade flows decline.

The rest of this article is structured as follows. The next section details the data. The empirical strategy is presented in Section 3. The main results are displayed in Section 4, and Section 5 details the robustness checks. Finally, Section 6 offers concluding remarks and discusses policy implications.

2. Data

2.1 Dependent variable: marine trophic level

To capture the status of fish stocks, we rely on the Marine Trophic Level (MTL) developed by (Pauly et al. (1998)) and provided by Sea Around US (Pauly, Zeller, and Palomares (2015)). This measure of fish stock condition has been used in the empirical economics literature (e.g. Chesnokova and McWhinnie (2019)) because of its global coverage, its consistency across countries and years, and its importance to the environmental science literature (Pauly et al. (1998)). As mentioned earlier, MTL is also a biodiversity indicator and was included by the Conference of the Parties to the Convention on Biological Diversity (2004) as one of the eight alternative indicators of biodiversity loss. MTL measures functional biodiversity: unlike specific biodiversity, which can be measured by species diversity (e.g., number of endangered species), functional biodiversity considers the structure and functioning of ecosystems through the abundance and role of different species in the food chain (Gascuel (2019)).

Each species of fish can be associated with a trophic level (TL), indicating where this species is in the food chain. The TL begins with 1 for algae by definition, and then each species' trophic level is 1+ the average trophic level of the species on which it feeds: the trophic level of herbivorous fish is 2, and so on. Cod are at the 4.4 level on average, and the largest predators, large sharks and rorquals, can exceed level 5.

The species-specific trophic level can be aggregated at the level of exclusive economic zone (EEZ) z by taking the average of the trophic level of each species s as weighted by the fish landings of the fish species s:

$$MTL_{zt} = \frac{\sum_s TL_s \, Y_{zst}}{\sum_s Y_{zst}}$$

where TL_s is the trophic level of species s, and Y_{zst} is the landings of species s in EEZ z at time t, as provided by Sea Around Us.

A decline in MTL indicates a decline in the proportion of the fish population that resides at the top of the food chain, i.e., mainly large fish, which have a longer reproductive cycle. This phenomenon, referred to as "fishing down marine food webs" (Pauly et al. (1998)), results in catches gradually occurring at lower marine trophic levels, which is the main characteristic of overexploited fish stocks (Pauly, Zeller, and Palomares (2015)). The average trophic level of global catches has declined from above 3.3 in the early 1950s to below 3.1 in the 1990s (Pauly et al. (1998)). Pauly et al. (1998) revealed the overall impact of fisheries not only on the abundance of a given exploited stock but also on the structure of marine ecosystems at the global level. This impact has also been observed in European fisheries. Between 1985 and 2010, the maximum size of the species found on the seafloor decreased from 90 to 74 cm, illustrating the decline of large predatory species in favor of smaller species. This phenomenon has been observed in many ecosystems around the world (Gascuel (2019)).

Our objective is to measure whether the implementation of a Regional Trade Agreement (RTA) has a negative effect on MTL at the agreement level, i.e., for all signatory countries, and whether its fishery-related provisions help to mitigate this negative effect. Thus, we aggregate this index at the country level and then at the agreement level. To aggregate this index at the country level

(Chesnokova and McWhinnie (2019)), we take the average of the MTLs of each country's EEZs, weighted by fish landings in each EEZ:

$$MTL_{it} = \frac{\sum_{z \in Z_i} MTL_{zt}\, Y_{zt}}{\sum_{z \in Z_i} Y_{zt}}$$

where MTL_{it} is the Marine Trophic Level of country i at time t, Z_i is the set of all EEZs belonging to country i, and Y_{zt} is the fish landings in EEZ z at time t.

At each step, we excluded the distant EEZs of countries and mainly considered the different coastal EEZs off the mainland of each country. This is a conservative assumption that is justified by the fact that overseas territories are not always included in trade agreements. In the case of the United Kingdom, for example, overseas territories have the option of requesting a treaty extension, which is not always granted.

The agreement-specific MTL is constructed by aggregating the MTLs of each signatory country, as weighted by their fish catches:

$$MTL_{gt} = \frac{\sum_{i \in I_g} MTL_{it}\, Y_{it}}{\sum_{i \in I_g} Y_{it}}$$

where MTL_{gt} is the Marine Trophic Level of agreement g at time t, I_g is the set of countries that have signed agreement g, MTL_{it} is the MTL of country i at time t, and Y_{it} is the fish landings of country i, which is the sum of the country's landings in all its EEZs.

The aggregation of EEZ-specific MTLs assigns important weight to the fish catches of each country. Indeed, the collapse of a small fishing country's stock may not have a significant effect on the aggregate MTL of an agreement among many larger fishing countries. Nevertheless, this approach allows us to interpret the variation in fish stock sustainability among those countries that signed the agreement. If the average MTL of the signatory countries does not decrease, then it means that the group of signatory countries has a good status of fish stocks even though some of them may be individually facing a decrease in their MTL.

Dynamics of the MTL

Figure 1 plots the MTL of the top 4 fish-harvesting countries and the world average over the last 50 years. Over that time, the world MTL decreased during two waves, one in the 1960s and one in the 1980s, indicating unsustainable exploitation patterns. However, the evolution of MTL varies by country. For example, Japan experienced a collapse in the 1980s and 1990s but now has an MTL close to its original level. Therefore, the evolution of the national MTL varies greatly depending on the exploitation regime and resource management of the country. That is why it makes sense to determine the impact of the implementation of a trade agreement and its environmental provisions on the MTL. Figure 2 shows the evolution of quantities harvested around the world. Total annual catches reached a peak in the 1970s and again at the end of the 1990s and have continued to decrease since then.

2.2 Trade agreements and environmental provisions

Recent trade liberalization shifted from multilateral to bilateral and regional fronts. Recent trade agreements are also deeper agreements that tackle beyond-borders policy areas. RTAs often go beyond the levels of commitment agreed to in the WTO (Mattoo, Rocha, and Ruta (2020)). In recent years, the scope of RTAs has been broadened, increasing from an average of 8 to 17 policy areas covered since the 1950s. The deepening of RTAs followed an extensive process of establishing new policies as well as an intensive process of implementing new specific commitments within existing policy areas (Mattoo, Rocha, and Ruta (2020)). Mattoo, Rocha, and Ruta (2020) highlight the wide diversity of provisions and the difficulty to identifying their effect. In addition, provisions differ in their enforcement mechanisms, and they may not have the same impact depending on the initial level of regulation prior to the RTA.

To identify fishery-related provisions in trade agreements, we use the Trade and Environment Database (TREND) (Morin, Dür, and Lechner (2018)). This is the most comprehensive and fine-grained dataset on environmental provisions in RTAs (Brandi et al. (2020))[4]. It is based on trade agreements provided by the Design of Trade Agreements (DESTA) dataset, which is by far the most comprehensive collection of RTAs (Dür, Baccini, and Elsig (2014)). It contains 726 RTAs that were signed between 1947 and 2018.

[4] An alternative source would be the Deep Trade Agreement database provided by the World Bank, including 283 Preferential Trade Agreements signed between 1957 and 2016, and their provisions grouped into seven categories. We preferred to rely on the TREND database because (i) it accounts for a greater number of trade agreements and (ii) the provisions are coded with more detail, enabling to precisely identify fishery-related provisions.

In this sample of agreements, Morin, Dür, and Lechner (2018) identify the set of provisions included in the agreements, including environmental provisions. For our study, we identify the provisions related to fisheries to empirically evaluate the impact of these specific provisions on the status of fish stocks. Table 1 provides an overview of the benchmark set of provisions that we consider in the analysis. The first column displays the provision identifier from Morin, Dür, and Lechner (2018). For the empirical analysis, in the second column, we classified the provisions into five types to assess their potentially heterogeneous effects The third column displays the number of agreements (out of 726) that are related to a specific provision. The last column displays the name of the provision.

Using this set of provisions, Figure 3 plots the number of RTAs and the number of RTAs with fishery-related provisions in our sample, ranked by the year of signature of the RTA, and shows the increase in the number of RTAs since the 1990s. Almost all recent RTAs include an FRP.

Panel A in Table 2 shows some statistics on the TREND sample of trade agreements with fishery-related provisions. Out of the 726 RTAs, we consider that 175 of them include a fishery-related provision. Together, these 175 RTAs include 322 provisions, meaning that each RTA with fishery-related provisions includes slightly fewer than 2 provisions.

Based on our classification of the provisions into five types (second column in Table 1), Figure 4 shows the composition of fishery-related provisions (detailed in Table 2). It plots the share of each type for each year in the total number of provisions in all agreements signed in that particular year. Excluding the first years in the sample, provisions related to fishery regulation have become the major type of provisions, while the importance of species and ecosystem protection has declined over time. Moreover, the regulation of subsidies harmful to the environment has only recently been included in RTAs, and very few agreements have included at least one so far.

2.3 Additional data

We also consider several control variables for individual countries: GDP (in current USD) as provided by the World Bank to account for the level of development of countries; the OECD classification to distinguish between developed and developing economies; fish catches (in tons) as provided by Sea Around US; exports of fish products (in current USD) as provided by FAO, and protected marine areas as provided by the International Union for Conservation of Nature. We deflate all the variables in value by the US consumer price index for 2010 (from the World Development Indicators).

3. Methodology

We adopt a matched agreement-level approach that estimates the impact of RTAs and an FRP on fish stock status, accounting for the potential endogeneity of fishery-related provisions. Our approach is similar to that of Abman, Lundberg, and Ruta (2021) regarding the effectiveness of environmental provisions in RTAs in preventing deforestation.

3.1 General model

We start by examining the effect of fishery-related provisions included in RTAs on the aggregated fish stock status and other outcomes in all the signatory countries (i.e., at the agreement level). We thus aggregate in a panel dataset the outcomes and controls at the agreement-year level.

The effects of fishery-related provisions are estimated using the following general specification at the RTA g x year t level:

$$y_{gt} = \alpha_0 + \alpha_1 1[PostRTA_{gt}] + \alpha_2 (1[PostRTA_{gt}] \times FRP_g) + \alpha_3 C_{gt} + \lambda_t + \lambda_g + \varepsilon_{gt} \quad (1)$$

This model estimates the joint impact of signing RTAs and fishery-related provisions on the agreement-level MTL in period t for all signatories of agreement g.

$\mathbf{1}[PostRTA_{gt}]$ is a dummy variable that is equal to 1 after the implementation of the agreement and 0 otherwise. FRP_g denotes the general measure of the presence of fishery-related provisions in agreement g. Empirically, this variable is a dummy that is equal to 1 if the agreement includes at least one FRP and 0 otherwise. We focus on the interaction between agreement implementation and the existence of FRPs in that agreement. In the following, we also estimate the impact of the number of provisions on the agreement-level MTL.

A set of controls at the agreement-year level, $\boldsymbol{C_{gt}}$, are included to capture other determinants of MTL (these variables are also aggregated at the agreement-year level). For instance, as fish stocks evolve through the reproduction of fish and fish catches, stocks in a particular period depend on the previous levels of stocks. To represent these dynamics of fish stocks, we include in $\boldsymbol{C_{gt}}$ a lagged variable for the MTL, with a lag of 2 years, $MTL_{g(t-2)}$.

We include year and agreement fixed effects to address unobserved heterogeneity. The year fixed effect absorbs trends in variables across all agreements, and the agreement fixed effect ensures that the estimates are derived from variation across time for the set of countries that signed the agreement. Note that the unconditional effect of fishery-related provisions cannot be included and estimated, as it is absorbed by the agreement fixed effect. ε_{gt} denotes the error term.

In this general model, α_1 measures the impact of the RTA on the agreement-level outcome (MTL), whereas α_2 captures the differential effect of the presence of fishery-related provisions on the outcome of interest. Focusing on MTL, in line with existing evidence, we expect to estimate α_1 <0, which suggests a negative impact of trade liberalization on fish stock status. Importantly, estimating a significant and positive α_2 would mean that the presence of fishery-related provisions works to increase fish stock status and counteracts the unconditional effect of trade liberalization. In that case, the fish stock status would decrease less, ceteris paribus, after trade liberalization if the RTA includes an FRP. In that specification, the net effect of trade liberalization and fishery-related provisions is obtained by adding α_1 and α_2. Regarding inference, we cluster the standard errors at the agreement level.

3.2 General dynamic model

In addition to this general model, we also estimate a dynamic version of the model, in which we allow the FRP to have time-varying effects. After signing the RTA, the FRP may affect fish stock status and other outcomes with some delay. We thus transition from a static version of the model (identifying the average effect across years) to a dynamic model:

$$\mathrm{y}_{gt} = \alpha_0 + \alpha_1 1\left[PostRTA_{gt}\right] + \sum_{\tau=-5}^{15} \delta_\tau\left(1\left[PostRTA_{gt}\right] \times FRP_g \times [t=\tau]\right) \\ + \alpha_3 C_{gt} + \lambda_t + \lambda_g + \varepsilon_{gt}. \qquad (2)$$

where τ denotes both the time since RTA signing ($\tau > 0$) and the time before RTA signing ($\tau < 0$). In this specification, our main interest is in the set of $\{\delta_\tau\}_{\tau=-5,\dots,15}$ that identify the pre-treatment and post-treatment effects of the FRP.

3.3 Endogeneity of the provisions: A matching approach

The main econometric issue in our models is the endogeneity of the FRP in the signed RTA. Indeed, a country may be interested in including fishery-related provisions in an RTA because its fishery stocks are depleting, and they want to protect them from increased exploitation pressure. As a result, the presence of an FRP is not random across agreements.

To correct this endogeneity issue, we use the difference in differences (DID) matching method (Baghdadi, Martinez-Zarzoso, and Zitouna (2013); Abman, Lundberg, and Ruta (2021)). First, we match the agreements that include a fishery-related provision with those agreements without a fishery-related provision according to their probability of including an FRP. Then, we estimate a DID model on the set of matched agreements. The matching procedure excludes non-credible counterfactual RTAs (without FRPs) from the sample.

First, we estimate the propensity score for the inclusion of FRPs in the cross-section of agreements through a regression on all RTAs included in the TREND database. This corresponds to the estimation of:

$$FRP_g = F(\beta_0 + \beta X_g)$$

with FRP_g set as the general measure of the presence of fishery-related provision in agreement g and $\boldsymbol{X_g}$ as a set of covariates describing the characteristics of the agreement and the countries signing it. In our case, $\boldsymbol{X_g}$ includes the covariates that translate the propensity for the countries signing the agreement to include an FRP. Therefore, it includes the log of the number of signatories, the log of the squared year of signature, the quantities fished the 5 years before the signature of the agreement by all signatories, the exports of fishery products from all signatories in the 5 years preceding the agreement and the sum of marine protected areas of all signatories.

