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OF BILATERAL TRADE FLOWS ONCE
BILATERAL RTAs ARE IMPLEMENTED

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Abstract

In this paper we study how 103 bilateral Regional Trade Agreements (RTAs) shape bilateral trade flows over time. The analysis of quarterly trade flows from 1982 Q4 to 2018 Q4 shows dynamic differences between RTAs and among trading partners. Results show that countries benefit unevenly from bilateral RTAs. The positive global trade trend since the 1990s and the negative effect of the 2008 economic crisis are captured by a factor analysis that allows us to study specifically how trade agreements affect bilateral trade asymmetrically. On average, RTAs lead to a 10% increase in bilateral trade flows above the mean trend, but disparities are found since Partial Scope Agreements (PSAs) tend to boost bilateral trade more than Free Trade Agreements (FTAs) (21% compared to 9%). However, most of the effects of PSAs occur during the first four quarters after the agreements come into force, whereas FTAs have effects over a longer period. The current study uses cluster analysis to classify bilateral trade flows into homogeneous groups according to the dynamic impact that RTAs have on them. This allows the heterogeneity between clusters to be explored. Moreover, the results show a difference relating to the economic crisis starting in 2008: in general, the impact on bilateral trade of agreements in force before 2008 is positive (30%), while it is negative for agreements signed after 2008 (-9%). This indicates that RTAs play a heterogeneous role as a cycle smoothing mechanism. Finally, there is evidence of an anticipation effect: we find that for more than half of the bilateral trade flows studied, the effect of the bilateral RTA is detected before it comes into force.

Keywords: bilateral RTAs, dynamic asymmetries, factor analysis, impulse responses.

JEL classification: F02, F14, F15, C22, C51.

Resumen

En este trabajo se estudia cómo 103 acuerdos comerciales regionales (ACR) bilaterales influyen en la evolución de los flujos comerciales bilaterales a lo largo del tiempo. El análisis de flujos comerciales trimestrales desde el segundo trimestre de 1982 hasta el cuarto trimestre de 2018 muestra diferencias dinámicas entre ACR y entre socios comerciales. Los resultados revelan que los países se benefician de forma desigual de los ACR bilaterales. La tendencia global positiva observada desde los años noventa, así como el impacto negativo de la crisis de 2008, se capta mediante un análisis factorial, de manera que se pueda estudiar específicamente el efecto asimétrico de los ACR bilaterales. De media, los ACR bilaterales promueven un aumento del 10 % en los flujos comerciales bilaterales por encima del comportamiento medio, pero se encuentran diferencias, dado que los acuerdos de alcance parcial (AAP) tienden a fomentar el comercio bilateral más que los acuerdos de libre comercio (ALC) (un 21 % respecto a un 9 %). Sin embargo, los AAP concentran sus efectos en los primeros cuatro trimestres tras la entrada en vigor de los acuerdos, mientras que los ALC tienen efectos más duraderos. Gracias al análisis de clústeres, el presente análisis permite una clasificación de los flujos comerciales bilaterales en grupos homogéneos en función del impacto dinámico que tienen los ACR sobre estos. Se explora así la heterogeneidad existente entre clústeres. Asimismo, los resultados muestran una diferencia relacionada con la crisis de 2008: en general, el impacto en el comercio bilateral de los acuerdos en vigor desde antes de 2008 es positivo (30 %), mientras que este es negativo para aquellos acuerdos en vigor desde 2008 (-9 %). Esto muestra que los ACR desempeñan un papel heterogéneo como mecanismo suavizador del ciclo económico. Finalmente, existe evidencia del efecto anticipación: para más de la mitad de los flujos comerciales analizados, el efecto de los ACR bilaterales se detecta antes de la entrada en vigor de estos.

Palabras clave: ACR bilaterales, asimetrías dinámicas, análisis factorial, funciones respuesta-impulso.

Códigos JEL: F02, F14, F15, C22, C51.

1 Introduction

After decades of proliferation of bilateral and multilateral trade agreements, the process of globalisation is currently experiencing important changes. Particularly, trade agreements have evolved and so have their purposes (see Fig.1). As Rodrik (2018) points out, the contents of trade agreements has evolved throughout history: they have expanded from a simple reduction of trade tariffs to deep integration. Indeed, new aspects of trade have been included in the past years in trade agreements such as investment, rules of origin, competition aspects and services as an example, making the study of their effects more difficult to assess.

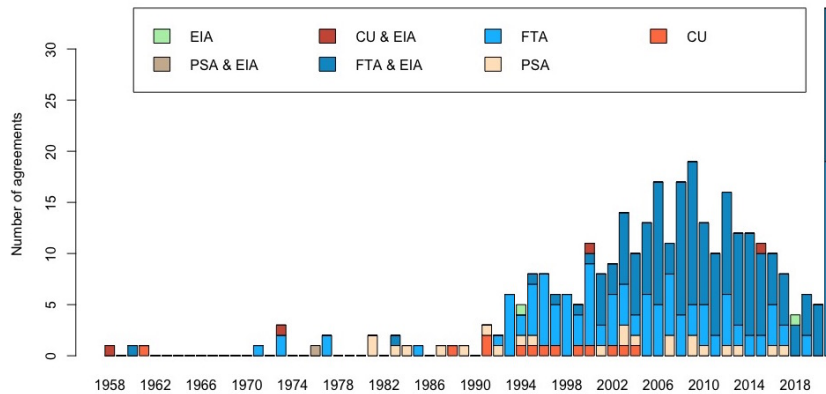


Fig. 1 Evolution of RTAs (1958-2021). Source: WTO RTA-IS.

As a consequence, the objectives of trade agreements are also different: if former trade agreements aimed at stopping protectionism by cutting trade tariffs, new trade agreements may increase the market power of the signatory countries. The increased complexity of trade agreements makes it more difficult to predict how trade flows will change after an agreement enters into force from an ex-ante perspective.

Fig. 2 shows that bilateral trade flows of both countries had similar trends before the entry into force of the bilateral RTA between the USA and Singapore in 2004 (dashed vertical line). However, after 2004 there seems to be a growing difference between both trade flows. Does trade react more rapidly in one country than the other after the entry into force of the agreement? Does this evolution depend on the type of trade agreement that was signed?

We describe here a novel approach in the quantification of the evolution of bilateral trade flows once RTAs are implemented. We employ a time series approach in order to find dynamic effects and how they change over time. We purposely focus on bilateral trade flows from countries that participate in bilateral RTAs, excluding country pairs that have

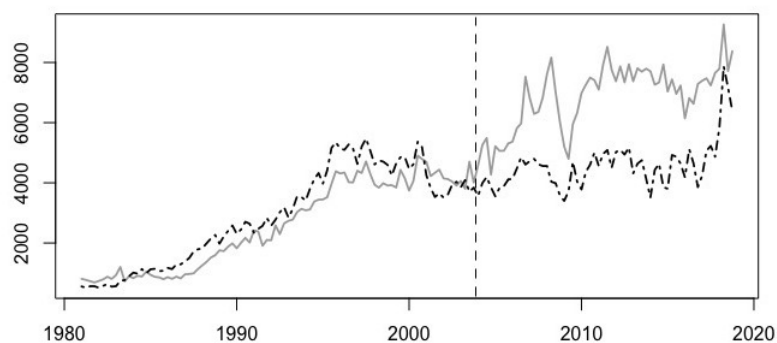


Fig. 2 Bilateral trade series between the USA and Singapore (in millions of US dollars): quarterly exports from the USA to Singapore (grey line) and quarterly exports from Singapore to the USA (black dotted line)

not signed an agreement. Countries sharing a same RTA might benefit differently from it, not only in aggregate terms but also when considering different moments in time. Thus, studying the dynamics of bilateral trade flows gives us a different approach of what happens when bilateral trade agreements enter into force and allows us to analyse another aspect of heterogeneity not considered in the related literature.

Since Tinbergen first employed the gravity equation for international trade purposes, gravity equations have been the workhorse to assess the impact of trade agreements on bilateral trade flows focusing mainly on a long-term horizon. For instance, Baier and Bergstrand (2007) point out an FTA approximately doubles two members' bilateral trade after 10 years. In addition, Baier and Bergstrand (2007) find an average treatment effect of FTAs between 0.61 and 0.76 (thus, a trade enhancing effect). Furthermore, Kohl (2014) finds that FTAs enhance trade by 50% at most.

In general, different studies find positive and significant average results (trade creation effects). More recently, heterogenous effects have been analysed (Kohl et al. (2016) and Baier et al. (2019)) and results reveal that contributions of trade agreements to economic welfare can be different among participants. For Kohl's study, 27% of the FTAs analysed have a positive and significant effect on trade. This percentage rises up to 54% of the agreements analysed in Baier et al. (2019). A common thread in all these studies is that they focus on the long-term and remain silent on the timing of these differential effects.

We intentionally focus on country pairs that participate in bilateral RTAs and keep out country pairs that have not signed an agreement. We are not trying to study the causal effect of trade agreements on trade volume, which has already been addressed by the literature (see Maggi (2014) for a theoretical and empirical survey of the economics of international trade agreements), but we intend to examine whether different countries and trade flows respond differently in the period right before and after the signature of an agreement with a short-term perspective.

We present here a complementary analysis where we study aggregated bilateral trade flows in a time series perspective. As a matter of fact, given that trade agreements have emerged and evolved quite rapidly, it might be accurate to assume that their effects might have also changed over time. In addition, the time series approach allows us to observe how bilateral trade flows evolve after the entry into force of an RTA.