These variables capture in particular political economy motives to include FRP in trade agreements, such as the importance of the fishery sector in signatory countries and its potential lobbying power on governments. Indeed political economy motives have been shown to be an important driver for the inclusion of environmental provisions (Lechner (2016); Morin, Dür & Lechner (2018)). Beyond political economy motives, other reasons to include environmental provision in a trade agreement are (i) to provide exceptions to trade liberalization for environmental reasons, (ii) to support environmental policy objectives, sometimes to improve compliance with environmental treaties and (iii) to promote environmental cooperation (Francois et al, (2022)).

As our main measure, we use FRP_g which is a dummy equal to 1 if the agreement includes at least a fishery-related provision and 0 otherwise, and we use a logit estimator to estimate this equation. Table A2 in Appendix provides the logit estimation results. Column (1) is the benchmark estimation and is the support of most of the results hereafter.[5] Note also that including a wide array of observables in this estimation also reduces the probability to have a selection issue due to unobservables.

Once β_0 and β are estimated, propensity scores are derived for each agreement, capturing the probability that this specific agreement includes a fishery-related provision. Appendix B provides supporting results to confirm the matching quality. First, Figure B1 plots the estimated propensity scores for the two groups of agreements (with and without FRPs). On average, propensity scores are larger for those agreements that contain a fishery-related provision than for agreements that do not include these provisions. Second, Figure B2 plots the trends of MTL for both treated and control agreements in the unmatched and matched samples. Whereas the parallel trends assumption is violated in the unmatched sample, the assumption is likely to hold in the matched sample.

After estimating the propensity score of each agreement to include FRPs, we match each agreement that includes an FRP with an agreement that has the closest propensity score but does not include an FRP. This allows the matching of agreements including FRPs with neighboring agreements that do not include FRPs. We then run the regressions of Equations (1) and (2) on the set of matched agreements.

[5] To check the robustness of results, used in section 5, we include additional variables to explain the likelihood of including FRP in trade agreements (Table A2, col.2 and onwards).

Characteristics of this matched sample. Panel B in Table 2 provides some statistics regarding the matched sample. On average, we can follow trade agreements 15 years after signature, the median RTA is signed in 1984, and an important number of agreements are signed by the EU.

4. Results

4.1 Impact of provisions on MTL

Average impact of FRPs on MTL

Table 3 presents the baseline results derived from the estimation of Equation 1, which focuses on the impact of the existence of an FRP. Using the matched sample, trade liberalization can be seen to decrease the average MTL of signatories, controlling for the lagged MTL level (Column 1). However, this negative effect of trade liberalization on fishery stock status is dampened for agreements that include a fishery-related provision (Column 2). Whereas the average trade agreements decrease fish stock status by 1% (Column 4), those agreements that include FRPs do not result in such a decrease and drive no change in fish stock status (compared to the counterfactual). The inclusion of fishery-related provisions compensates for the decrease in MTL. This result holds across specifications controlling for other determinants of MTL at the agreement level, i.e., when controlling GDP level and the change in marine protected areas.

Marine protected areas have an unexpected negative and significant sign on MTL in some specifications, while its coefficient is close to zero. It should be noted that the environmental constraints imposed on marine protected areas are usually low, and those areas including a ban on fishing are extremely limited (Gascuel (2019)).

The main explanatory variable of the specification is the lagged level of MTL, which leaves almost no variance and no potential pathway for trade agreements or FRPs to exert an impact on stocks. When this demanding assumption is relaxed in the specification and the 5-year lag of the MTL level is controlled (Column 4), the point estimates are larger, and their significance levels are unaffected. The main result is confirmed in this specification: the presence of an FRP offsets the decline in fish stock status from trade liberalization.

Dynamic impact of an FRP on MTL

Figure 5 plots the dynamic response of fishery stocks to the inclusion of FRPs based on the estimation of Equation 2. Methodologically, we allow the inclusion of FRPs to exert a delayed response over time and to have an anticipated effect. On the matched sample, we allow the fish stock status response to FRPs to be heterogeneous over time. Figure 5 plots the OLS effect per year prior and after treatment. We find that the positive impact of FRPs on fish stock status mainly comes into play approximately 5 to 9 years after the RTA signature and FRP inclusion. The average positive impact of an FRP is driven by a medium-run effect. In addition, we find that there is no clear pre-treatment effect.

This medium-run effect may be determined by various factors. First, trade agreements take time to be implemented. Whereas we identify the signature year, the proper implementation may happen a few years after signature. Second, if FRP generate changes in behavior (such as fishing practices), these changes are not immediate either. Third, fish stock status is the result of dynamic ecological process and adjustments take time: there is a large autocorrelation over time in MTL level.

4.2 Potential mechanisms: impact of provisions on other outcomes

Whereas trade agreements tend to decrease MTL, the impact of fishery-related provisions almost offsets this negative impact. There are two broad ways of explaining this result: provisions either reduce trade opportunities (counteracting the RTA effects) or foster the adoption of better fishery resource management practices without affecting trade opportunities. We investigated both potential mechanisms.

Fish catches.

Figure 6 plots the time-varying effect of FRPs on fish catches. We estimate that FRPs decreases fish catches on average, and the main effect occurs 5 to 10 years after the RTA signature, which is in line with the effect on MTL.

Fish exports.

Figure 7 plots the time-varying effect of FRPs on fish exports. We estimate that FRPs massively decreases fish exports on average. The treatment effect associated with an FRP is sizable, and the main coefficient is close to -0.1. Exports are decreased by 10% in those RTAs that contain FRPs compared to those that do not.

Fishing technology.

Figure 8 investigates the impact of FRPs on fishing techniques. We use data on the fish caught by trawling, measured as the percentage of a country's fish that were caught by bottom or pelagic trawling, which is a procedure where a fishing net is pulled through the water behind a boat. If better resource management practices are incentivized by FRPs, this should be reflected by a decrease in the share of fish caught by trawling. Indeed, this fishing technique is particularly harmful to marine biodiversity. The trawl favors short-lived species with high turnover that are capable of reproducing quickly and recolonizing the environment after the passage of a trawl. Fishing by trawling has contributed to the transition from an ecosystem dominated by demersal fish to one dominated by mollusks (that are on lower food webs). The adverse impacts of trawling on marine ecosystems include a reduction in the productivity of these ecosystems and the homogenization of habitats, as nets have a large bycatch impact and may harm non-target species (Gascuel (2019)). These impacts have contributed to the decrease in the state of fish stocks in marine ecosystems. Figure 8 shows no significant change in the share of fish caught by trawling after an FRP. The results are mostly non-significant and point toward no increase to a slight increase. Overall, we infer that an FRP tends to decrease catches and fish exports but does not lead to a change in fishing techniques. FRPs are thus effective in increasing MTL by simply counteracting trade liberalization effects.

4.3. Omitted Variables

Omitted Variables: Other environmental provisions.

The existence of an FRP and other environmental provisions, within a single agreement, is highly correlated (Corr.= 0.835, N=726). This represents a threat to the validity of our estimation, as the effect of FRPs on fish stock status could also result from the existence of other provisions related to environmental topics and concerns.

Environment-related provisions (ERPs) are thus an omitted variable in our main specification. Table 4 challenges our main result by including the interaction between trade liberalization and a dummy that captures whether the agreement includes an ERP, as well as the interaction between the existence of any FRP and trade liberalization. We consider the existence of an ERP that excludes FRPs (Columns 1 to 3). The results suggest that the differential effects associated with an FRP are not threatened by the inclusion of an ERP in the same agreement. Across specifications, most results confirm that fish stock status improves when trade agreements include an FRP.

Beyond trade agreements, Columns 4 to 6 explore the impact of FRPs controlling for the existence of International Environment Agreements (IEAs) signed by countries. Trade agreement signatories may also be IEA signatories, which specifically target environmental issues. The change in MTL could then be driven by IEAs signed by trade agreement signatories. We do not observe this pattern: the positive impact of FRPs on fish stock status is unaffected when controlling for the number of IEAs signed by the trade agreement signatories.

Overall, our results suggest that the effect of FRPs is positive and significant. If there is any negative effect of trade liberalization on fishery stock status, FRPs reduces this impact, even if the agreement also includes other environmental-related provisions or if signatories are also engaged in international environmental agreements.

Omitted Variables: Other domestic regulations.

In addition to provisions included in international trade agreements, changes in fish stock status and fishery outcomes could be related to changes in domestic regulations that are unrelated to trade issues. Indeed, there is a global trend toward the protection of the environment, and this is occurring at the same time as the increase of provisions in trade. In addition, we cannot exclude the idea that both types of regulations (domestic, unrelated to trade and trade-related regulations) are correlated via, for instance, increasing revenues and demand for protection. Controlling for changes in other sources of regulation is thus important.

Table 5 verifies that our results are not determined solely by changes in other regulations at the agreement level. We consider five measures of domestic regulations outside of trade. First, we allow the impact of trade liberalization to have a differential impact due to provisions and an increase in marine protected areas (aggregated at the agreement level)[6]. National governments could indeed unilaterally decide to increase marine protected areas, which would result in a change in fishing efforts. Second, we allow the effect of trade liberalization to vary with changes in GDP (aggregated at the agreement level). This measure serves as a proxy for national, unrelated to trade, demand for environmental regulation. For a given trade liberalization agreement, results imply that the initial

[6] As the specification includes an interaction term between trade liberalization and other regulations, the coefficient on the "Post RTA" variable may be hardly interpretable. The coefficient captures the effect of liberalization on MTL evaluated for a zero regulation (such as GDP for instance). As for quotas, since they can realistically be 0, the coefficients are more directly readable.

drop in MTL is hardly magnified when countries increase their marine protected areas, or their GDPs increase simultaneously. Third, governments may also set up catch-share programs (quotas) to use as fishery management tools. We use data from Eisenbarth (2022) and control for this potential government tool without affecting our conclusions. Fourth, the ability of governments to impose fishery management tools could be determined by their quality of governance (Teorell et al. (2019)). Including a measure of government effectiveness in the analysis does not change the main result.

Fifth, as the worldwide fishery subsidies are large (USD 35.4 billion in 2018 dollars) (Sumaila, Ebrahim, et al. (2019)) and are at the origin of the degradation of fish stocks, we include them as a control in the estimation of the MTL. We use the most recent data provided by the Sea Around Us Project (Sumaila, Skerritt, et al. (2019)) for the year 2018. The Sea Around Us Project contains information on many countries and provides an interesting categorization of subsidies in terms of fish stock sustainability (beneficial, ambiguous, and harmful subsidies for fish stocks, the latter being the highest category provided, at over USD 22.2 billion).

This data set is however time –invariant. This may be a drawback for our analysis as the level of global subsidies has decreased over time (OECD, 2022) and for a given country, the temporal variation of granted subsidies can be large. But we believe that it is more important to describe in a more relevant way the individual heterogeneity among countries in granted subsidies. The seven leading subsidizing entities, including China, the European Union, the United States, South Korea, Japan, Russia, Thailand, and Indonesia, collectively contribute to over $23 billion (USD) in fisheries subsidies per annum, representing over 65% of the overall global total. The results suggest that most of these omitted variables affect MTL but do not affect the effectiveness of FRPs. The previous results regarding the effect of FRPs are confirmed when accounting for these other domestic regulations.

4.4 Heterogeneity

Depth of FRPs

Table 6, Columns 1 to 3, displays the number of FRPs per agreement. Indeed, many trade agreements include more than one FRP. Some agreements include, for instance, both ecosystems protection-related FRPs and fish trade regulation-related FRPs. The main variable of interest is the interaction between the existence of a trade agreement and the number of provisions in that agreement, and such estimation relies on the variation across agreements (that all include at least one provision, hence affecting the sample) as to the number of provisions. The results in Table 6 Columns 1 to 3 show that the number of FRPs is not associated with any differential effect on the status of fish stocks after trade liberalization and even indicates a (slightly significant) negative impact of including an increasing number of FRPs.

Number of agreements containing FRPs

Table 6 Columns 4 to 6 reveal the differential effects of the number of agreements that include at least one FRP on fish stock status ("Nb. Agreements FRP"). MTL values are indeed harmed by trade liberalization, but the effect vanishes when signatories have signed many agreements including FRPs. Note that in the last specification, controlling for a 5-year lag of the MTL, neither trade liberalization nor provisions affect current MTL. We infer that the existence of the FRP is what matters most, rather than the number of FRPs. Aggregated over many agreements, these provisions mitigate the negative impact of trade liberalization.

Types of FRPs

For the purpose of the empirical analysis, we classified the FRPs into five types (see Table 2 and Fig. 3). The type of environmental provision included could also be important in shaping MTL variations after trade liberalization. We thus use the different types of FRPs and allow the impact of RTAs to differ along the types of provisions included in the RTA. The results displayed in Figure 10 show a strong differential effect across FRP types. The positive impacts of fishery-related provisions on MTL seem to be mainly driven by the presence of a single provision.

Figure 10 displays only four provision types, as the provision on the Whaling Convention has very few observations. Our empirical results show that the main effect derives from FRPs related to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement regulating international trade in wildlife to prevent its decline. It is interesting to note that the CITES Convention has broader coverage than marine wildlife but seems to be at play in the marine context as well. In our context, the fact that MTL is affected solely by banning and restricting trade in endangered species suggests that the functional biodiversity channel is effective in that the absence of trade of some species has a positive impact on other species. This result is in line with the evidence supporting the effectiveness of the CITES Convention in preserving species (Heid and Márquez-Ramos (2023)). Those findings show a positive effect of CITES (but with a considerable lag) almost exclusively for populations located in those member countries with strong enforcement. The positive effect of CITES in member countries with weak enforcement only exists for large species such as elephants, rhinos, or whales.

In contrast, the other types of FRPs do not seem to play a mitigating role on MTL after trade liberalization. In particular, we would expect the provision of fishery regulations to exert a positive significant impact on MTL. These findings suggest that these provisions are not necessarily binding.[7]

5. Robustness checks

This section focuses on robustness checks regarding the main joint effect of trade liberalization and the existence of FRPs on fish stock status, catches and exports. The results are displayed in Appendix C.