We proceed as follows. Considering that bilateral trade flows are influenced by the international trade events and that the global economic crisis of 2008 was devastating for international trade, we employ the factor analysis in order to capture both trends. Once both events (captured in a common factor) are isolated, we focus on deviations from this trend and estimate the particular effects of bilateral RTAs using transfer functions and studying their impulse response functions. We are therefore able to assess the intertemporal changes in trade as well as phase-in effects (considering that the liberalisation in trade agreements is realised gradually over the course of several years). In addition, this approach lets us compare the idiosyncratic component of RTAs across a large number of bilateral RTAs over time. To our knowledge, no study in international trade has applied a similar methodology. In addition, since the time horizon is wide, the current study effectively analyses RTAs' impacts on bilateral trade flows before and after the Great Recession.

Since the extensive literature that analyses the causal impact of trade agreements finds a positive effect, we expect that the average effects of RTAs on trade flows should be positive. However, we consider the presence of heterogeneity since some RTAs are more successful than others and bilateral trade flows are asymmetrically affected by a same agreement. In addition, given the evolution of trade agreements and international trade, the effects might not be constant over time. The time series approach allows us to consider the evolution of the effects, analysing the specific effect in each quarter. Moreover, this approach lets us study separately each bilateral trade flow in order to examine the heterogeneity among trade partners. Following Kohl (2014), we assume that this heterogeneity is related to the trade agreements' characteristics.

We find that the average total effects are positive: on average, an increase in 10% above the mean trend is observed. However, effects are different in the short and the medium term. In addition, FTAs and PSAs affect bilateral trade differently as well as agreements in force by Art. XXIV and the Enabling Clause (EC). The type of agreement is therefore a distinction and might be a determinant of the effects. Furthermore, countries benefit from bilateral RTAs differently not only in aggregate terms but also considering several time horizons. We

also find that the economic size and the number of agreements in which countries participate are not factors explaining the dynamic effects. Moreover, results vary when we divide the sample into two periods: bilateral agreements signed before the economic crisis of 2008 affect bilateral trade flows greater (30% above the mean trend) than those whose date of enforcement is after 2008 (9% below the mean trend). We also find evidence of the "anticipation effect" (McLaren (1997) and Baier and Bergstrand (2007)): for 52.2% of the bilateral trade flows studied, the effect of the bilateral RTA has been observed before its effective date.

We believe that the trade agreements' specific characteristics might play a role in the effectiveness of the bilateral trade agreements and that this efficiency is different among trade partners. As Baier et al. (2018) showed, "heterogeneous partial effects are related to levels of development". We find that FTAs and PSAs affect differently bilateral trade flows. Thus, the structure and contents of trade agreements might be relevant to explain (at least, partially) the heterogeneous effects they have on countries and, also, the different participation in international trade and mixed levels of development of countries.

The article is divided as follows. Section 2 presents the data used for the study, as well as the final model. In Section 3, the methodology employed is explained: first, the factor analysis that allows for a distinction between the common and the own performance of the trade series, and second, the transfer function that captures the effect of the entry into force of trade agreements for each trade series. In Section 4, results of the estimations are commented. Finally, this study ends with conclusions that might be of interest given the current trade policy debate.

2 Data and construction of the model

There are currently 304 RTAs notified to the WTO, from which 297 are strictly bilateral (country to country). From these 297 bilateral RTAs, 178 are in force. However, considering that countries born from the Soviet Union (Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Montenegro, North Macedonia, Tajikistan, Turkmenistan, Russia, Serbia, Ukraine and Uzbekistan) have only complete trade series since 1993 (2005 for Serbia and Montenegro as separate countries), we eliminate these countries from the current study as it would imply working with shorter trade series and a less number of agreements. In addition, countries like the Chinese Taipei and the Palestinian Authority do not have trade data available at the IMF and are therefore ex-

Table 1 Number of bilateral RTAs in force by country.

Country	Number of agreements	Country	Number of agreements
Japan	14	Macao	2
Chile	12	Morocco	2
United States	12	Sri Lanka	2
Peru	11	Argentina	1
China	10	Afghanistan	1
Republic of Korea	10	Albania	1
Singapore	10	Bahrain	1
Canada	9	Brazil	1
Turkey	9	Brunei Darussalam	1
Australia	8	Dominican Republic	1
India	8	Ecuador	1
Mexico	7	El Salvador	1
Panama	7	Iceland	1
Colombia	6	Indonesia	1
Malaysia	6	Laos	1
New Zealand	6	Mautitius	1
Thailand	5	Mongolia	1
Costa Rica	4	Nepal	1
Hong Kong	4	Norway	1
Israel	4	Oman	1
Pakistan	4	Philippines	1
Faroe Islands	3	Syria	1
Switzerland	3	Tunisia	1
Honduras	2	Uruguay	1
Jordan	2	Vietnam	1

cluded from the present analysis. Finally, countries like Cuba and Bhutan have partial data available, which could make the study less robust if they were included in the analysis. Consequently, they are also excluded from the study. *Table 1* shows the countries of our database with at least one bilateral RTA in force.

To construct the dataset for our model, we use the bilateral trade agreements notified and in force of the Regional Trade Agreements Information System (RTA-IS) from the WTO as well as the value of quarterly exports and imports of goods ¹(in millions of dollars) of those countries participating in bilateral RTAs from the Direction of Trade Statistics of the International Monetary Fund (DOTS-IMF) from Q4-1982 to Q4-2018.

The database is constructed with 103 bilateral trade agreements in force, which involves the analysis of 206 bilateral trade series (exports and imports). However, for three trade series (imports from Chile to Turkey, imports from Jordan to Canada and exports from Iceland to China), the number of missing observations is extremely high. Thus, these trade series are not considered for the study. The proportion of missing data is quite low and for those series with missing data, the trade series are interpolated by the Tramo-Seats programme through regression by the additive outlier approach.

Table 2 Number of bilateral trade series analysed by type of agreement.

Agreements in force	Before 2008	After 2008	Total
FTAs	90	97	187
PSAs	10	6	16
WTO Art.XXIV	84	93	177
Enabling Clause	16	10	26
Total RTAs	100	103	203

Table 2 shows the number of trade series according to the date of entry into force of their respective agreements. Almost 50% of the trade series analysed have an agreement that became effective before the economic crisis of 2008 and the other 50% after the 2008 crisis. Thus, apparently, whether there has been or not an economic crisis might not be closely related to the fact that countries sign more or less bilateral RTAs.

Bilateral Free Trade Agreements (FTAs) and Partial Scope Agreements (PSAs) represent 92% and 8% of the total bilateral RTAs analysed respectively. PSAs gather countries that lower or eliminate tariffs only for certain products. However, FTAs go further as they eliminate tariffs for a great number of products and incorporate additional rules. According to the way of notification to the WTO, 87% of the bilateral agreements analysed have been notified through the Article XXIV of the WTO while only 12% have been notified through the Enabling Clause (EC). Article XXIV of the WTO allows an exception of the non-discrimination rule by permitting WTO members to form Custom Unions or Free Trade Areas under some conditions. The Enabling Clause allows "derogations to the most-favoured nation treatment in favour of developing countries". This distinction might be relevant for our analysis, as it is one of the characteristics of the bilateral trade agreements and it is useful for our classification. Other characteristics of the agreements and the related trade series are summarised in the following tables.

Fig. 3 shows all the bilateral trade series analysed in this work: bilateral quarterly trade flows of countries which have at least one bilateral RTA in force. A distinction between exports and imports is made here only relative to the order of appearance in the name of the bilateral RTA. As mentioned before, exports from Country A to B should be equal to imports of Country B from A.

It can be observed that there is a common behaviour to all of them: an increase in trade since the 90's (trade series have a positive trend) and a depression in 2008-2009. The rise in trade flows since the 90's might be explained by the implementation of the WTO rules after the Uruguay Round in 1994 and the globalisation process. It involved the settlement of a multilateral trade system that allowed for global, wider and clearer common rules (compared to the previous ones). Thus, international trade eased and expanded. The depression of 2008 corresponds to the negative impact of the economic recession of 2008, when the

¹ Exports are expressed in f.o.b while imports are expressed in c.i.f. According to the IMF: "Exports from Country A to B should be equal to the imports of Country B from A, after taking into account the insurance and freight costs under the generally observed case that Country B imports are valued on a c.i.f. basis."

global economy collapsed. In addition, a second impact of the Great Recession is identifiable between 2012 and 2013.

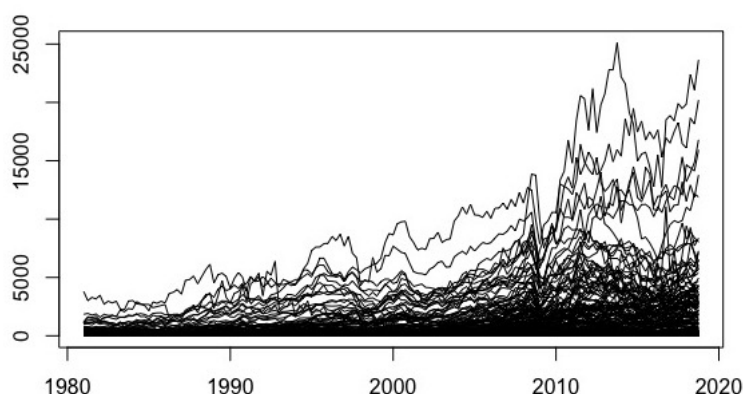


Fig. 3 All bilateral trade series analysed with a bilateral RTA in force (in millions of US dollars).

Hence, in order to accurately study the individual effects of the different trade agreements on trade flows, these common features need to be seized and isolated. They are therefore captured by factor analysis (see section 3.1).

As an example, Fig. 4 shows quarterly bilateral trade flows between the USA and Chile. Both countries share a common bilateral RTA since 2004. The vertical dotted line indicates the date of entry into force of the agreement (January 1st, 2004).