Alternative sets of fishery-related provisions

We verified the validity of our conclusions using alternative sets of provisions. Indeed, based on our understanding and knowledge, we made choices in selecting the set of provisions to be considered. To overcome this bias, we use two additional sets of provisions. Table C1 describes the additional provisions provided by Morin, Dür, and Lechner (2018) that we use for our robustness check. Compared to the benchmark set, alternative list 1 adds potential but minor provisions that only relate to fisheries. Alternative list 2 adds provisions that could affect fisheries, but whose objective is not restricted to fisheries.

We replicate our analysis using these alternative sets of provisions. Figure C2 confirms that our choice was not arbitrary and that our conclusions are independent of the set of provisions considered. If any, increasing the set of FRPs in the analysis decreases the magnitude of the estimated impact, but the pro-MTL effect of FRPs remains significant 5 to 9 years after RTA signature.

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[7] Additional results (not displayed in the article) support no significant difference in the trajectory of binding agreements (N=96) compared to non-binding ones. A provision is considered as “binding” if the related agreement mentions some binding obligations (i.e., the agreement mentions “shall”, “have to”, “must”), see (Morin, Dür, and Lechner (2018)) as opposed to voluntary actions (”best efforts”, ‘wishes”…).

Alternative estimation procedures

Alternative clustering level.

Baseline results allow for the serial correlation of errors for observations within a single agreement. We check that our results hold by using alternative clustering levels of standard errors. Figure C3 shows the results when clustering the errors at the observation year x decade of the RTA signature.

In addition, one country's fish stock status will be used as the dependent variable multiple times if that country has multiple agreements. This induces a relationship among the different observations of the dependent variable that could affect inference. We allow errors to be correlated across groups of observations along the number of agreements with FRPs in place. We thus group observations into clusters, depending on the number of agreements with FRPs in place across signatories in the year of observation. By using these groups (N =387), Figure C4 shows a confirmation of the inference previously discussed.

Alternative fixed effects

We take full advantage of the matched diff-in-diff strategy. Whereas baseline results use the matched sample without any further constraints, we constrain our estimation to include more demanding fixed effects to ensure comparability across agreements. Precisely, once a matched sample is created, we can identify the exact match of each agreement with an FRP, namely, the most similar agreement without an FRP. In the baseline matched sample strategy, the treated agreement is compared to the average untreated agreement (in which treated and untreated agreements can be compared). We now explicitly condition the estimation to compare any agreement with its own, untreated neighbor. Each treated agreement - untreated agreement (neighbor) couple is assigned as a match, and we include this match fixed effect in our estimation. Note that match fixed effects absorb agreement fixed effects. Figure C5 plots the results. Estimated effects are slightly lower in this specification, but the significance remains unchanged. FRPs increase the MTL on average, and the main effect occurs between 5 and 9 years after RTA.

Dynamic specification of MTL.

Our main estimation either includes 2-year or 5-year lags of the MTL as independent variables. We first check that considering other lags does not alter the main finding. Table C6, Columns 1 to 5 use the various lags of MTL in the specification without affecting the signs and magnitude of the effect of an FRP. Finally, by including a lagged dependent variable, the model becomes a dynamic panel model (Arellano and Bond (1991)). We thus consider a dynamic panel estimator in Column 6 of Table C6. The conclusions are unaffected by the use of this alternative estimator.

Alternative propensity scores

Our results resist the use of alternative propensity scores. We have used an alternative set of variables in $\boldsymbol{X_g}$ that determines any probability of an agreement including an FRP. In addition to the variables already included (see Section Methodology), $\boldsymbol{X_g}$ also includes the maximum MTL level by signatories, the aggregate land area of signatories, the number of environmental provisions already signed by all signatories of the agreement, the mean GDP of signatories, the total amount of protected areas (including land protected areas), the share of signatories from developed countries, and the fishing ground biocapacity per capita (as a measure of the ability of the signatories to produce seafood). The alternative propensity scores (see Figure B3) lead to a different matched sample, with which we replicate the main tables. The results in Figure C7 confirm the baseline effects we highlighted using our former set of matching variables. Our results are not dependent on these assumptions.

Heterogeneity-robust treatment effect

Recent studies (de Chaisemartin and D'Haultfœuille (2022)) argue that the treatment effect from the two-way fixed effects estimations can be biased due to heterogeneity in the treatment effect across groups and across time. Recent papers acknowledge this bias and propose unbiased heterogeneity-robust estimators (de Chaisemartin and D'Haultfœuille (2020); Borusyak, Jaravel, and Spiess (2021); Sun and Abraham (2021)). We use these estimators and check the sensitivity of our results. The dynamic, heterogeneity-robust estimations are plotted in Figure C8. Overall, most results remain unaffected by using alternative estimators. We consistently estimate a positive and significant effect of FRPs on fish stock status, no pre-treatment effect and of the majority of the impact to come into play approximately 5 to 10 years after the RTA. Different estimators, however, provide different time profiles of the effect across years: the Borusyak, Jaravel, and Spiess (2021) estimator suggests that the effect comes into play earlier than the estimator in de Chaisemartin and D'Haultfœuille (2020).

Constrained matching

Recent trade agreements almost all include FRPs (Figure 4). As a result, finding an untreated agreement for these recent RTAs is challenging and can lead to inaccurate doubtful comparisons between recent RTAs (with FRPs) and very old RTAs without FRPs. To overcome this potential bias, we restrict our sample to matches that have less than 15 years of difference, and the propensity score estimation remains unchanged, implying that treated agreements and untreated agreements must have been signed in a 15-year window. From this additional matched dataset, Figure C9 plots the estimations from this constrained-matching sample and compares them to the benchmark estimates. All our conclusions are confirmed using this constrained estimation.

Another possible concern regarding our research design is that agreements composition may overlap across agreements. Indeed, it is possible that treatment affects the control group because of country overlap: including an FRP in an agreement between countries *i* and *j* affects the average trophic level of all agreements that include country *i* or *j*, which may serve as counterfactuals. First, note that this it mechanically reduces the difference between control and treatment average MTL. Second, we constrained the estimation to match treated and control agreements with no overlap in country composition. In this estimation on a reduced sample, treated and control agreements cannot be signed by any common country. Figure C10 plots the effects: we estimate similar patterns, with lower precision of estimates however, which is driven by lower matching quality.

6. Conclusions

In this paper, we evaluate the effectiveness of fishery-related provisions (FRPs) in regional trade agreements (RTAs) in mitigating the depletion of fisheries that results from trade liberalization. Our empirical strategy addresses the potential endogeneity of the inclusion of environmental provision in RTAs. For the 726 RTAs signed during the period 1947-2018, we estimate the impact both of signing a trade agreement and that of the FRPs on fish stock status using a difference-in-differences (DID) propensity score matching method. Our empirical results thus reflect causal relationships between the inclusion of environmental provision and fish stock status.

Our empirical results provide interesting insights. First, we find that the average trade agreements reduce fish stock status by 1%, while the agreements that include FRPs result in no change in the status of fish stocks (compared to the agreements without these provisions). This means that the FRPs in RTAs offset the negative effects of trade liberalization on fish stock status. This result is robust to different specifications, controlling for other determinants of fish stock status at the agreement level, and to a variety of additional robustness checks, including the use of alternative sets of FRPs, alternative clustering of standard errors, alternative fixed effects, alternative propensity scores, constrained matching, and heterogeneity-robust treatment effects.

Regarding the impact of the number and type of provisions, our results show that the number of FRPs included in an agreement is not associated with any differential impact on fish stock status following trade liberalization. Thus, we conclude that it is the existence of FRPs that matters most, rather than the number of FRPs. The next issue is revealing which FRPs have the greatest impacts on fish stock status. We have therefore used five different types of FRPs and allowed the impact of RTA to differ along the types of the provisions included in the RTA. Our results indicate that the positive impacts of FRPs on fish stock status seem to be mainly driven by one particular type of provision, namely, the CITES Convention on endangered species. This result is in line with evidence supporting the effectiveness of the CITES Convention in preserving especially large species such as whales (Heid and Márquez-Ramos (2023)). These results suggest that trade agreements, including a provision on the CITES Convention, do not harm functional biodiversity and the marine trophic level.

Our overall results suggest that the signature of a trade agreement leads to a depletion in fishery resources among signatory countries, which is consistent with the literature on trade and renewable resources, and that relevant environmental provisions (related to marine resource conservation) tend to offset this negative outcome, in line with evidence regarding deforestation (Abman, Lundberg, and Ruta (2021)).

Regarding the possible mechanisms, the effectiveness of FRPs could result from improved resource management and/or enforcement linked to the FRPs or decreased trade opportunities in fishery products that occurs following the adoption of a trade agreement with an FRP. On the one hand, our empirical results show that FRPs decrease both fish catches and exports at the agreement level. On the other hand, we do not find a significant effect of FRPs on fishing techniques (e.g., the proportion of fish caught by trawling, which is particularly harmful to biodiversity). These findings suggest that fishery-related provisions do not foster the adoption of better fishery resource-management practices but rather serve to reduce trade opportunities. Furthermore, the provision of the CITES Convention seems to have a non-negligible effect through the effective enforcement of trade bans on endangered species, especially those on larger species.

This work has important policy implications. Our paper shows that the content of trade agreements is not sufficient to align trade-related objectives and environmental concerns. In our context, the increase in biodiversity after trade liberalization results in a reduction in trade due to the inclusion of provisions. Provisions related to fishery in trade agreements may require harmonization of product standards and adoption of labels, which are costly especially for exporters from developing countries. This may reduce fish trade opportunities between signatories of trade agreements including these provisions.

The lack of impact of fishery-related provisions on fisheries management, such as the use of more sustainable fishing methods, may also be linked to the lack of enforcement of the environmental provisions contained in trade agreements. This issue is also highlighted by European Parliament. Directorate General for External Policies of the Union (2020), which recommend "*to reduce the number of clauses but make the remaining ones binding*" (p.32). The key requirement for an environmental provision to be enforceable is the imposition of transparent and automatic sanctions for non-compliance. In the context of the European Union, European Parliament. Directorate General for External Policies of the Union (2020) recommend that the EU could make greater use of dispute settlement mechanisms with the help of the Chief Trade Enforcement Officer, a role established by the EU Green Deal in late 2019.

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Tables

Table 1: Fishery-related Provisions. Benchmark list.

Provision identifier [a]	Type [b]	# Agreement	Provision Name [a]
1008	Species Protection	32	Whales and seals (ex: import ban based on CITES)
100102	Ecosystems	3	Specific environmental issues: Coral reefs
100103	Ecosystems	111	Specific environmental issues: Seas and oceans
100106	Ecosystems	32	Specific environmental issues: Protection of coastal areas
100401	Fishery Regulation	78	Specific environmental issues: Conservation of fishery resources
100402	Fishery Regulation	18	Specific environmental issues: Sustainable trade in fishery products
100403	Fishery Regulation	23	Specific environmental issues: Combat illegal fishing
140301	CITES	21	Relation with international institutions: Prevalence CITES
140409	Whaling Convention	4	Relation with international institutions: Whaling Convention

a From Morin, Dür, and Lechner (2018).

b Authors typology.

Table 2: Sample characteristics

Panel A: Raw Sample	
Number of Agreements (RTA)	726
Number of Agreements with environmental provisions	630
Number of Agreements with FRP	175
Number of FRP	322
Average number of FRP per RTA	0.44
Average number of provisions per RTA with FRP	1.84
Number of Agreements with FRP related to …	
CITES	66
Ecosystems	122
Fishery Regulation	79
Species Protection	63
Whaling Convention	4
Panel B: Matched sample	
Number of matched agreements with FRP	134
Average length after signature	15.07 yrs
Average difference in signature years btw control and treated agreements	6.6 yrs
Median year	1984
Average number of FRP	0.86
Share of agreements with the US and/or Canada	6%
Share of agreements with the EU	27%

Table 3: Benchmark results.

	Dep. Variable: MTL_{gt}			
	(1)	(2)	(3)	(4)
Post RTA	-0.005***	-0.007***	-0.006***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.005)
Post RTA x Fish Provision		0.005**	0.006***	0.011**
		(0.002)	(0.002)	(0.005)
MTL (t-2)	0.903***	0.903***	0.894***	
	(0.009)	(0.009)	(0.009)	
Ln GDP			-0.000	0.005
			(0.001)	(0.003)
Ln Marine Prot. Area			-0.001***	-0.001
			(0.000)	(0.001)
MTL (t-5)				0.584***
				(0.020)
Observations	17956	17956	11728	11728
R^2	0.980	0.980	0.987	0.956

Standard Errors (in parentheses) are clustered at the agreement level. All estimations include agreement fixed effects and year fixed effects. Matched sample. See text for details.

Table 4: Omitted Variables: other environmental concerns.

	Dep. Variable: MTL_{gt}					
	(1)	(2)	(3)	(4)	(5)	(6)
Post RTA	0.009	0.009	0.008	-0.025*	-0.027**	-0.019
	(0.008)	(0.008)	(0.020)	(0.014)	(0.014)	(0.033)
Post RTA x Fish Provision		0.007***	0.012**		0.006***	0.012**
		(0.002)	(0.005)		(0.002)	(0.005)
MTL (t-2)	0.894***	0.894***		0.903***	0.902***	
	(0.009)	(0.009)		(0.009)	(0.009)	
Post RTA x Other Env. Prov. (0/1)	-0.012	-0.016**	-0.021			
	(0.008)	(0.008)	(0.021)			
Post RTA x Ln Nb. IEA				0.004	0.004	0.001
				(0.003)	(0.003)	(0.006)
MTL (t-5)			0.585***			0.583***
			(0.020)			(0.020)
Observations	11728	11728	11728	10961	10961	10961
R^2	0.987	0.987	0.956	0.987	0.987	0.956

Standard Errors (in parentheses) are clustered at the agreement level. All estimations include agreement fixed effects and year fixed effects. Matched sample. See text for details.

Table 5: Omitted Variables: other domestic regulations.