The common trend mentioned before is here depicted: trade flows grow particularly from the 90's and are negatively affected by the economic and financial crisis of 2008. Besides, both trade flows seem to grow at a faster pace after 2004. Before the enforcement of the agreement, both trade flows grow at a similar path. After 2004, they follow a different behaviour. The US exports to Chile (grey line) recover from the pre-agreement phase and exceed the Chilean exports (black dotted line) after the Great Recession. Thus, one should know if this specifically trait is related to the entry into force of the agreement. Particularly, do both countries benefit equally from the agreement in terms of trade? Can an agreement cause an asymmetry in the trade relation between two countries? Have the bilateral trade agreements played a different role as stabilising instruments among their trade partners? In

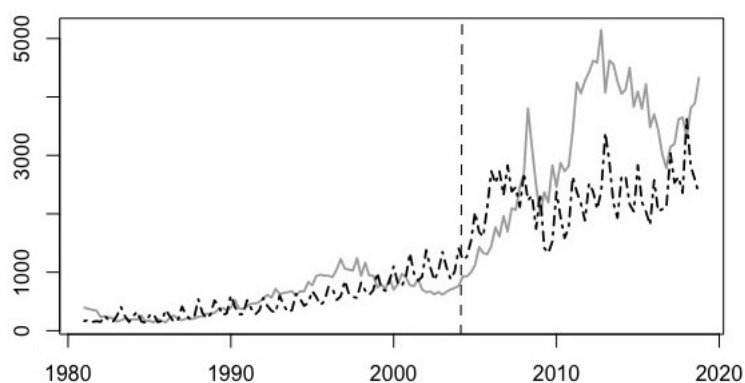


Fig. 4 Bilateral trade series between the USA and Chile (in millions of US dollars): quarterly exports from the USA to Chile (grey line) and quarterly exports from Chile to the USA (black dotted line).

order to answer these questions, transfer functions are used for studying the specific effect of bilateral RTAs (see section 3.2).

It is crucial to isolate the common trends from the individual effects of bilateral RTAs. The next section precisely studies the methodology employed in order to analyse how bilateral RTAs affect bilateral trade flows.

3 Methodology

In the previous section, the importance of capturing the common trend has been explained: in order to better seize the particular effects of each bilateral RTA (i,j) on the bilateral trade flows (ij and ji) of its signatory countries (i and j), the growing trend since the 90's and the deep depression of 2008-2009 must be isolated. Therefore, a common factor captures the mentioned common features and, once this effect is eliminated from each bilateral trade flow, the specific effect of bilateral RTAs will be depicted by transfer functions. Since a time series approach is employed, each trade series with a RTA in force ($T_{(i,j)}$) is specified as follows:

$$Y_{ijt} = f_{ijt} + m_{ijt} + N_{ijt} \quad (1)$$

where

- Y_{ijt} : bilateral trade flows, exports from country i to country j .
- f_{ijt} : common component obtained in the factor analysis (see section 3.1).
- m_{ijt} : change in the mean function due to the entry into force of each agreement (see section 3.2).
- N_{ijt} : own dynamic of the series.

In the next two sections, both the factor analysis and the transfer function methodologies are explained.

3.1 Factor analysis

Before quantifying the trade agreements' effects (by the means of transfer functions), it is important to isolate them from other economic episodes that might interfere. We therefore extract global common behaviours to all trade series. Following Stock and Watson (2002)'s methodology and Peña and Box (1987), we capture the common trend to all trade series that have a bilateral RTA in force with a factor: the trade expansion due to the globalisation phenomenon and the deep recession starting in 2008. This way, it is possible to isolate the effect of each trade agreement once the common effect has been eliminated and captured by this factor.

Bilateral trade series are first transformed. Since we follow Box and Jenkins' methodology, all trade series are log-differenced, and some are even seasonally adjusted in order to work with stationary trade series. Therefore, each trade series has its own transformations. The factor and transfer functions will have a slightly different interpretation for each series depending on the transformations applied.

According to Stock and Watson (2002):

$$Y_t = \Lambda F_t + e_t \quad (2)$$

where

- Y_t : vector of stationary time series (stationary bilateral trade flows).
- Λ : weight matrix.
- F_t : vector of common latent factors (F_{1t}, F_{2t}, \dots).
- e_t : idiosyncratic perturbations.

As a consequence, each trade flow is explained by a unique common factor (F_{1t}) that captures the growing trend (globalisation) and the deep recession of 2008.

Fig. 5 shows the factor that captures precisely both features. Only one factor (F_{1t}) is necessary since the purpose of the analysis is to capture an average trend of all the countries that have a bilateral RTA in force. It should be noticed that Fig. 5 shows the factor obtained with all trade series transformed (stationary trade series). Hence, it displays a common trend

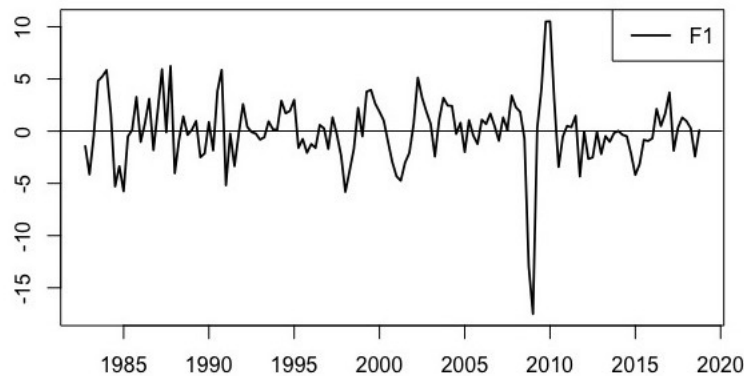


Fig. 5 Common factor (F_{1t}) to all trade series with a bilateral RTA in force.

in terms of growth. From 1985 to 2007, the factor displays an increase in trade denoting the global trade growth mainly due to globalisation (an important rise in international trade and global trade relations). However, it also shows the deep impact of the Great Recession of 2008 with the intense decline in global trade. In addition, international trade does not recover until 2015, date when trade flows seem to grow again (as the factor above 0 shows). To summarize, the factor captures the growth in trade flows from the period containing the 80's, 90's and 00's but it also captures the profound economic and financial recession affecting international trade from 2008. Additionally, the common factor also reveals how economies with a bilateral RTA in force are interdependent since they share a global common behaviour.

However, it is significant to point out that the common factor is not identical to all trade series.

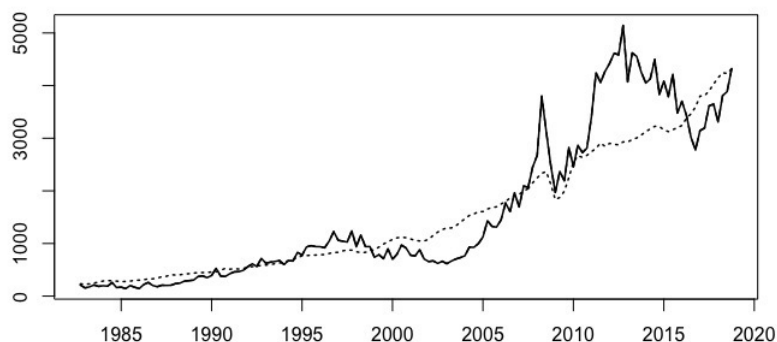


Fig. 6 The US exports to Chile (Y_{ijt}) (black line) and the scaled factor (f_{ijt}) (dotted line) (in millions of US dollars).

As Fig. 6 shows, the factor is scaled for every trade series. Since we have inverted the transformations employed in this series, it is now noticeable how the common factor affects this specific series. We appreciate a positive trend and a depression corresponding to the economic crisis of 2008, captured by the scaled factor. However, the factor does not seize the specific impact of the bilateral FTA in force since 2004. A transfer function is thus needed.

3.2 Transfer function

According to Box and Tiao (1975), transfer functions are useful to obtain dynamic responses given an intervention to the system. The system is, in this case, bilateral trade flows and the intervention is the entry into force of each trade agreement. Transfer functions are therefore helpful to analyse how the effect of every trade agreement spreads across time (short, medium and long run). We combine the factor analysis with the transfer function method in

order to study the specific impact of bilateral RTAs on bilateral trade flows. Thus, from Eq. (1), we obtain that:

$$Y_{ijt} = \underbrace{\alpha_0 + \alpha_1 F_{1t}}_{f_{ijt}} + \underbrace{\frac{\omega(B)}{\delta(B)} B^b RTA_t^T}_{m_{ijt}} + \underbrace{\frac{\theta(B)}{\phi(B)} u_{ijt}}_{N_{ijt}} \quad \forall i \neq j \quad (3)$$

where

- α_0 : drift of the series.
- α_1 : variance related to the scaled factor F_{1t} .
- $\frac{\omega(B)}{\delta(B)} B^b RTA_t^T \simeq \sum_{i=b-1}^{\infty} v_i RTA_{t-i}$: sum of the dynamic responses. The total effect can be calculated as the sum of the instantaneous effect (v_0), plus the effect a period after (v_1), and so on. B^b is a lag operator that indicates the exact moment when the consequences of the agreements' enforcements appear, which can be before ($b < 0$) or after ($b > 0$) their actual entry into force (T).
- RTA_t^T : a step function where T is the moment of entry into force of the agreement between countries i and j .

$$RTA_t^T = \begin{cases} 1, & \text{if } t \geq T \\ 0, & \text{otherwise} \end{cases} \quad (4)$$

- $\frac{\theta(B)}{\phi(B)} u_{ijt}$: ARMA (p, q) process approximation, own dynamic of the series.