	Dep. Variable: MTL_{gt}									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Post RTA	-0.001	-0.002	0.097***	0.333***	-0.007***	-0.014***	-0.003	-0.000	0.045**	0.176***
	(0.005)	(0.012)	(0.022)	(0.056)	(0.002)	(0.005)	(0.003)	(0.007)	(0.021)	(0.055)
Post RTA x Fish Provision	0.006***	0.011**	0.006***	0.012**	0.005**	0.010*	0.009**	0.028**	0.006**	0.011*
	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.005)	(0.004)	(0.011)	(0.003)	(0.007)
Post RTA x Protected Area	-0.001	-0.001								
	(0.001)	(0.001)								
MTL (t-2)	0.893***		0.885***		0.893***		0.915***		0.899***	
	(0.009)		(0.008)		(0.009)		(0.013)		(0.008)	
MTL (t-5)		0.582***		0.559***		0.583***		0.483***		0.576***
		(0.020)		(0.019)		(0.021)		(0.035)		(0.022)
Post RTA x GDP			-0.004***	-0.013***						
			(0.001)	(0.002)						
Post RTA x Quota Program					0.007*	0.013				
					(0.004)	(0.010)				
Post RTA x Government Effect.							-0.003	-0.015**		
							(0.003)	(0.007)		
Post RTA x Fishery Subsidies									-0.003**	-0.010***
									(0.001)	(0.003)
Observations	11728	11728	11728	11728	11728	11728	5330	5330	10116	10116
R^2	0.987	0.956	0.987	0.957	0.987	0.956	0.989	0.963	0.955	0.956

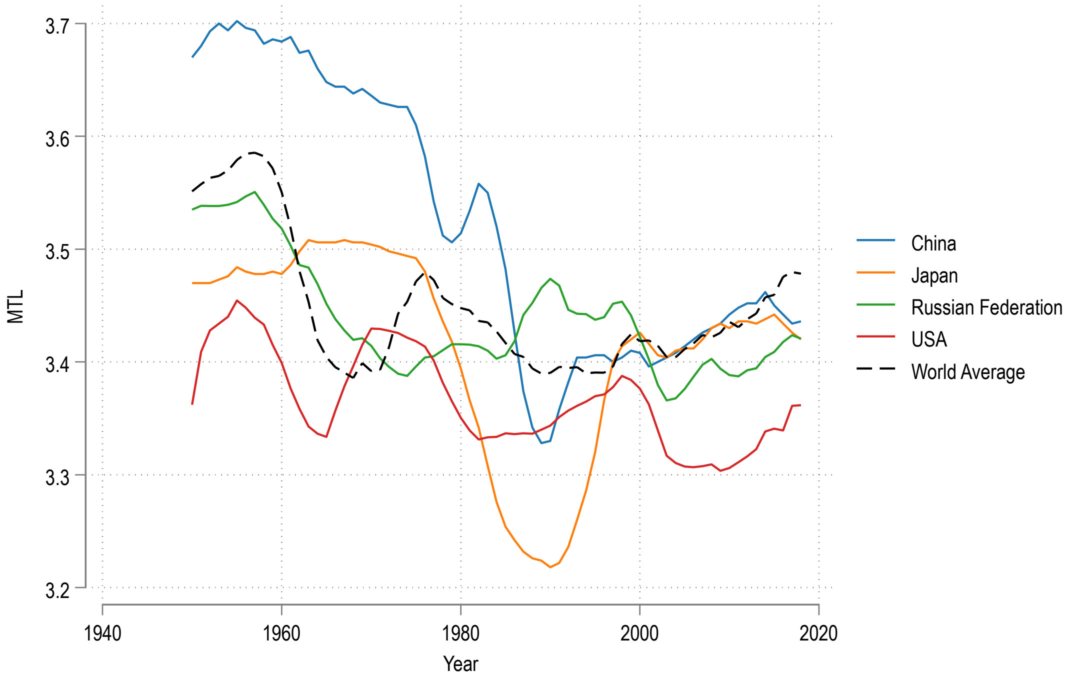
Standard Errors (in parentheses) are clustered at the agreement level. All estimations include agreement fixed effects and year fixed effects. Matched sample. See text for details.

Table 6: Depth of FRP and number of agreements with FRP

	Dep. Variable: MTL_{gt}					
	(1)	(2)	(3)	(4)	(5)	(6)
Post RTA	0.002	0.002	0.006	-0.003**	-0.008***	-0.011
	(0.002)	(0.002)	(0.006)	(0.002)	(0.002)	(0.007)
Post RTA x Nb. FRP	-0.004	-0.004	-0.011			
	(0.003)	(0.003)	(0.008)			
MTL (t-2)	0.890***	0.890***		0.925***	0.927***	
	(0.011)	(0.011)		(0.010)	(0.010)	
MTL (t-5)			0.577***			0.600***
			(0.028)			(0.025)
Nb. Agreements FRP				0.002*	0.001	-0.002
				(0.001)	(0.001)	(0.002)
Post RTA x Nb. Agreements FRP					0.003***	0.004
					(0.001)	(0.003)
Observations	5778	5778	5778	8579	8579	8579
R^2	0.988	0.988	0.958	0.988	0.988	0.958

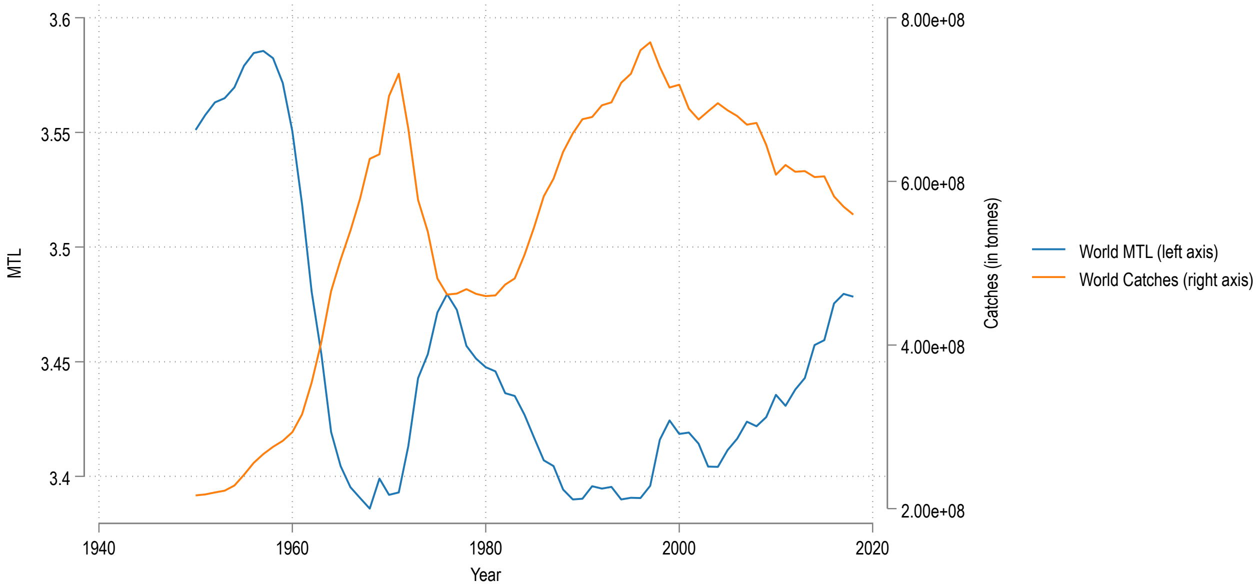
Figures

Figure 1: Evolution of MTL



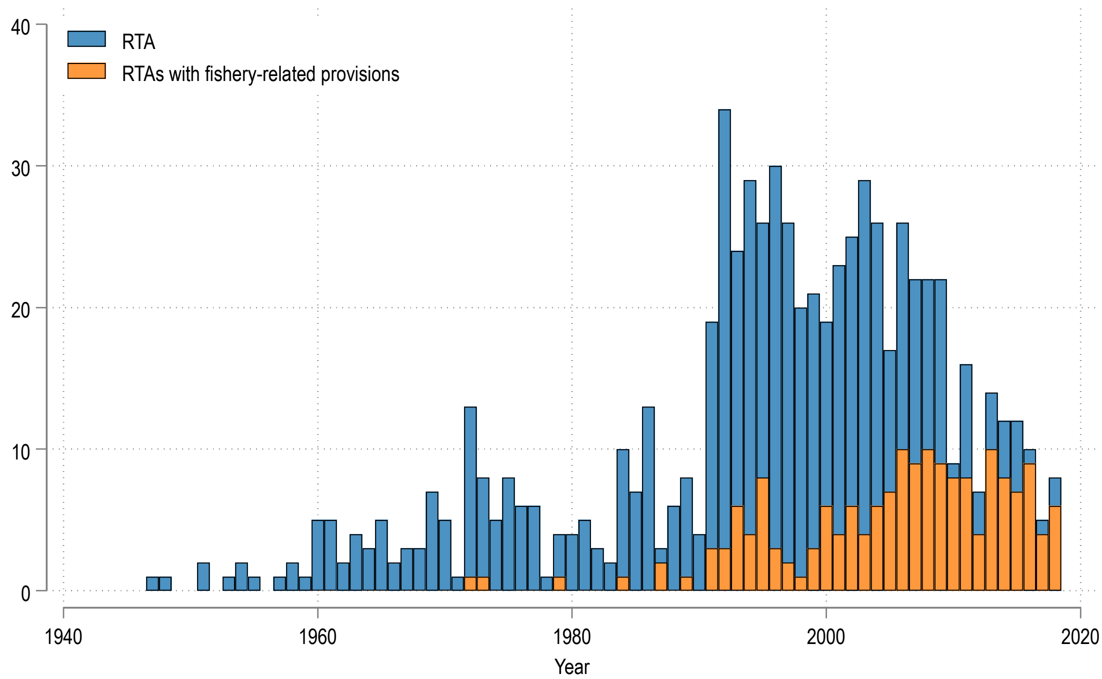
Source: Sea Around US.

Figure 2: Catches and MTL



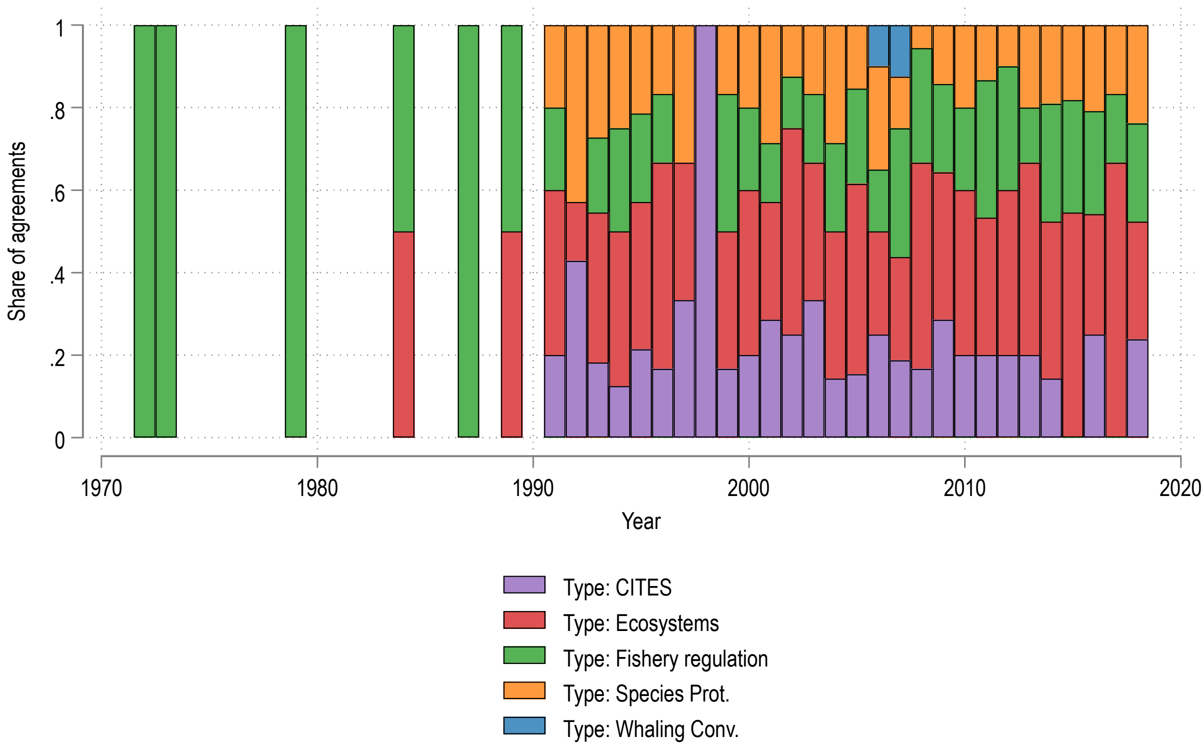
Source: Sea Around US.

Figure 3: RTAs and FRPs



Source: TREND dataset. 726 RTAs are considered.

Figure 4: Distribution and type of FRPs over time



Source: TREND dataset.