The parameters for every trade series are estimated by Maximum Likelihood. For each trade series, the dynamic response is different. Box et al. (2015)'s methodology is used for the identification of the ARMA (p,q) models as well as for the estimation and validation of each model.

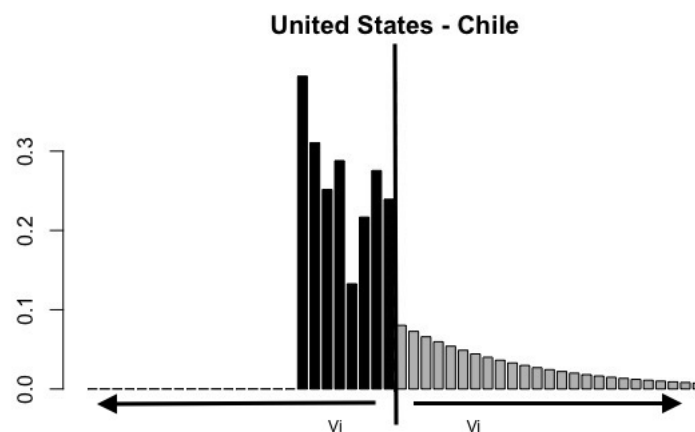


Fig. 7 Dynamic responses (v_i) of the US exports to Chile (grey bars) and the Chilean exports to the USA (black bars).

Fig. 7 shows the dynamic responses of the bilateral trade flows between the USA and Chile. Each bar corresponds to a v_i and, in order to make the comparison easier, the vertical dotted line separates the impulse responses of the Chilean exports (black bars) from the impulse responses of the US exports (grey bars). As an example, the instantaneous effect of the bilateral RTA between the USA and Chile on the US exports to Chile is $v_0 = 0.08$. This means that the agreement has immediately enhanced the US exports by 8% above their mean trend. In contrast, this effect is higher for the Chilean exports (24%). Even if both effects are positive (all bars are above 0), they are not symmetrical. Firstly, the scale of the total effects is completely different: calculated as the sum of each bar $-\sum_{i=0}^{\infty} v_i$, it is 211% for the Chilean exports compared to 85% for the US exports. Secondly, the spread of the effects is dissimilar: the Chilean exports have a shorter effect (the effects disappear 8 quarters after the entry into force of the agreement) than the US export flow whose effects spread longer in time and fade away slowly. That the effects disappear 8 quarters after the effective date

does not mean that there are no more effects of the bilateral RTA on the Chilean exports to the USA: on the contrary, it implies that after 8 quarters, the Chilean exports should behave as the mean (captured by the factor F_{1t}).

Fig. 8 depicts precisely the specific effect of the bilateral RTA between the USA and Chile on the US exports to Chile.

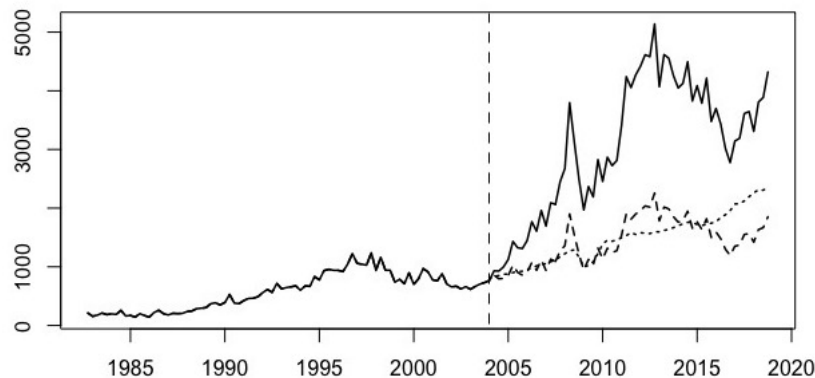


Fig. 8 The actual US exports to Chile (Y_{ijt}) (black line), the scaled factor ($f_{ijt}|RTA^{2004}$) (dotted line) and the US exports to Chile if no effect of the agreement is detected (dashed line) (in millions of US dollars).

As it is shown, the dashed line displays the US exports to Chile if no effect of the agreement between both countries is observed. The dotted line shows the trade flow behaving as the mean of the bilateral trade flows analysed (with bilateral RTAs in force, Fig. 3). Finally, the black line displays the actual US exports to Chile (the observed series). The difference between the black and the dashed line is the actual impact of the bilateral agreement on the US exports to Chile. It is clear how this bilateral FTA has enhanced the US exports: they grow more than if the agreement has no effect and more than the average progression of all the trade series analysed. In this case, the bilateral FTA has enhanced considerably this particular trade flow. As it was displayed in Fig. 7, the effect is considerably positive (the v_i are positive).

As an example, in the first quarter of 2007, the US exports reached \$2064.4 million while it would only reach \$1090.9 million if the agreement was not in force. Hence, the agreement almost doubled the US exports at this time. This difference is even bigger two years later. This agreement has therefore a positive impact on the bilateral trade flows of its signatory countries.

This analysis implies to consider the fact that trade series are affected by global events such as economic crises and to isolate these episodes is essential to assess the particular impact of trade agreements on trade flows. The factor analysis employed in this paper, which has been used for different economic issues addressed by central banks, helps to distinguish global episodes from specific events. It takes into account the behaviour of all the time series analysed and removes a common trend to all of them. This trend corresponds to the common factor: common because it affects all the trade flows analysed but it is also specific to each trade flow since every trade flow is affected differently by global common events. Once the common factor is isolated, we are able to quantify the specific influence of each trade agreement on each trade flow. In particular, we introduce a shock in each time series that corresponds to the date of entry into force of each agreement. This shock is captured by a transfer function and allows us to quantify how the trade flows react to the agreements. The response of the trade flows to the trade agreement takes into account not only the size of the impact but also its length. Moreover, since this analysis is done for each time series separately (each trade flow), we are able to compare the effect of a same bilateral trade agreement on two different trade flows.

In comparison to the gravity model, this approach eliminates variables (traditionally included in gravity equations as important determinants) that remain almost constant over

time (population, distance, etc.) since we consider transformations such as differences (the differences of variables that stay almost at the same level over time are closed to zero). In this way, the time series emphasises the time aspect of trade flows and trade agreements. The comparison between the gravity model and our approach is not straightforward: we focus on bilateral trade flows that might have been affected by RTAs and we quantify how these effects spread over time.

To summarise: bilateral exports and imports share only one common feature, that is, a bilateral trade agreement in force. However, the impact of this agreement on both trade series is asymmetrical according to the methodology employed. The amount of the effects (positive or negative), their scale and their spread over time (more concentrated in the short or in the long run) are some of the differences. In addition, the moment at which the effects are detected is also a difference (the b in Eq. (3)). For this example, $b = 1$ for the US exports implying that the impact has occurred a period after the effective date, and $b = 3$ for the Chilean exports, meaning that the impact of the bilateral agreement is observed two quarters later for the Chilean exports than for the US exports.

Expectations might thus play an important role when signing a trade agreement: if effects are remarked before the actual entry into force of the agreements (it is the case for 52% of the trade series analysed), it could imply that countries tend to prepare their economies and look for some stability when adopting a bilateral RTA. This is an evidence of the anticipation effect discussed in McLaren (1997) and in Baier and Bergstrand (2007) among others.

4 Estimates and results

4.1 Global results

As shown in the previous section, FTAs do not affect trade in both directions symmetrically.

Since the aim of this study is to analyse the dynamic responses of the trade flows, we distinguish short-term (STE: $\sum_{i=0}^3 v_i$) and medium-term effects (MTE: $\sum_{i=0}^7 v_i$). Baier and Bergstrand (2007) point out that every FTA is phased-in over 10 years. However, according to our analysis, for a high percentage of the agreements, their specific effects fade away after 8 quarters of the effective date. We consider that it is reasonable to assume that the short term is a year after the actual entry into force of each agreement and that the medium term is two years later. Of course, the entire effect of the agreements is captured by adding all the responses (TE: $\sum_{i=0}^{\infty} v_i$).

The analysis of the 203 transfer functions shows that for 45% of the cases, trade agreements have a total null effect. This does not imply that trade agreements do not have an effect since we have eliminated a common trend for all of the series. It indicates that trade agreements do not improve or deteriorate in comparison to the situation where the effects of the agreements are zero. It seems in line with Kohl (2014): "estimates of the agreements' individual effects on trade are often zero when endogeneity bias has been eliminated". On the contrary, for 34% of the series, trade agreements have a positive effect: they strengthen the increasing trend captured by the factor and the own dynamic of the series (see Fig. 6). For 20% of the bilateral trade series analysed, however, the effect is negative: trade agreements contribute to diminish the growing trend observed.

Our results are expressed relatively to a common trend that is captured by a common global factor (F_1). The results presented in the different tables of the paper must be understood as the agreements effects in comparison to the common dynamic. It is therefore a complementary approach to gravity equations. It should be mentioned that direct comparisons between gravity models' results and our results do not seem suitable.

On average, the total effects (TE: $\sum_{i=0}^{\infty} v_i$) are positive: bilateral RTAs boost bilateral trade 10% above the mean trend captured by the common factor.

The methodology employed in this study allows us to analyse not only an average effect for all the trade agreements but also how this effect spreads over time. In particular, on average, bilateral RTAs enhance bilateral trade flows 2% above the mean trend in the first

year after the effective date of entry into force. The impact is higher if we consider the medium term with an increase of bilateral trade flows by 10%. A first conclusion is therefore that the bilateral RTAs analysed enhance bilateral trade on average, but this increase is not constant over time: it is larger in the medium term.

Table 3 Mean effects by type of agreement and notification to the WTO.

Effects	Total (TE)	Short-term (STE)	Mid-term (MTE)
FTAs	0.090	-0.010	0.113
PSAs	0.213	0.389	-0.088
Art.XXIV	0.074	-0.021	0.108
EC	0.270	0.298	0.022
Total RTAs	0.100	0.020	0.100

In addition, *Table 3* also shows information about the mean total effects not only in a dynamic way but also by type of agreement. The mean TE for PSAs (21.3%) and ECs are higher than for FTAs and Art. XXIV. Since PSAs and ECs include particularly developing countries, it implies that bilateral RTAs involving developing countries tend to enhance bilateral trade more than bilateral RTAs involving developed countries. Of course, this should be nuanced. Bilateral PSAs and ECs involve developing countries but also developed countries. Hence, asymmetry in the degree of development is a possible factor of dynamic asymmetrical effects of bilateral trade agreements.

Moreover, it is also noticeable that the mean effects for PSAs and ECs are greater in the short term (38.9% and 29.8% respectively) than in the medium term (-8.8% and 2.2% respectively). The dynamic responses of PSAs and ECs are therefore different compared to those from FTAs and Art. XXIV. On average, bilateral RTAs involving developing countries concentrate the positive effects on bilateral trade in the quarters immediately following the entry into force. Since dynamic effects are different according to the type of agreement, the features of trade agreements might also play an important role in their effects. It is possible that shallower RTAs (associated with developing countries) do not promote long-lasting trade effects.

To extend the previous information, *Table 4* shows the distribution of the total effects (TE) among the bilateral trade series studied.

Table 4 Proportion of trade series distributed according to the total effects in the short and medium-term.

	Short-term effects			Mid-term effects		
	$STE > 0$	$STE = 0$	$STE < 0$	$MTE > 0$	$MTE = 0$	$MTE < 0$
% of series analysed	45%	17%	38%	46%	21%	33%

The positive effects are slightly more present in the short (45% of the cases) and the medium term (46%), supporting the previous conclusions. However, more trade series present a null effect from the bilateral RTA in the medium (21%) than in the short term (17%). This could imply that during the second year after the effective dates, the effects that still persist and have not disappear are mainly positive. As previously mentioned, for 34% of the cases, the bilateral RTAs have a positive effect: bilateral trade flows grow more than the average and more than if no agreement had been signed. However, this positive effect is not constant over time. In the next section, we present the results by country showing how RTAs affect countries' trade unevenly.

4.2 Country results

As previously stated, bilateral RTAs affect trade partners heterogeneously. The next table presents the dynamic mean effects of bilateral RTAs for each country.

The total effects (TE: $\sum_{i=0}^{\infty} v_i$) are mainly positive except for Turkey, Australia, Malaysia, Costa Rica, Hong Kong, Faroe Islands, Honduras, Iceland, Bahrain, Brunei Darussalam,

Indonesia, Oman and Vietnam. A positive effect implies an increase above the natural mean and if no agreement has been signed. On the contrary, a negative effect implies that bilateral trade flows grow less than the average (of all the trade series with a bilateral RTA in force) and less than if the agreement has no effect at all.

Table 5 Dynamic mean effects by country: total, short and mid-term effects.

Country	TE	STE	MTE	Country	TE	STE	MTE
Japan	0.03	0.06	-0.01	Iceland	-0.76	-0.03	-0.24
Chile	0.54	0.010	0.21	Macao	0.00	-0.01	0.01
United States	0.16	0.03	0.14	Morocco	0.17	-0.12	0.40
Peru	0.06	-0.12	0.16	Sri Lanka	0.53	0.28	0.21
China	0.05	-0.04	0.11	Afghanistan	0.00	0.90	-0.70
Republic of Korea	0.11	-0.01	0.25	Albania	0.15	-1.16	1.20
Singapore	0.18	-0.09	0.21	Argentina	0.00	0.52	-0.32
Canada	0.29	-0.07	0.02	Bahrain	-0.21	-0.64	0.43
Turkey	-0.26	0.09	0.43	Brazil	0.00	0.52	-0.32
Australia	-0.03	0.08	0.00	Brunei Darussalam	-0.02	-0.05	-0.10
India	0.20	0.18	0.02	Dominican Republic	0.89	0.97	0.19
Mexico	0.06	-0.06	0.08	Ecuador	0.40	0.40	0.00
Panama	0.34	0.23	0.07	El Salvador	0.40	0.40	0.00
Colombia	0.08	-0.08	0.18	Indonesia	-0.03	-0.01	0.04
Malaysia	-0.91	0.14	0.01	Laos	0.17	0.19	-0.03
New Zealand	0.21	-0.09	0.16	Mauritius	0.26	0.44	-0.18
Thailand	0.13	0.09	-0.03	Mongolia	0.43	0.07	0.36
Costa Rica	-0.16	0.11	-0.08	Nepal	0.00	0.00	0.00
Hong Kong	-0.03	-0.15	0.19	Norway	0.56	-0.22	0.18
Israel	0.19	0.16	-0.15	Oman	-0.44	-0.58	0.77
Pakistan	0.34	0.24	0.13	Philippines	0.00	-0.19	0.30
Faroe Islands	-0.39	-0.35	0.81	Syria	1.29	-0.02	1.15
Jordan	0.37	0.51	-0.09	Tunisia	1.47	0.37	1.11
Switzerland	-0.23	-0.33	-0.69	Uruguay	0.26	0.22	-0.17
Honduras	-0.06	-0.58	0.52	Vietnam	-0.13	-0.12	-0.20

Table 5 shows that countries that benefit the most from bilateral RTAs (more than a 10% increase in bilateral trade flows) are not necessarily those that have the greatest number of RTAs in force nor those biggest in size (in terms of GDP). Indeed, countries whose RTAs enhance the most their trade are Tunisia, Syria, Dominican Republic, Norway, Chile, Sri Lanka, Mongolia, Ecuador, El Salvador, Jordan, Pakistan, Panama, Canada, Mauritius, New Zealand, India, Israel, Singapore, the USA, Albania, Thailand and the Republic of Korea. Important countries like Japan or China (in terms of GDP and considering their role in international trade) see their bilateral trade flows increase by 5% at most. Additionally, Malaysia, Turkey and Costa Rica have negative results: the bilateral RTAs in which they participate deter their bilateral trade flows. Since all the countries portrayed in Table 5 belong to the WTO since 1995 (with the exception of China that gained access to the WTO in 2001), we cannot consider being a member of the WTO as a determinant of bilateral trade. These results are also summarised in the Appendix.

To broaden the country analysis, Table 6 and Table 7 summarise the mean total effects (TE) by country trade flows for the 50 countries studied. It distinguishes the trade flows' effects between the short (STE) and the medium-term (MTE).

For example, for Japan, the mean total effect of the Japanese bilateral exports involved in bilateral RTAs is 0.02. This means that the Japanese bilateral exports grow on average 2% more than if the bilateral RTA had no impact at all. The Japanese bilateral imports rise 3% on average more than if the bilateral RTA had no impact. Hence, Japanese bilateral RTAs tend to enhance the Japanese imports more than its exports. However, the positive effect appears in the short run, while it is negative in the medium term. The contrary occurs with Chilean bilateral RTAs: they tend to benefit more Chilean exports (76%) than its imports (33%). In addition, there is a wider positive effect in the medium term than in the short run. Again, some countries that see their exports grow above the average trend are Chile, Pakistan, Panama, Singapore and the USA. These countries are also countries that benefit the most from bilateral RTAs (see Table 5). However, others like Canada, India, Israel and Thailand benefit more from bilateral RTAs in terms of imports.

If we compare exports and imports, some countries have different mean total trade gains. For instance, Peru's imports increase more than if its agreements had no effects whereas its exports decrease compared to the situation where the agreements have no effect. The

Table 6 Dynamic mean effects by countries' bilateral trade flows: total, short and mid-term effects.

Effects	TE		STE		MTE	
	Exports	Imports	Exports	Imports	Exports	Imports
Japan	0.02	0.03	0.13	-0.01	-0.06	0.04
Chile	0.76	0.33	-0.02	0.20	0.26	0.17
United States	0.23	0.09	0.06	0.01	0.06	0.21
Peru	-0.01	0.13	-0.07	-0.18	0.09	0.24
China	0.03	0.08	-0.13	0.07	0.11	0.11
Republic of Korea	0.02	0.21	-0.05	0.03	0.35	0.16
Singapore	0.28	0.08	0.04	-0.21	0.13	0.29
Canada	0.12	0.48	-0.09	-0.04	0.13	-0.11
Turkey	0.09	-0.66	-0.01	0.20	0.16	0.73
Australia	0.01	-0.06	0.06	0.09	-0.05	0.04
India	0.04	0.34	0.14	0.22	-0.06	0.10
Mexico	0.03	0.10	-0.13	0.00	0.10	0.05
Panama	0.32	0.37	0.10	0.37	0.19	-0.05
Colombia	0.11	0.05	-0.15	-0.02	0.18	0.17
Malaysia	-1.92	0.11	0.31	-0.03	-0.08	0.10
New Zealand	0.11	0.31	-0.01	-0.17	0.14	0.18
Thailand	0.09	0.17	0.04	0.14	-0.06	0.01
Costa Rica	0.00	-0.31	-0.09	-0.13	-0.01	-0.12
Hong Kong	0.13	-0.18	0.22	-0.51	0.02	0.36
Israel	0.08	0.30	0.16	0.16	-0.17	-0.12
Pakistan	0.48	0.21	0.22	0.26	0.33	-0.06
Faroe Islands	-0.04	-0.74	-0.28	-0.42	-1.70	0.08
Jordan	0.85	0.06	1.34	-0.04	-0.36	0.09
Switzerland	-0.54	0.09	-0.41	-0.24	0.33	-1.70
Honduras	0.26	-0.38	-0.78	-0.38	1.04	0.00

same behaviour can be observed for the Malaysian exports and imports. On the contrary, for Turkey, Australia and Costa Rica, their bilateral exports grow more, on average, while their imports are hindered by the introduction of a bilateral trade agreement.