Figure 5: Time-Varying Impact of FRP on MTL

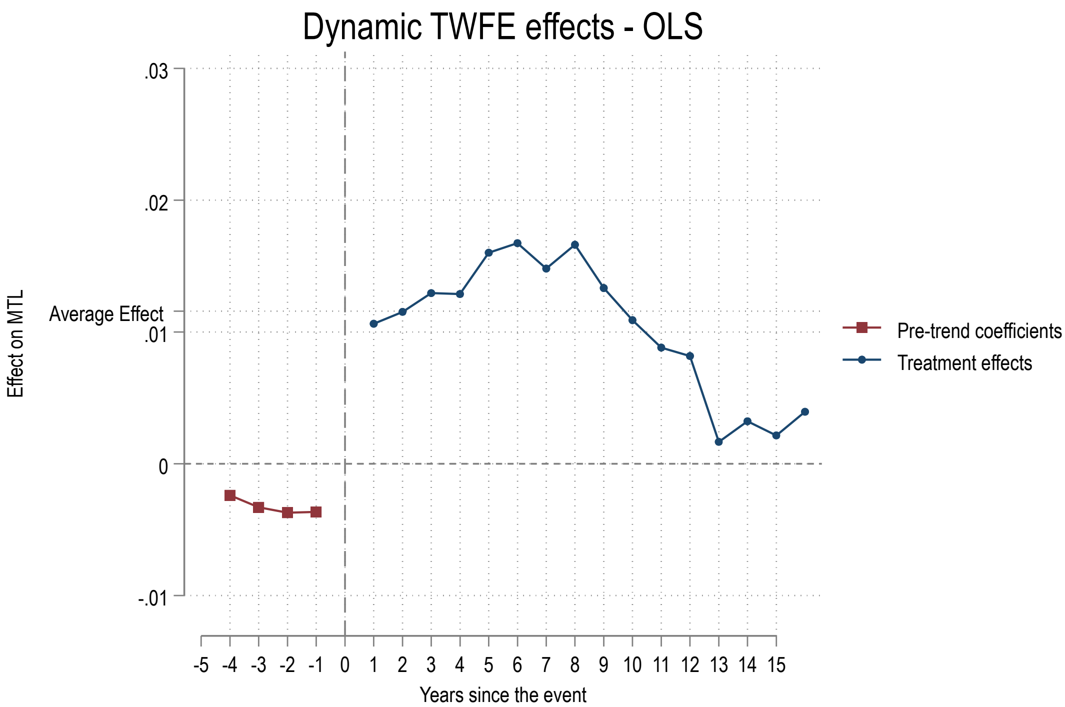


Figure 6: Time-Varying Impact of FRP on fish catches

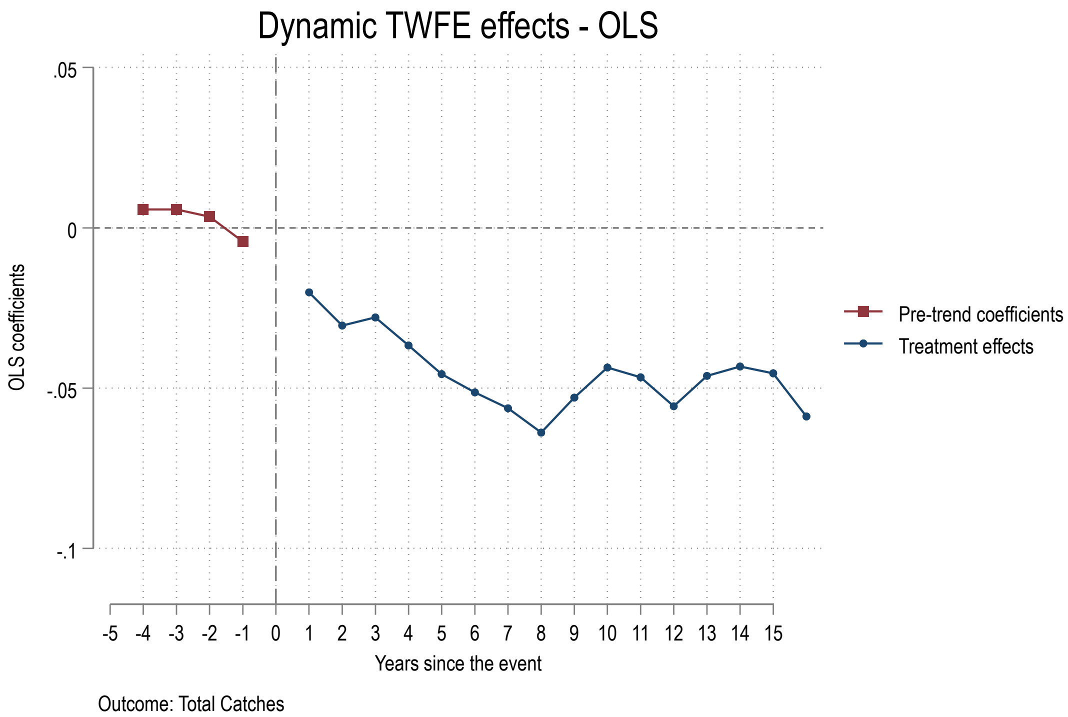


Figure 7: Time-Varying Impact of FRP on Fish Exports

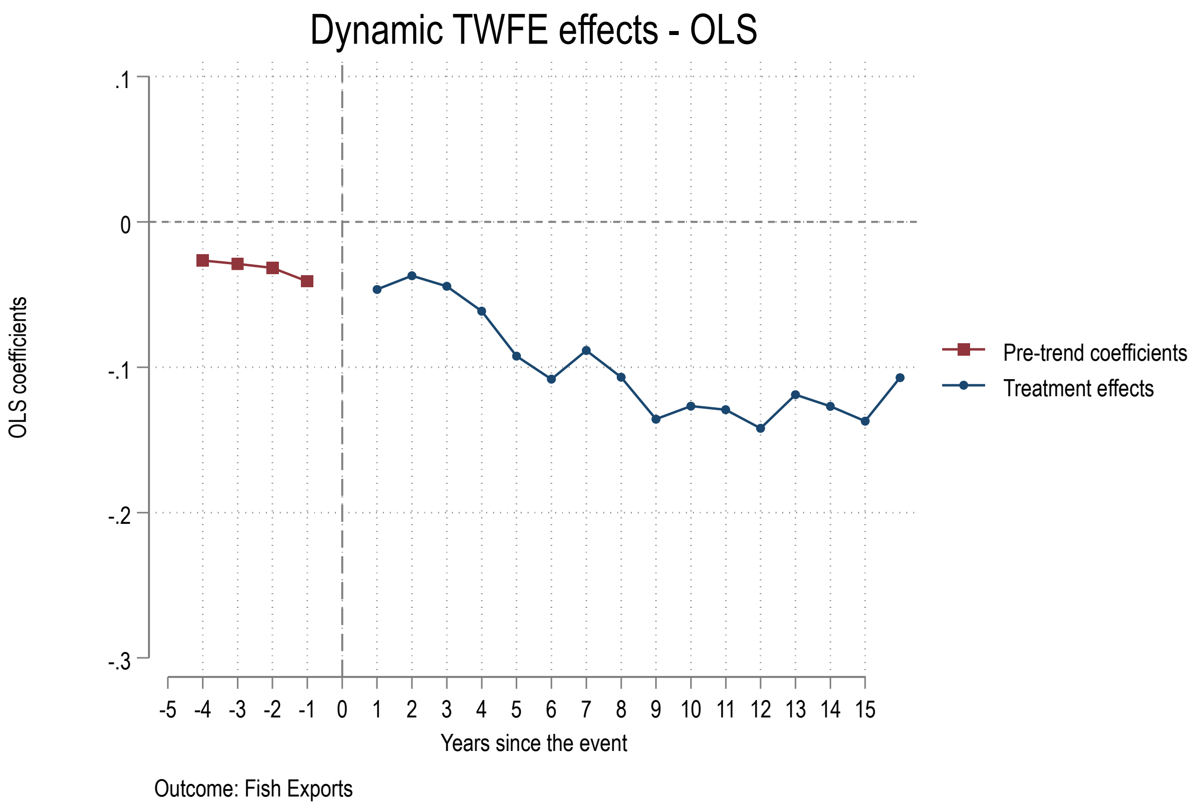


Figure 8: Time-Varying Impact of FRP on fishing technique.

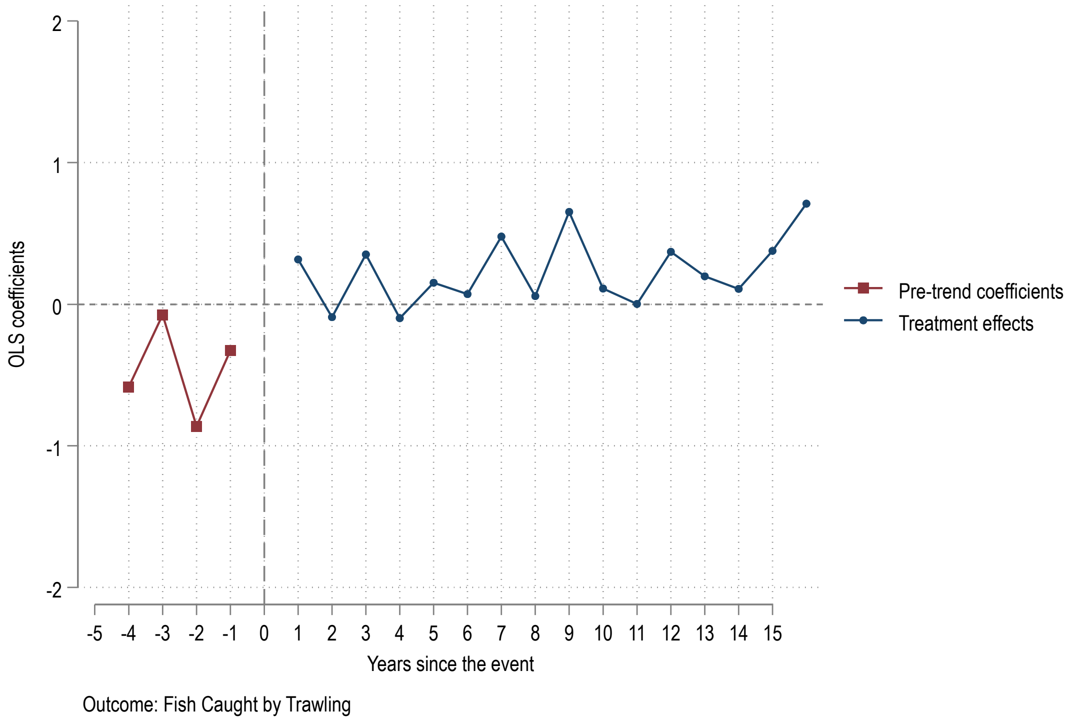


Figure 9: Time-Varying Impact of FRP on fish stocks.

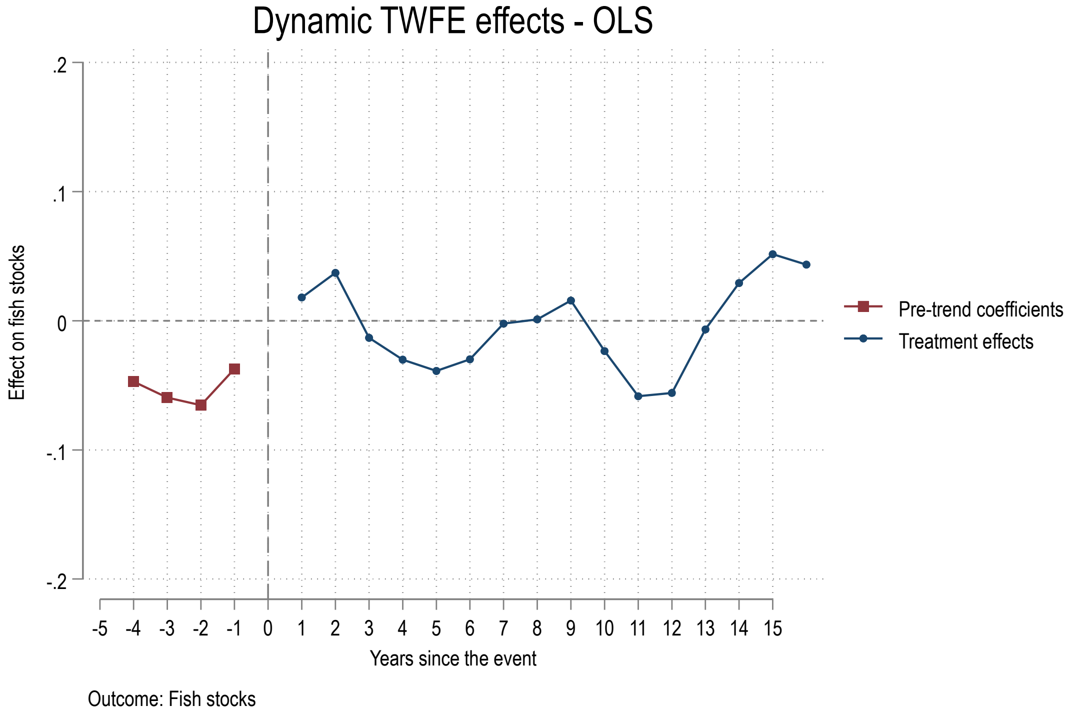
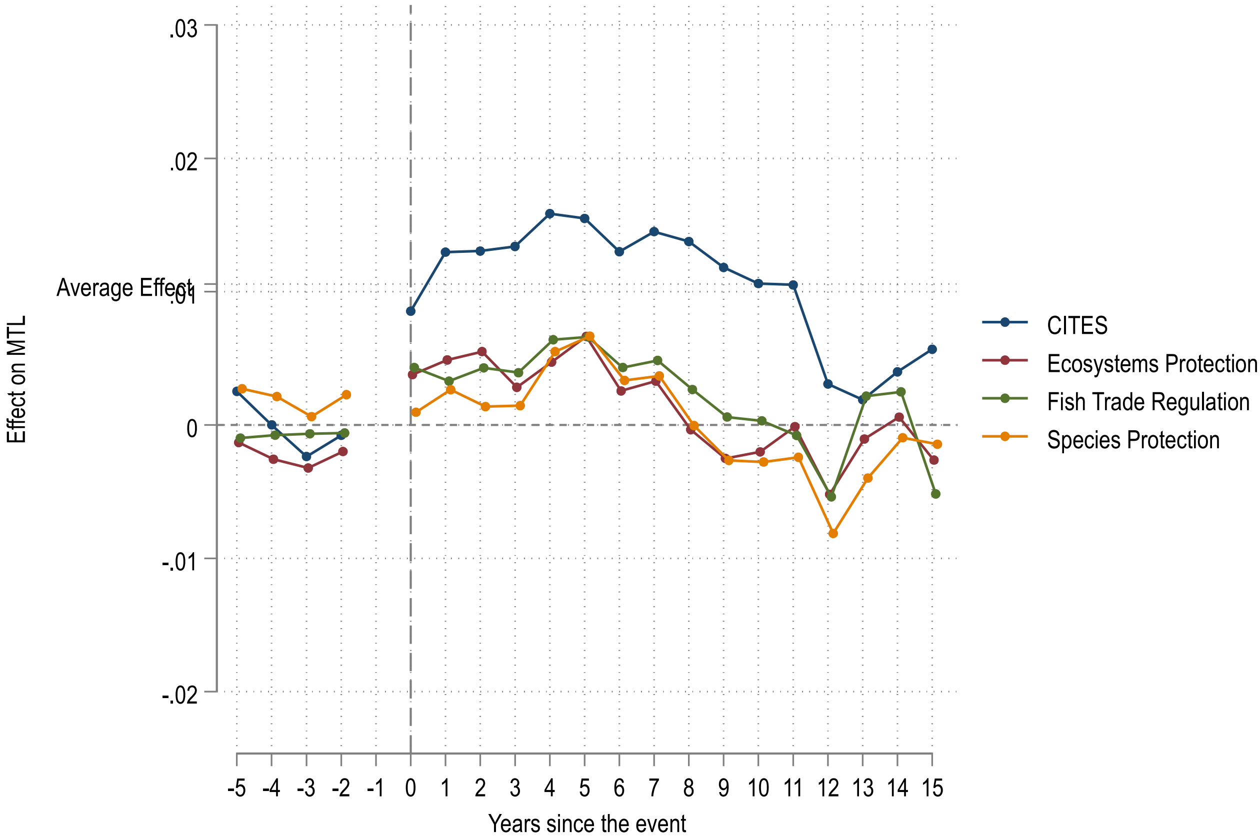


Figure 10: Heterogeneity across types of FRPs.