In most of the cases, countries' trade benefit from a mean positive total effect from the bilateral RTAs: agreements tend to reinforce the positive trend observed for the trade flows studied. One conclusion is that whether countries have more or less bilateral RTAs in force does not seem to have an impact on the size and the sign of the trade agreements' effects. The countries' size (in terms of GDP and if we consider also in terms of a degree

Table 7 Dynamic mean effects by countries' bilateral trade flows. Cont'

Effects	TE		STE		MTE	
	Exports	Imports	Exports	Imports	Exports	Imports
Iceland	-0.39	-0.95	-0.39	0.15	0.00	-0.36
Macao	0.00	0.00	0.08	-0.09	-0.08	0.09
Morocco	0.00	0.33	-0.40	0.16	0.50	0.29
Sri Lanka	0.94	0.12	0.44	0.12	0.29	0.13
Afghanistan	0.00	0.00	0.63	1.17	-0.63	-0.76
Albania	1.25	-0.96	-1.32	-0.99	2.37	0.03
Argentina	0.00	0.00	0.58	0.45	-0.34	-0.30
Bahrain	-0.41	0.00	-0.85	-0.42	0.44	0.42
Brazil	0.00	0.00	0.45	0.58	-0.30	-0.34
Brunei Darussalam	-0.12	0.09	-0.28	0.19	0.00	0.20
Dominican Republic	0.54	1.23	1.14	0.80	-0.06	0.43
Ecuador	0.67	0.13	0.67	0.13	0.00	0.00
El Salvador	0.13	0.67	0.13	0.67	0.00	0.00
Indonesia	-0.06	0.00	-0.07	0.06	-0.03	-0.05
Laos	0.00	0.33	0.05	0.33	-0.05	0.00
Mauritius	0.30	0.21	0.57	0.30	-0.27	-0.09
Mongolia	1.30	-0.44	0.24	-0.11	1.06	-0.34
Nepal	0.00	0.00	-0.33	-0.35	0.33	0.35
Norway	-0.39	1.51	-0.39	-0.05	0.00	0.35
Oman	-0.88	0.00	-0.73	-0.42	1.11	0.42
Philippines	0.00	0.00	-0.07	-0.30	0.05	0.54
Syria	0.44	2.13	-0.47	0.44	0.91	1.39
Tunisia	2.97	-0.03	1.08	-0.35	1.89	0.32
Uruguay	0.51	0.00	0.51	-0.07	0.00	-0.34
Vietnam	-0.26	0.00	-0.13	-0.10	-0.37	-0.03

of market power) is therefore not a determinant of the effects of bilateral RTAs, contrary to what gravity equations might show.

Another distinction is presented regarding the short and the mid-term effects. More negative effects appear in the short-term for exports and imports. However, this effect seems to fade away in the mid run. In some cases, the short-term effects are negative for both trade flows (exports and imports) while the medium-term effects are positive (Peru, Colombia and New Zealand, for example). These countries benefit more from their trade agreements in the medium run. Other countries notice mixed effects in their trade flows in the short and in the medium term like Japan, Malaysia, Thailand and Hong Kong. Additionally, Israel, for its part, obtains a positive effect in the short term and a negative one in the medium term. This implies that Israel tends to improve its trade more in the short-term rather than in the long term.

As a consequence, countries do not benefit equally from a same bilateral RTA. In addition, asymmetries are also observed between trade flows of a same agreement: exports and imports are not equally enhanced by a same RTA. Trade agreements alter bilateral trade balances. It is particularly relevant to study how the total effects are distributed over time and how countries benefit from bilateral RTAs in different moments of time.

4.3 Cluster results

We proceed to examine the degree of homogeneity/heterogeneity of the effects found in the previous section. We employ a multivariate analysis to conduct a descriptive evaluation of the results. An interesting analysis is to see if the impulse responses (v_i) can be gathered in order to form homogeneous groups with some specific features. Two trade series should belong to the same group (or cluster) if their RTAs' effects are similar.

The purpose of clustering is to identify groups of observations (the impulse responses) that are cohesive and separated from other groups. We proceed following Fraley and Raftery (2002) with a model selection based in the mixture modelling approach. For clustering, a hierarchical or a partitioning approach is usually employed. The hierarchical clustering calculates a distance between a pair of observations and stores it into a distance matrix. Using a linkage method, it categorises the objects and forms a dendrogram where the shortest distance between groups is identifiable. For its part, the partitioning method is harder to estimate, mainly done by the K-means algorithm (or the iterative relocation, where the data points are moved from one group to another until there is no improvement in some criterion). It relies on the analyst's knowledge to classify the information in a meaningful way. The idea here is a mixture of both models (hierarchical and partitioning), keeping the advantages of both methods under some assumptions on how groups should be formed. It starts from the hierarchical approach (assuming different sizes and shapes of the groups) and applies the partitioning method to estimate different structures (in size and shape) in order to define an objective function based in mixed distributions. The process starts by initialising the expectation-maximisation (EM) with partitions from model-based hierarchical agglomeration. The number of groups present in the data is obtained by using approximate Bayes factors with the Bayesian Information Criterion (BIC) approximation. Estimation is done via Maximum Likelihood.

Cluster analysis is therefore applied for each bilateral trade flow's effects: for the short-term (v_0, v_1, v_2, v_3) and the medium-term effects ($v_0, v_1, v_2, v_3, v_4, v_5, v_6, v_7$). For the short term, the minimisation of the Bayesian Information Criterion (BIC) concludes that the optimal structure is ellipsoidal with equal shape and number of clusters is 7 while for the medium term it indicates that 6 is the optimal number of groups (the optimal structure is also ellipsoidal with equal shape). Table 8 shows the number of series included in each group, in the short and in the medium run. Each group is formed with trade series that are similarly affected by the RTAs analysed.

Table 8 Components of each cluster obtained by analysing the agreements' dynamic effects.

	Gr.1	Gr.2	Gr.3	Gr.4	Gr.5	Gr.6	Gr.7
Short run	38	21	18	52	23	30	21
Long run	50	31	18	51	31	22	-

We present here the results only for the short-term cluster analysis since the medium-term analysis is similar. In addition, the short-term cluster analysis uses less variables.

As previously mentioned, the short term includes the first four quarters after the bilateral trade agreements have entered into force (v_0, \dots, v_3). The idea is to find groups where similar short-term effects of the bilateral RTAs on bilateral trade flows are gathered.

Group 1 is mainly characterised by bilateral trade series having a decreasing negative effect from the RTAs. A decreasing negative effect implies that bilateral trade flows have grown less than the mean trend and also less than if the agreements had no impact. However, this impact is decreasing. An example of a series gathered in this group is the Japanese imports from Indonesia (see Fig. 9).

Group 2 has the peculiarity of including trade series with a declining positive effect. A representative series of this group is the Mexican imports from Uruguay (see Fig. 9).

Group 3 contains trade series whose effect swings around 0. The total effect in the short-term for the series included in this group is predominantly null: bilateral trade series tend to behave as the average trend. A characteristic series is the exports from the USA to Jordan (see Fig. 9).

Group 4 depicts also a null effect, but the fluctuations are smaller than for Group 3. Trade series forming this group obtain mostly a null effect of their bilateral trade agreements on their bilateral trade flows, as the Chilean exports to China show (see Fig. 9).

Group 5 gathers series with a declining positive effect between the first and fourth quarter. An example of series included in this group is the one presented before (see Fig. 4, Fig. 6 and Fig. 7), the US exports to Chile.

The last two groups have a particular feature. For Group 6, there is only a negative instantaneous effect. On the contrary, for Group 7, the effects plummet immediately from positive to null between the first and second quarter and stagnate at 0 afterwards. Hence, trade series included in these groups are series whose effects are only instantaneous and non-lasting such as the Canadian exports to Costa Rica (Group 6) and the Indian exports to Sri Lanka (Group 7) (see Fig. 9).

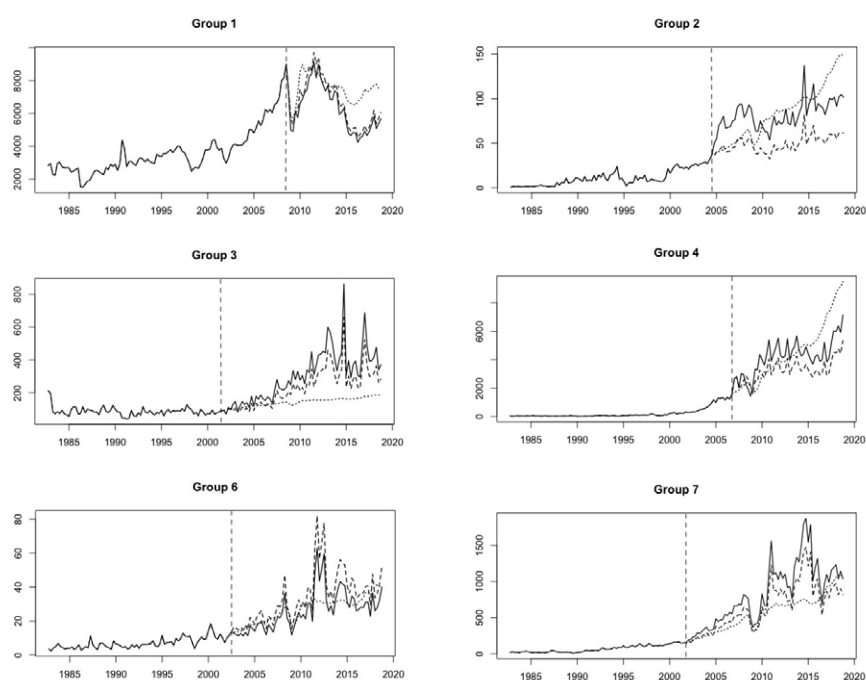


Fig. 9 Short-term clusters: Japanese imports from Indonesia (Group 1), Mexican imports from Uruguay (Group 2), US exports to Jordan (Group 3), Chilean exports to China (Group 4), Canadian exports to Costa Rica (Group 6) and Indian exports to Sri Lanka (Group 7) (in millions of US dollars). The vertical dotted line indicates the date of entry into force of each bilateral RTA.

To summarise some of the results, Fig. 9 displays a representative series of each group found in the short-term cluster analysis. Groups are made of series with similar short-term effects (similar v_0, v_1, v_2, v_3).

Group 1 clearly shows the declining negative effect mentioned before. As an example, the Japanese imports from Indonesia belong to this group. Both countries signed a bilateral RTA that entered into force in the third quarter of 2008 (vertical dotted line). From the time series displayed, it is clear that the agreement has a negative effect on this trade flow: with this agreement, the Japanese imports from Indonesia (black line) have grown less than the average trend (dotted line) and less than if the agreement has no effect (dashed line). Indeed, both the total effects (-6%) and the short-term effects (-7%) are negative.

A representative series of Group 2 are the Mexican imports from Uruguay. The observed series (black line) lie above the dashed line: the agreement has a positive effect since this trade flow grows more than if the agreement has no effect. However, the Mexican imports grow less than the mean effect (dotted line). The total effect of the agreement is 51%, exactly the same as the short-term effect. The mid-term effect is 0. As previously stated, this group is mainly formed by series with a declining positive effect.

Group 3 is characterised by series whose agreements have almost no effect. The US exports to Jordan are a perfect illustration: the difference between the behaviour with and without the bilateral RTA is small compared to other cases (difference between the black line and the dashed line). However, the US exports behave better than the mean trade flows (all the trade flows with a bilateral RTA in force): the total effect of this particular agreement is 27%.

Group 4 is similar to Group 3. The Chilean exports to China belong to this group. As it is shown in Fig. 9, the Chilean exports with the agreement in force (black line) behave better than if the agreement has no effect (dashed line) even if the difference is not especially wide compared to other cases. Both series are below the mean (dotted line): the impact is negative in the short term (-31%) and positive in the medium term (60%), that is why the total effect of this agreement on the Chilean exports is 29%.

Group 6 has only a negative instantaneous effect. As Fig. 9 displays, the Canadian exports to Costa Rica with the agreement in force (black line) behaving worse than if the agreement has a null effect (dashed line) and around the average behaviour of the trade series with a bilateral agreement in force. Indeed, the impact of this agreement is negative on this trade flow: the total effects are -26%.

On the contrary, trade series gathered in Group 7 have only an instantaneous positive effect in the first quarter. As an example, the Indian exports to Sri Lanka are a representative series of this group. The bilateral RTA between these two countries became effective the fourth quarter of 2001 (vertical dotted line). The impact is only immediate and positive (24%). Therefore, the total effects happen to meet the short-term effects. It is noticeable how the average trend of the bilateral trade flows analysed (dotted line) is below the actual performance of the Indian exports (with an agreement in force): the agreement has here a positive impact on the Indian exports as they grow more than the mean trend and more than the trend if the agreement has no effect at all (dashed line).

The cluster analysis uses the responses to the transfer functions and gathers the short-term responses (the first four quarters after the effects are noticeable on the trade flows) and the medium-term responses (the first eight quarters) into similar groups. Each group is formed with series that have been similarly affected by trade agreements. This means that knowing that a cluster is formed by trade series that have, for instance, a positive impact, there might be other shared characteristics between the members of a group: these could be the agreements' features, the countries involved in these agreements, etc. It must be pointed out that clustering the short-term and the medium-term responses gives different classifications. However, we found that nor countries nor regions were a shared trait between the members of the different groups (in the short and in the medium-term).

This method applied for the short-term effects (the first four impulse responses) shows homogeneous groups. Each group is formed with trade series whose agreements have a similar impact on bilateral trade flows. We find heterogeneity not only between bilateral RTAs but also among trade partners. Indeed, almost no pair of trade flows with a same bilateral RTA in force belong to the same cluster. Bilateral RTAs have dynamic heterogeneous effects on the bilateral trade flows of the signatory countries.

The clusters found in this work show the heterogeneity of the impulse responses of bilateral RTAs on bilateral trade flows, according to their distribution over time. This heterogeneity is present not only between RTAs but also among trade partners of a same agreement. The cluster analysis has separated the dynamic effects into homogeneous groups: having found 6 and 7 clusters shows how heterogeneous the dynamic effects can be. In addition,

since a low number of pairs of trade series belonging to a same agreement are gathered in the same cluster, bilateral RTAs do not affect both trade series symmetrically.

This study complements the heterogeneity found in Baier et al (2019) with a dynamic approach. The clustering of the dynamic responses allows us to better understand the asymmetrical effects of the bilateral RTAs. This asymmetry can derive from the own characteristics of the RTAs, following Kohl (2014) or the own characteristics of the signatory countries. We leave this study for a further research.

4.4 Additional findings

4.4.1 *The economic and financial crisis of 2008*

An interesting policy implication to study is whether bilateral RTAs have behaved differently before and after the economic and financial crisis of 2008 ² and thus if they are a good smoothing cycle tool for countries.

Table 9 displays the dynamic mean effects distributed before and after the Great Recession and, consequently, shows how bilateral trade agreements play a role as stabilising instruments. It shows the dynamic effects of the agreements that entered into force before the crisis and after the crisis.

Table 9 Dynamic mean effects by the date of entry into force and type of agreements.

Agreements in force	Before 2008			After 2008		
	TE	STE	MTE	TE	STE	MTE
Effects						
FTAs	0.30	0.03	0.11	-0.11	-0.05	0.11
PSAs	0.26	0.51	-0.15	0.13	0.19	0.01
Art.XXIV	0.28	0.01	0.10	-0.11	-0.05	0.11
EC	0.37	0.42	0.01	0.13	0.16	0.03
Total RTAs	0.30	0.08	0.09	-0.09	-0.04	0.11

In particular, the bilateral trade agreements that entered into force before 2008 have a positive mean total effect (30%), as well as in a dynamic way (8% for the short term and 9% for the medium term).

However, for agreements with an effective date after 2008, the effects are mixed. For all the RTAs that became effective after 2008, the mean total effects (-9%) and the mean short-term effects (-4%) are negative. Only the mean mid-term effects are positive (11%). This implies that the economic and financial crisis of 2008 has been devastating for international trade and that bilateral RTAs have not been a good smoothing tool to level such a negative and deep impact. However, as the mean medium-term effects are positive, bilateral RTAs might contribute to the trade recovery. Even with a bilateral RTA in force after 2008, bilateral trade flows grow less, on average, than the mean trend. Hence, it might be possible that bilateral RTAs do not have such a stabilising role as it was first thought. Nevertheless, this also denotes that countries might have different motivations for participating in a bilateral RTA.

Table 9 also shows that bilateral PSAs and bilateral ECs have different effects after 2008. They do offer a mean positive total effect (13%) as well as a mean total short-term effect (19% and 16% respectively) but, in the medium run, the positive effect diminishes considerably (1% and 3% respectively). Following the previous results (see *Table 3*), agreements involving developing countries differ from those involving only developed countries. PSAs and ECs tend to enhance bilateral trade not only for those signed before 2008 but also for those that entered into force afterwards. Again, the dynamic effects are more concentrated in the short term than in the medium term.

The dynamic effects considering the crisis of 2008 can also be studied by country (*Table 10* and *Table 11*). In general, countries tend to obtain greater total effects from the agreements that entered into force before 2008 than afterwards: more positive total effects are

² The start of the 2008 global economic crisis is taken to be on September 15th2008, date of the collapse of Lehman Brothers.

found for agreements enforced before 2008 whereas more negative results are found for agreements enforced after 2008.

Table 10 and Table 11 also show that some countries have signed bilateral agreements only before the crisis (Thailand, Israel and Pakistan) or only after the crisis (Peru).

This shows that RTAs affect countries unevenly and, according to the results, that they might not be such a stabilising instrument as we could have thought. As agreements might have changed before and after the global financial crisis, the heterogeneity might be related to the RTAs characteristics apart from each country's own features. The design of RTAs might play an important role in determining their effects.

4.4.2 The anticipation effect

Another result of our study is the evidence for the anticipation effect. Different authors have pointed out that nations trade more in anticipation of their governments enforcing a new trade agreement (see McLaren (1997), Baier and Bergstrand (2007), Ghosh and Yamarik (2004b) and Kohl (2014)). These authors draw attention to the fact that the effects of RTAs might occur before the actual implementation of the agreements for different reasons: governments might sign a RTA only after substantial changes in their trade levels, suppliers can reorient their exports in anticipation of future tariff reductions or infrastructure and delivery systems may be redirected to increase trade in anticipation of an agreement.

As we have seen, RTAs can affect trade flows before ($b < 0$) or after ($b > 0$) the enforcement date.

Table 10 Dynamic mean effects by country and date of entry into force of the agreements.