Appendices - Not for publication

Trade agreements and sustainable fisheries.

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Appendix A: Information about fishery-related provisions

Figure A1: Set of agreements with FRP (benchmark list): next page


EC (9) Enlargement Conditions 1972
West African Economic Community (CEAO) 1973
Lomé II 1979
Lomé III 1984
EC (12) Enlargement 1987
Andean Group Quito Protocol 1987
Lomé IV 1989
EFTA Turkey 1991
EC San Marino 1991
African Economic Community 1991
EFTA Poland 1992
EFTA Israel 1992
North American Free Trade Agreement (NAFTA) 1992
EC Romania 1993
EFTA Hungary 1993
Bulgaria EFTA 1993
Bulgaria EC 1993
Common Market for Eastern and Southern Africa (COMESA) 1993
Economic Community Of West African States (ECOWAS) 1993
Association of Caribbean States 1994
Economic and Monetary Community of Central Africa (CEMAC) 1994
Israel PLO 1994
EC Maastricht (15) Enlargement 1994
EC Tunisia Euro-Med Association Agreement 1995
EFTA Latvia 1995
EFTA Estonia 1995
EFTA Slovenia 1995
EC Israel Euro-Med Association Agreement 1995
EC Lithuania Europe Agreement 1995
EC Latvia Europe Agreement 1995
EC Estonia Europe Agreement 1995
EC Morocco Euro-Med Association Agreement 1996
EC Slovenia Europe Agreement 1996
Canada Chile 1996
EC Jordan Euro-Med Association Agreement 1997
EFTA Morocco 1997
Chile Mexico 1998
Central America Chile 1999
East African Community (EAC) 1999
EC South Africa 1999
Mexico NorthernTriangle2000
EFTA Macedonia 2000
EFTA Mexico 2000
New Zealand Singapore 2000
Jordan US 2000
Cotonou Agreement 2000
EFTA Jordan 2001
Canada Costa Rica 2001
Caribbean Community (CARICOM) revised 2001
EC Egypt Euro-Med Association Agreement 2001
Chile EC 2002
EFTA Singapore 2002
Central America Panama 2002
Japan Singapore 2002
EC Lebanon Euro-Med Association Agreement 2002
Algeria EC Euro-Med Association Agreement 2002
Australia Singapore 2003
Chile Korea 2003
Panama Taiwan 2003
Chile EFTA2003
Jordan Singapore 2004
EFTA Tunisia 2004
EFTA Lebanon 2004
Morocco US 2004
Bahrain US 2004
Australia US 2004
India Singapore 2005
Korea Singapore 2005
EFTA Korea 2005
Chile China 2005
Trans Pacific Strategic EPA 2005
Japan Malaysia 2005
New Zealand Thailand 2005
EFTA SACU 2006
Japan Philippines 2006
Albania EC SAA 2006
EFTA Southern African Customs Union (SACU) 2006
Panama Singapore 2006
Oman US 2006
Nicaragua Taiwan 2006
Colombia US 2006
Peru US 2006
Chile Colombia 2006
Indonesia Japan 2007
Brunei Japan 2007
El Salvador Honduras Taiwan 2007
EC Montenegro SAA 2007
EC Lisbon 2007
Korea US Environment
Panama US 2007
Japan Thailand 2007
Korea US 2007
Peru Singapore 2008
Gulf Cooperation Council (GCC) Singapore 2008
Bosnia and Herzegovina EC SAA 2008
EC Serbia SAA 2008
Colombia EFTA 2008
Japan Vietnam 2008
Canada Peru 2008
China NewZealand2008
CARIFORUM EC EPA 2008
Canada Colombia 2008
East African Community Common Market 2009
Chile Turkey 2009
EFTA GCC 2009
India Korea 2009
EFTA Serbia 2009
India Korea 2009
Canada Jordan 2009
Malaysia New Zealand 2009
China Peru 2009
Hong Kong New Zealand 2010
EFTA Ukraine 2010
Costa Rica Singapore 2010
China Costa Rica 2010
Chile Malaysia 2010
Canada Panama 2010
EFTA Peru 2010
EC Korea 2010
India Malaysia 2011
Panama Peru 2011
EFTA Montenegro 2011
EC (28) Enlargement 2011
Japan Peru 2011
India Japan 2011
Korea Peru 2011
EFTA Hong Kong 2011
Chile Hong Kong 2012
Korea Turkey 2012
Colombia Peru EC 2012
Central America EC 2012
Colombia Panama 2013
Bosnia and Herzegovina EFTA 2013
China Switzerland 2013
Singapore Taipei 2013
New Zealand Taiwan 2013
China Iceland 2013
Canada Honduras 2013
Colombia Korea 2013
Chile Thailand 2013
Central America EFTA 2013
Malaysia Turkey 2014
Canada Korea 2014
Australia Korea 2014
China Korea 2014
EC West African states 2014
EC Ukraine 2014
EC Moldova 2014
EC Georgia 2014
Korea Vietnam 2015
Honduras Peru 2015
Singapore Turkey 2015
EC Kosovo SAA 2015
Australia China 2015
EC Kazakhstan 2015
Korea New Zealand 2015
EFTA Philippines 2016
Canada Ukraine 2016
Chile Uruguay 2016
EFTA Georgia 2016
EC SADC 2016
Canada EC (CETA) 2016
EC EAC 2016
EC Vietnam 2016
Transpacific Partnership 2016
Hong Kong Macao 2017
Pacific Agreement on Closer Economic Relations (PACER) Plus 2017
China Georgia 2017
Argentina Chile 2017
Colombia MERCOSUR services 2018
EC Singapore 2018
Armenia EC 2018
EC Japan 2018
Comprehensive and Progressive Agreement for Transpacific Partnership
USMCA 2018
1
2
3
4
5
6
Number of Provisions

Table A2- First-stage results.

Dep. Variable:	Baseline FRP		FRP Alternative 1		FRP Alternative 2	
	(1)	(2)	(3)	(4)	(5)	(6)
Nb. Signatories	0.047	-0.143	-0.004	-0.207	-0.085	-0.156
	(0.175)	(0.224)	(0.181)	(0.227)	(0.181)	(0.222)
Signature Year (squared)	64.165***	39.267	67.322***	39.031	90.081***	74.999***
	(20.731)	(25.668)	(20.980)	(25.974)	(17.910)	(24.468)
Total catches (t to t-5)	-0.354***	-0.193	-0.339***	-0.179	-0.384***	-0.219**
	(0.106)	(0.133)	(0.107)	(0.136)	(0.098)	(0.109)
Total Exports (t to t-5)	0.707***	0.538***	0.730***	0.539***	0.572***	0.418***
	(0.104)	(0.116)	(0.107)	(0.118)	(0.084)	(0.093)
Ln Marine Prot. Area	-0.044	-0.020	-0.033	-0.015	0.051	0.067
	(0.053)	(0.061)	(0.053)	(0.062)	(0.044)	(0.051)
Biocapacity		0.009		0.044		0.086
		(0.131)		(0.133)		(0.123)
% of developed countries		0.351		0.455		0.277
		(0.695)		(0.702)		(0.686)
Max. MTL		0.345		0.387		0.313
		(0.568)		(0.576)		(0.512)
Total land area		0.000		0.000		-0.000
		(0.000)		(0.000)		(0.000)
Nb. FRP (t-1)		0.040**		0.049***		0.039**
		(0.016)		(0.017)		(0.018)
GDP		-0.114		-0.145		-0.113
		(0.153)		(0.155)		(0.138)

Standard errors in parentheses. Robust S.E.

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

Appendix B: Matching

Figure B1: Propensity scores for the two groups (treated and control).

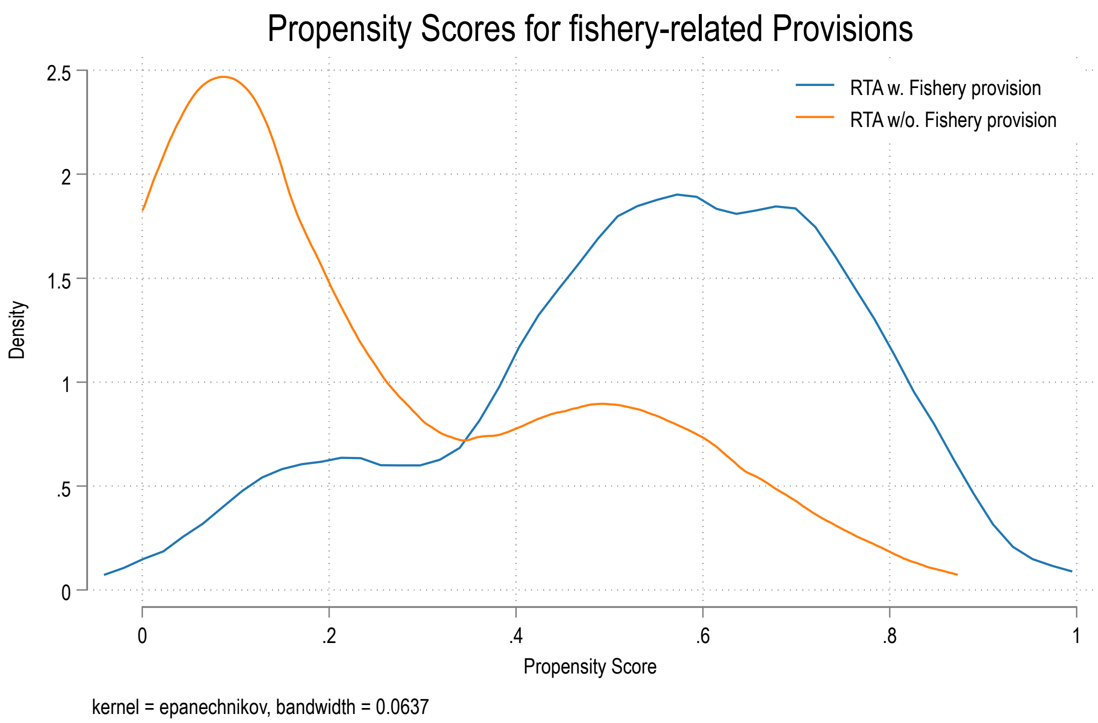


Figure B2: Trends in MTL, unmatched and matched samples

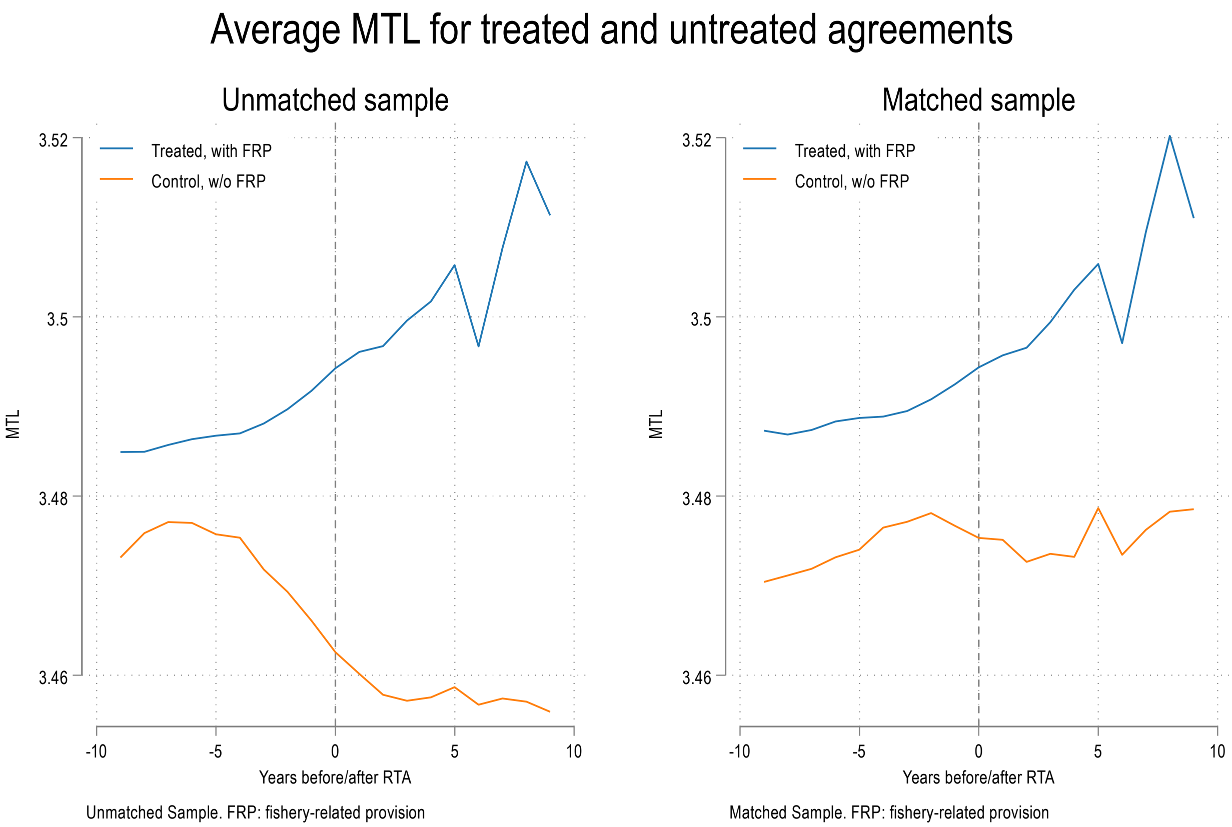
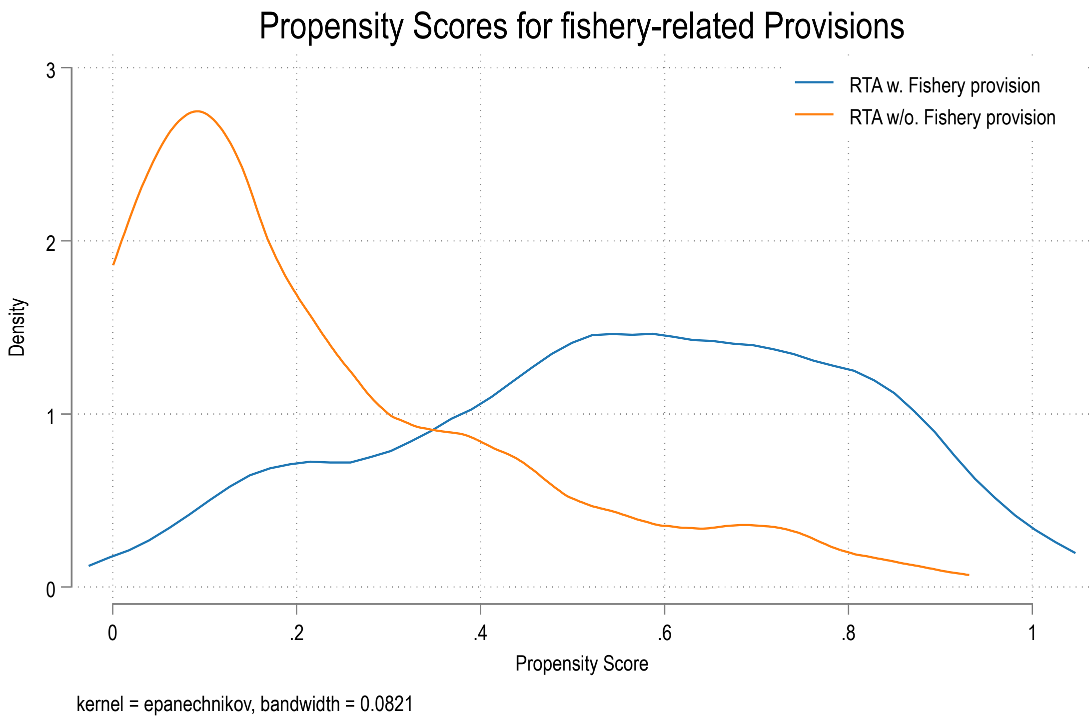


Figure B3: Alternative propensity scores



Appendix C: Further results

Table C1: Alternative sets of FRP

Item	Description	N	Name	Benchmark	*Alternative 1*	*Alternative 2*
1006	Species	38	Endangered species and their illegal trade			x
1008	Species	32	Whales and seals (ex. import ban based on CITES)	x	x	x
1011	Species	13	Shared species			x
1013	Ecosystems	56	Protected areas			x
10703	Sovereignty	7	Sovereignty over hydrobiological and fishery resources			x
100102	Ecosystems	3	Specific environmental issues: Coral reefs	x	x	x
100103	Ecosystems	111	Specific environmental issues: Seas and oceans	x	x	x
100106	Ecosystems	32	Specific environmental issues: Protection of coastal areas	x	x	x
100109	Ecosystems	1	Marine plastic pollution			x
100401	Fishery	78	Specific environmental issues: Conservation of fishery resources	x	x	x
100402	Fishery	18	Specific environmental issues: Sustainable trade in fishery products	x	x	x
100403	Fishery	23	Specific environmental issues: Combat illegal fishing	x	x	x
100404	Ecosystems	8	Prevent pollution from fishing activities			x
100405	Fishery	6	Bycatch prevention		x	x
100406	Subsidies	3	Prevent harmful subsidies		x	x
140221	other IEA	191	Implementation other agreements related to the environment			x
140301	CITES	21	Relation with international institutions: Prevalence CITES	x	x	x
140401	CITES	48	Other references CITES		x	x
140409	Whaling	4	Relation with international institutions: Whaling Convention	x	x	x
14020101	CITES	15	Implementation of CITES (whole treaty)		x	x
14020102	CITES	7	Implementation of CITES (specific parts)		x	x
14020901	Whaling	4	Implementation Whaling Convention (Whole treaty)		x	x

Figure C2: Alternative sets of fishery-related provisions

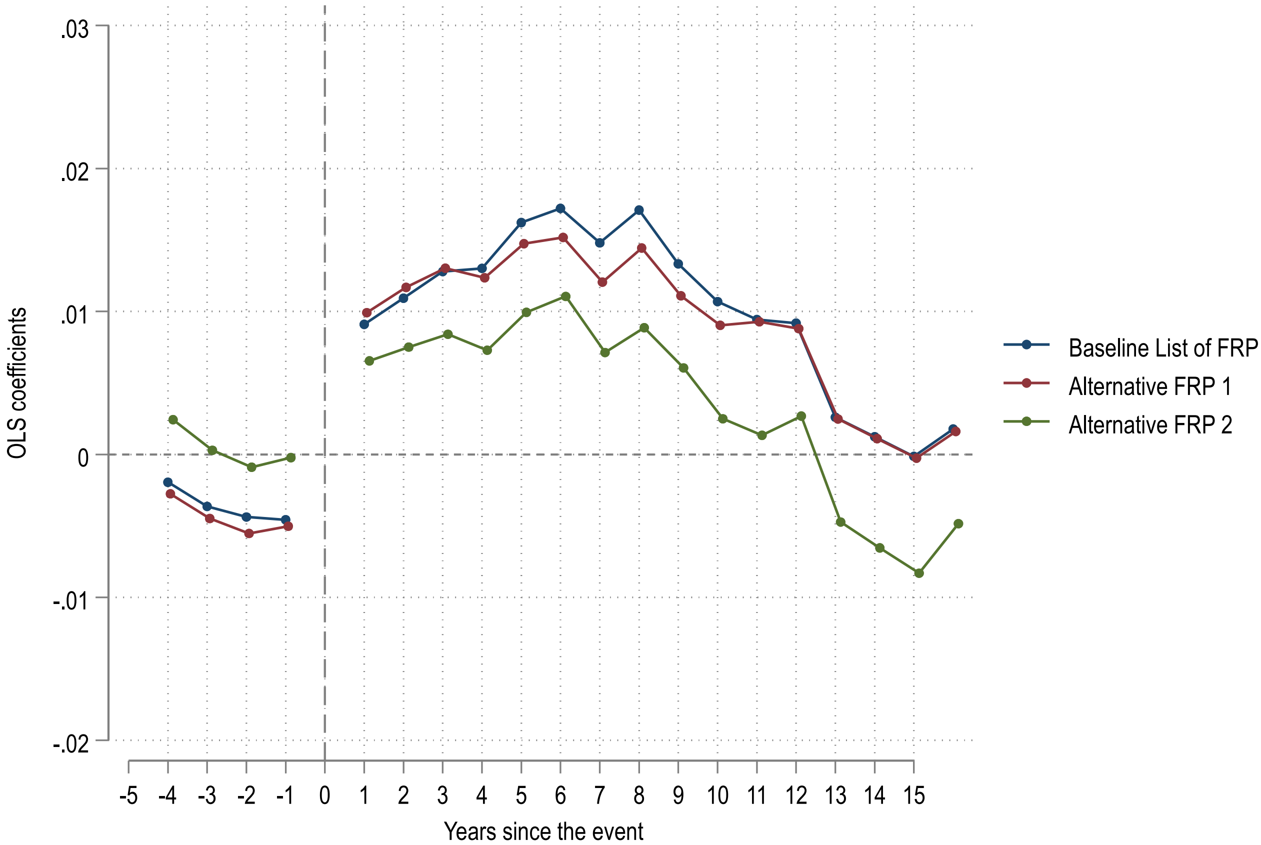


Figure C3: Alternative clustering level - observation year x decade of the RTA signature

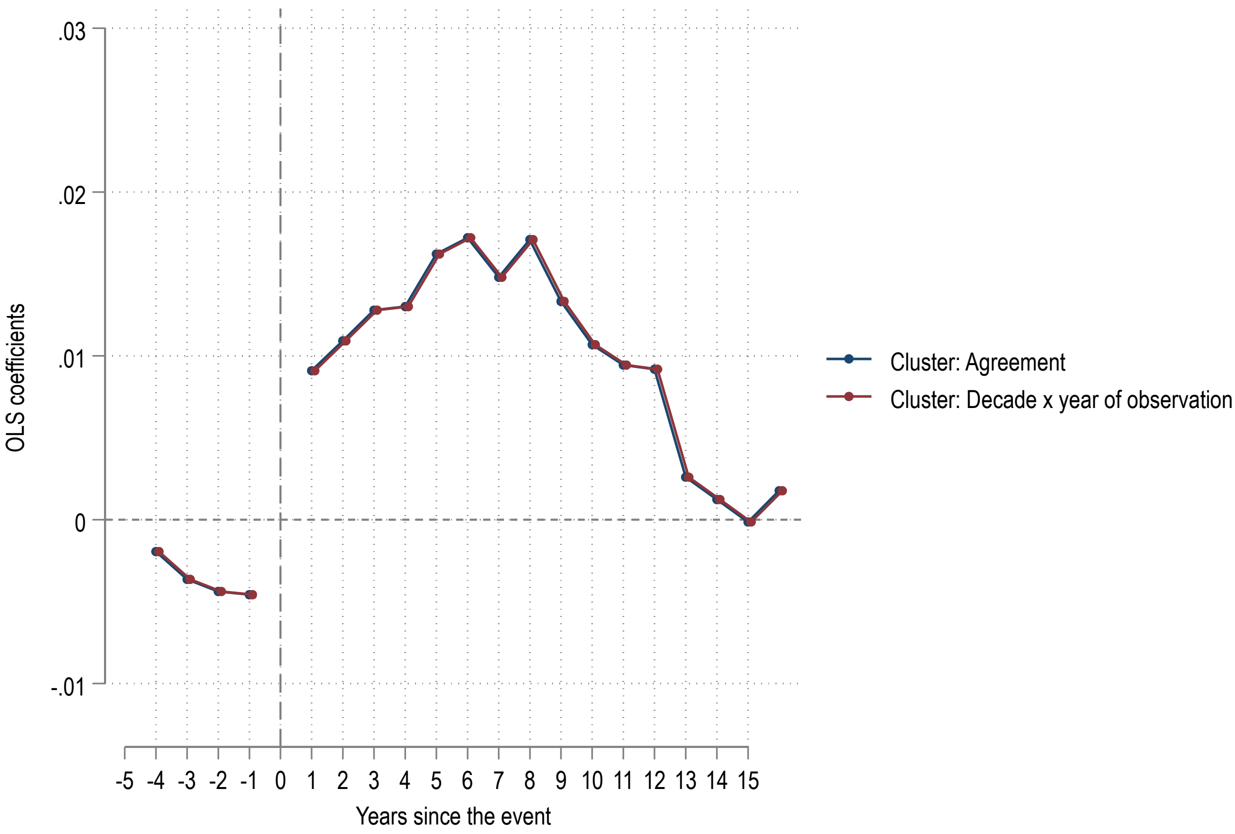


Figure C4: Alternative clustering level – observation year x number of agreements with FRP

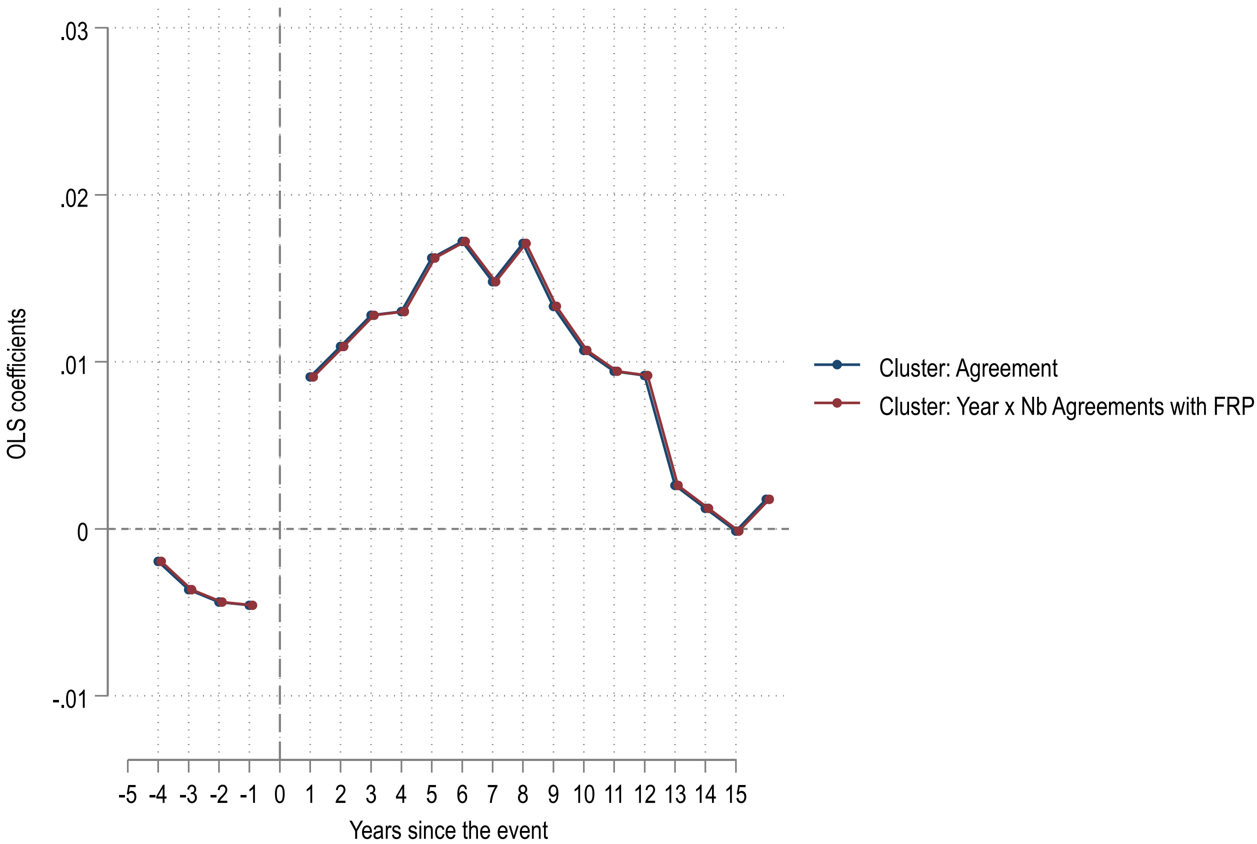


Figure C5: Specification with a match-specification fixed effect

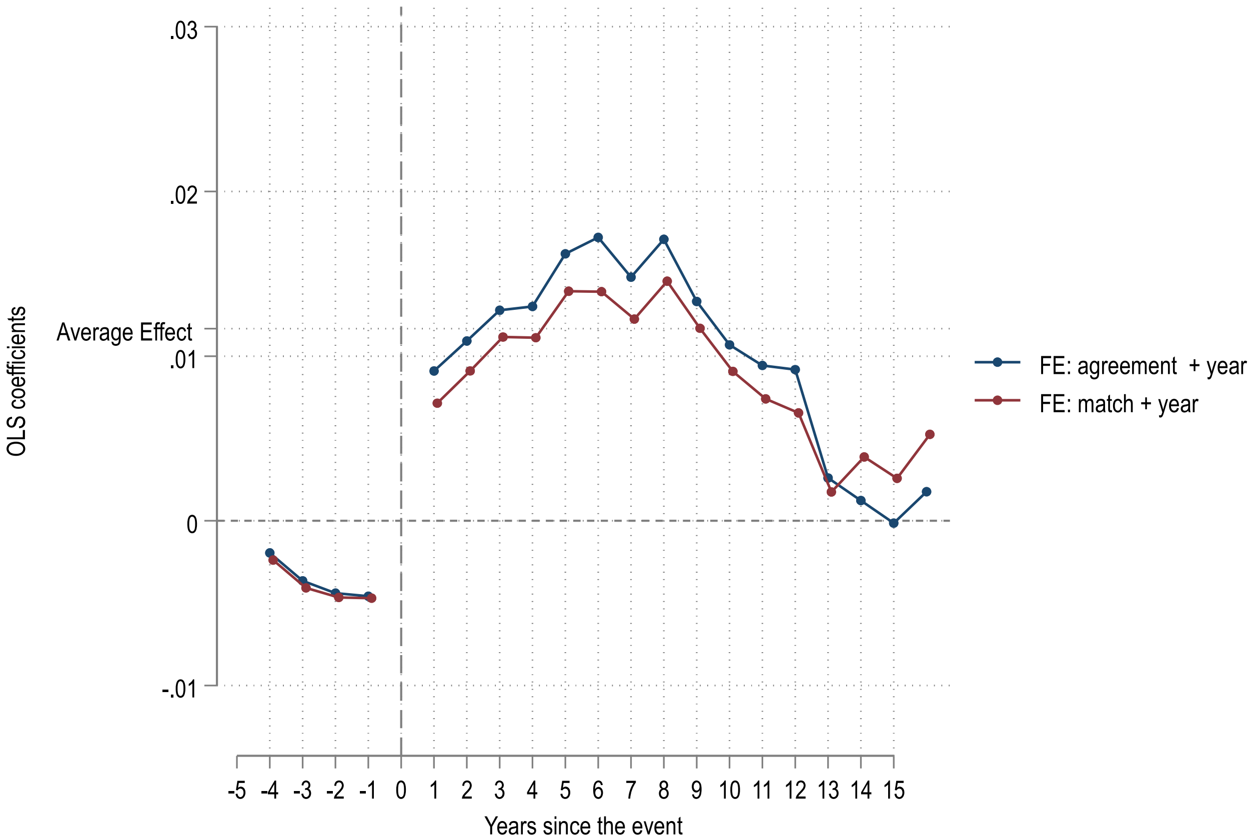


Table C6: Robustness - Dynamic specification of MTL.

	Dep. Variable: MTL_{gt}					
	(1)	(2)	(3)	(4)	(5)	(6)
Estimator	*OLS*	*OLS*	*OLS*	*OLS*	*OLS*	*Dynamic Panel*
Post RTA	-0.003***	-0.006***	-0.009***	-0.011***	-0.012***	-0.002***
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)	(0.001)
Post RTA x Fish Provision	0.003**	0.006***	0.008**	0.010**	0.011**	0.005***
	(0.001)	(0.002)	(0.003)	(0.004)	(0.005)	(0.001)
MTL (t-1)	0.967***					1.402***
	(0.005)					(0.009)
MTL (t-2)		0.894***				-0.286***
		(0.009)				(0.015)
MTL (t-3)			0.796***			-0.155***
			(0.013)			(0.015)
MTL (t-4)				0.689***		0.086***
				(0.017)		(0.015)
MTL (t-5)					0.584***	-0.379***
					(0.020)	(0.015)
MTL (t-6)						0.292***
						(0.008)
Ln GDP	-0.000	-0.000	0.001	0.002	0.005	0.002***
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)	(0.000)
Ln Marine Prot. Area	-0.001***	-0.001***	-0.001**	-0.001	-0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
Observations	11728	11728	11728	11728	11728	11460
R^2	0.996	0.987	0.976	0.965	0.956	

Figure C7: Results with alternative propensity scores

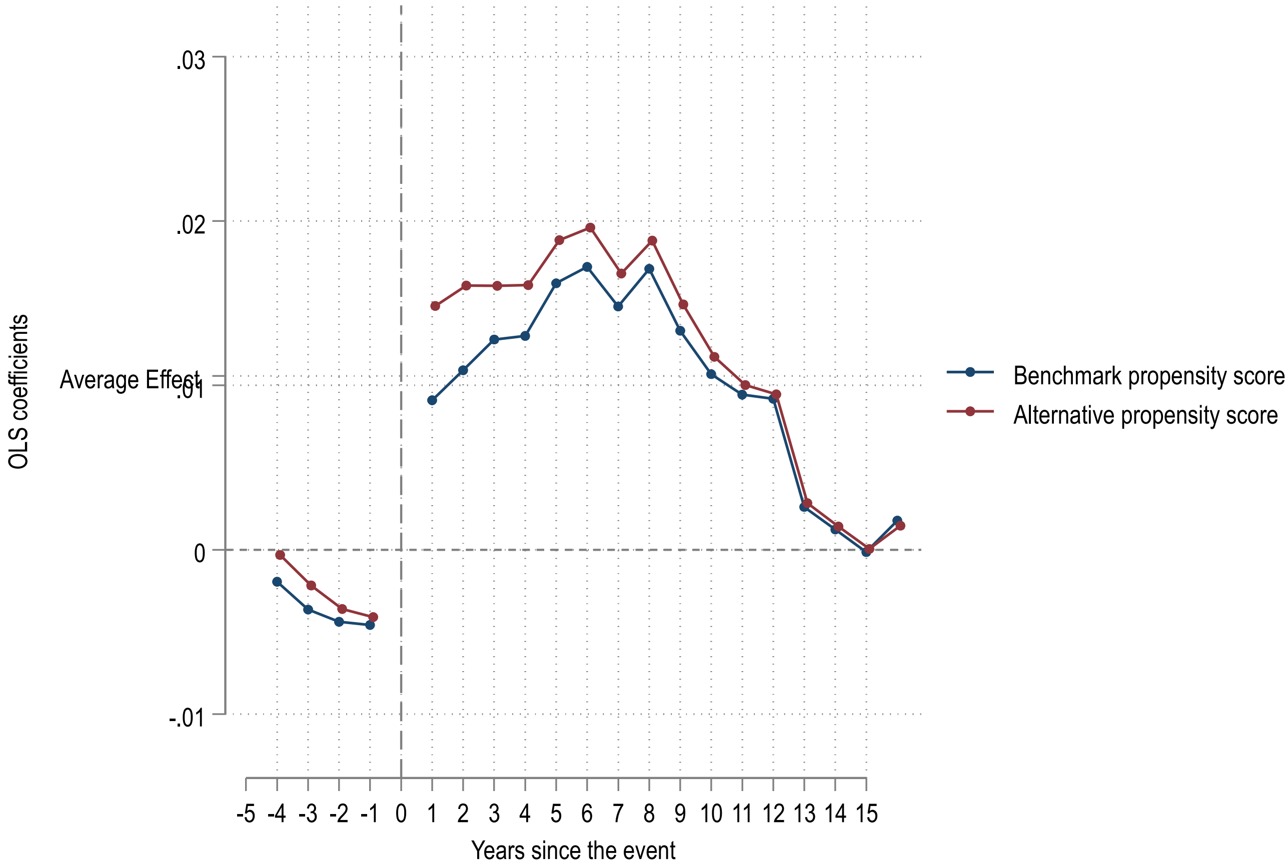


Figure C8: Dynamic, heterogeneity-robust estimations

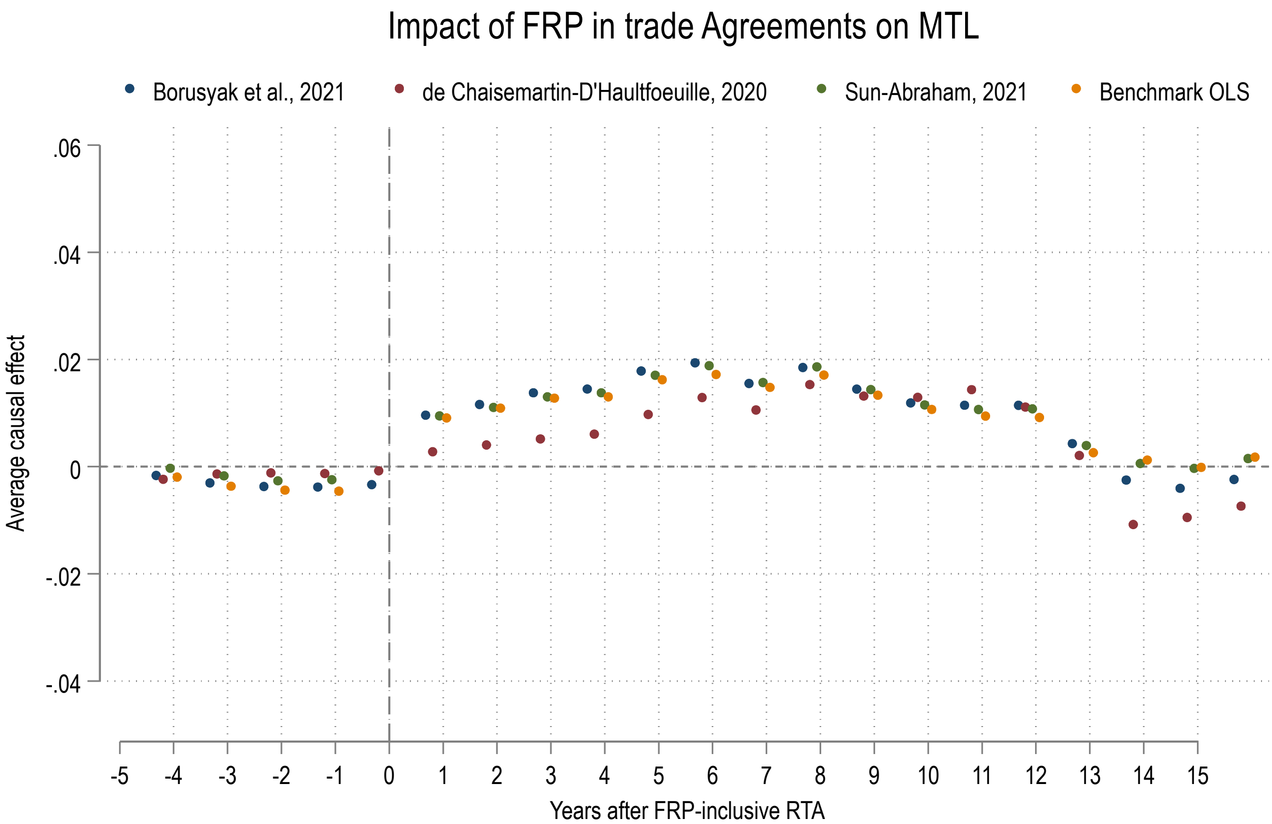


Figure C9: Constrained Matching

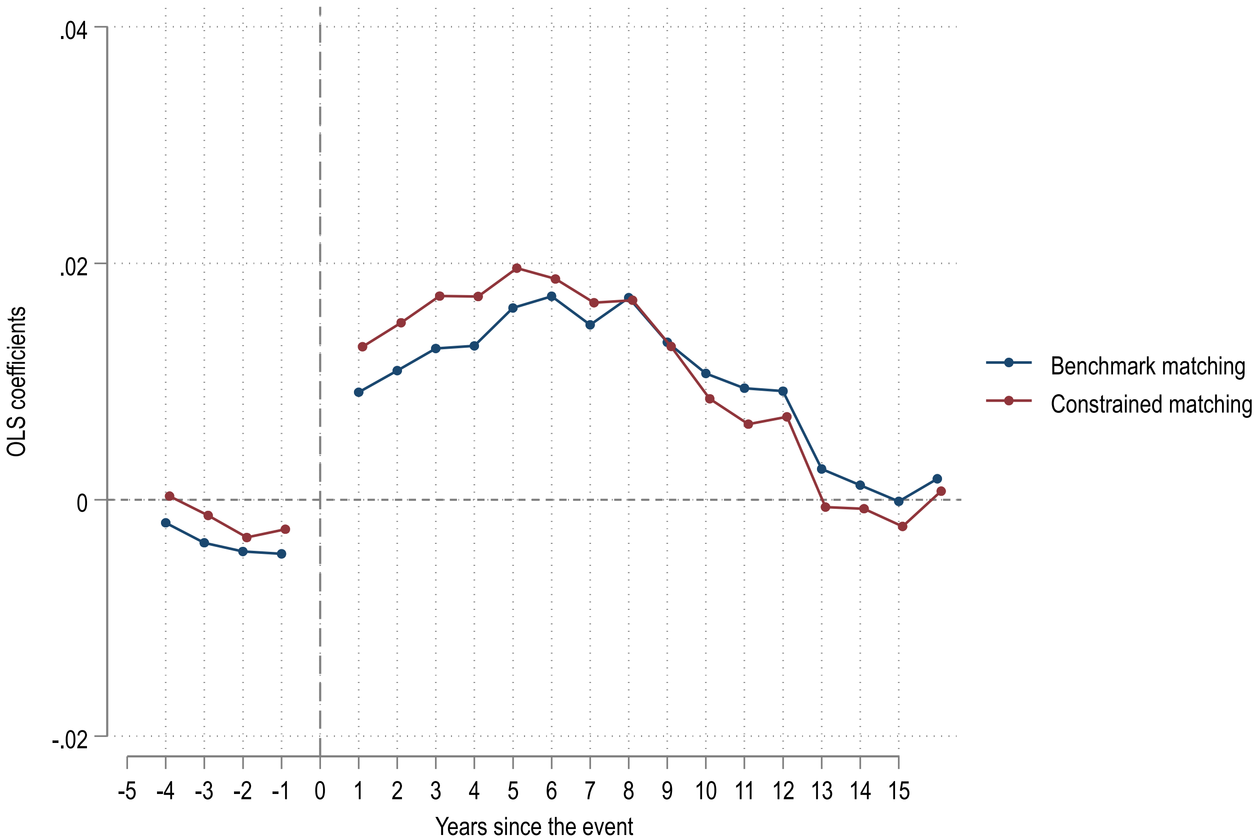


Figure C10 – Matching without any overlap