Agreements in force	Before 2008			After 2008		
	TE	STE	MTE	TE	STE	MTE
Japan	0.01	0.02	-0.03	0.05	0.10	0.01
Chile	0.88	0.13	0.31	0.17	0.06	0.11
United States	0.31	0.12	0.11	-0.05	-0.09	0.17
Peru	-	-	-	0.06	-0.12	0.16
China	0.13	0.01	0.12	0	-0.07	0.10
Republic of Korea	0.31	0.19	0.22	0.06	-0.06	0.26
Singapore	0.30	0.06	0.14	-0.10	-0.43	0.37
Canada	1.17	0.23	-0.04	-0.19	-0.23	0.05
Turkey	0.53	-0.10	0.67	-1.40	0.36	0.08
Australia	0.01	0.06	-0.06	-0.05	0.09	0.03
India	0.34	0.40	-0.06	0.06	-0.04	0.09
Mexico	0.02	-0.21	0.16	0.17	0.31	-0.14
Panama	0.87	0.60	0.27	-0.05	-0.04	-0.08
Colombia	0.00	-0.72	0.62	0.10	0.05	0.09
Malaysia	0.31	0.11	0.22	-1.51	0.16	-0.10
New Zealand	0.56	-0.17	0.38	0.03	-0.05	0.05
Thailand	0.13	0.09	-0.03	-	-	-
Costa Rica	-0.13	0.09	-0.22	-0.17	-0.18	-0.04
Hong Kong	0.00	0.11	-0.11	-0.04	-0.23	0.23
Israel	0.19	0.16	-0.15	-	-	-
Pakistan	0.34	0.24	0.13	-	-	-
Faroe Islands	-0.39	0.35	-0.81	-	-	-
Jordan	0.14	0.94	-0.67	0.53	0.23	0.30
Switzerland	-0.60	-0.84	-2.2	-0.04	-0.07	0.07
Honduras	-	-	-	-0.06	0.58	0.52

$$Y_{ijt} = \underbrace{\alpha_0 + \alpha_1 F_{1t}}_{f_{ijt}} + \underbrace{\frac{\omega(B)}{\delta(B)} B^b RTA_t^T}_{m_{ijt}} + \underbrace{\frac{\theta(B)}{\phi(B)} u_{ijt}}_{N_{ijt}} \quad \forall i \neq j \quad (5)$$

From our results, we find that for more than half of the bilateral trade flows studied (52.2%), the effect of the bilateral RTA has been detected before its effective date ($b < 0$). Therefore, it implies that countries tend to anticipate to RTAs. This is more striking for agreements involving developing countries (62.5% for EC): it might indicate that developing countries tend to create more anticipated expectations regarding trade agreements than developed countries.

Table 12 presents the anticipated/lagged effects distributed before and after the Great Recession. Considering the trade agreements that become effective before and after September 2008, it shows how many of the trade series exhibit an anticipated effect ($b < 0$) or a lagged effect ($b > 0$). It is noticeable how after 2008 more trade series have an anticipated effect (65 compared to 41). Overall, the mean anticipation effect for agreements before 2008 is 0.04, which indicates roughly an instantaneous effect. On the contrary, the mean anticipation effect for agreements enforced after September 2008 is -0.87, which is almost a quarter before their actual entry into force. Hence, agreements signed after 2008 tend to be more anticipating than those in force before the collapse of the global economy in 2008.

Consequently, the global economic crisis may have influenced the RTAs effectiveness: not only in terms of economic welfare (bilateral trade) but also in terms of economic policy. The anticipation effect is more evident after September 2008.

Table 11 Dynamic mean effects by country and date of entry into force of the agreements. Cont'

Agreements in force	Before 2008			After 2008		
	TE	STE	MTE	TE	STE	MTE
Iceland	-1.15	0.01	-0.42	0	-0.11	0.11
Macao	0.00	-0.05	0.05	0.00	0.04	-0.04
Morocco	0.17	-0.12	0.40	-	-	-
Sri Lanka	0.52	0.28	0.21	-	-	-
Afghanistan	0.00	0.90	-0.70	-	-	-
Albania	0.15	1.16	1.20	-	-	-
Argentina	-	-	-	0.00	0.52	-0.32
Bahrain	-0.21	-0.64	0.43	-	-	-
Brazil	-	-	-	0.00	0.52	-0.32
Brunei Darussalam	-0.02	-0.05	-0.10	-	-	-
Dominican Republic	0.89	0.97	0.19	-	-	-
Ecuador	-	-	-	0.40	0.40	0
El Salvador	-	-	-	0.40	0.40	0
Indonesia	-0.03	-0.01	0.04	-	-	-
Laos	0.17	0.19	-0.03	-	-	-
Mauritius	0.26	0.44	-0.18	-	-	-
Mongolia	-	-	-	0.43	0.07	0.36
Nepal	-	-	-	0.00	0.00	0.00
Norway	0.56	-0.22	0.18	-	-	-
Oman	-	-	-	-0.44	-0.58	0.77
Philippines	-	-	-	0.00	-0.19	0.30
Syria	1.29	-0.02	1.15	-	-	-
Tunisia	1.47	0.37	1.11	-	-	-
Uruguay	0.26	0.22	-0.17	-	-	-
Vietnam	-	-	-	-0.13	-0.12	-0.20

Table 12 Number of series with anticipated/lagged effects by date of entry into force of their respective bilateral trade agreements.

Agreements in force	Before 2008			After 2008			
	Lag	$b < 0$	$b = 0$	$b > 0$	$b < 0$	$b = 0$	$b > 0$
FTAs		36	10	44	60	7	30
PSAs		5	2	3	5	0	1
Art.XXIV		33	8	43	57	6	30
EC		8	4	4	8	1	1
Total RTAs		41	12	47	65	7	31

5 Conclusions

The current study presents a novel and complementary approach of the analysis of bilateral RTAs. We employ a time series approach to examine the dynamic heterogeneity in bilateral trade flows after agreements are implemented.

We proceed in two steps. In the first one, we seize the increase in international trade since the 90's and the deep impact of the Great Recession that began in 2008 with a factor in order to analyse the specific effects of RTAs (see Sec. 3.1). The factor also shows how interdependent countries are: all trade series analysed have been affected (with a more or less intensity) by global events.

Once this factor (that captures both international trade trends) is isolated, we study the impulse responses obtained by the analysis of transfer functions (see Sec 3.2).

The results show that, on average, bilateral trade flows grow in the presence of bilateral RTAs. Nevertheless, intertemporal asymmetries are present not only between RTAs but also among trade partners. We find that two countries participating in a same bilateral RTA do not benefit equally from the agreement: not only in total terms (total effects: positive or negative) but also in dynamic terms (short and medium-term effects). The country size and the number of bilateral RTAs in which countries participate do not seem to be determinant for RTAs to be trade promoting.

On average, RTAs promote a 10% increase in bilateral trade flows above the mean trend captured by the common factor. However, PSAs tend to enhance bilateral trade more than FTAs (21% compared to 9%). Additionally, PSAs gather most of the effects during the first four quarters after the entry into force of the agreements while FTAs have longer effects over time. Thus, RTAs' heterogeneity matters for bilateral trade. The RTAs' effectiveness may be related to the agreement-specific characteristics, a result also found by Kohl (2014).

Moreover, we carry out a cluster analysis in order to classify the dynamic effects obtained by the impulse responses. We obtain homogeneous groups for the study of the short-term and the medium-term effects. Since these homogeneous groups are different from each other (they contain trade series with similar effects), we consider the heterogeneity of the bilateral RTAs' effects. This heterogeneity might be related to the agreements' characteristics, a relationship that is left for further research.

In addition, we analyse the results considering the impact of the economic crisis of 2008. We find that the bilateral trade flows affected by agreements in force before 2008 have a positive mean total effect (30%), as well as in a dynamic way (8% for the short term and 9% for the medium term). However, for trade flows with an agreement in force after 2008, the effects are mixed. For all the trade series affected by RTAs that became effective after 2008, the mean total effects (-9%) and the mean short-term effects (-4%) are negative. Only the mean mid-term effects are positive (11%). This implies that the economic and financial crisis of 2008 has been devastating for international trade and that bilateral RTAs have not been resilient enough to prevent such a negative and deep impact. Moreover, PSAs and ECs tend to enhance bilateral trade not only for those signed before 2008 (26%) but also for those that entered into force afterwards (13%). Again, the dynamic effects are more concentrated in the short term than in the medium term. RTAs affect countries unevenly and, according to the results, that they might not be such a good stabilising instrument as we could have thought.

Moreover, from our results, we find that for more than half of the bilateral trade flows studied (52.2%), the effect of the bilateral RTA has been observed before its effective date ($b < 0$). Therefore, it implies that countries tend to anticipate to RTAs as other authors have discussed. This is more striking for agreements involving developing countries (62.5% for EC): it might indicate that developing countries tend to create more anticipated expectations regarding trade agreements than developed countries. Additionally, agreements signed after 2008 tend to be more anticipating than those in force before the collapse of the global economy in 2008.

This study is relevant given the current international trade episodes and the proliferation of protectionist measures. Since more countries decide to participate in a bilateral RTAs, it seems important to quantify the evolution of trade flows after trade agreements are in force. The analysis of the dynamic effects shows that the way bilateral RTAs are structured is determinant to explain the evolution of the RTAs' impact on the countries' bilateral trade flows.

We have here presented the analysis of ex-post effects of 103 bilateral RTAs and how heterogeneity is present in different ways. It is now interesting to study where these differences might come from. Probably, the type and characteristics of the agreement might influence the results: how bilateral RTAs are formulated or what kind of products they include. We will follow Kohl et al. (2016) since it offers a classification of trade agreements

according to different features. With our clusters, we will study if a relation between the RTAs' characteristics and the trade agreements' effects can be found.

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix

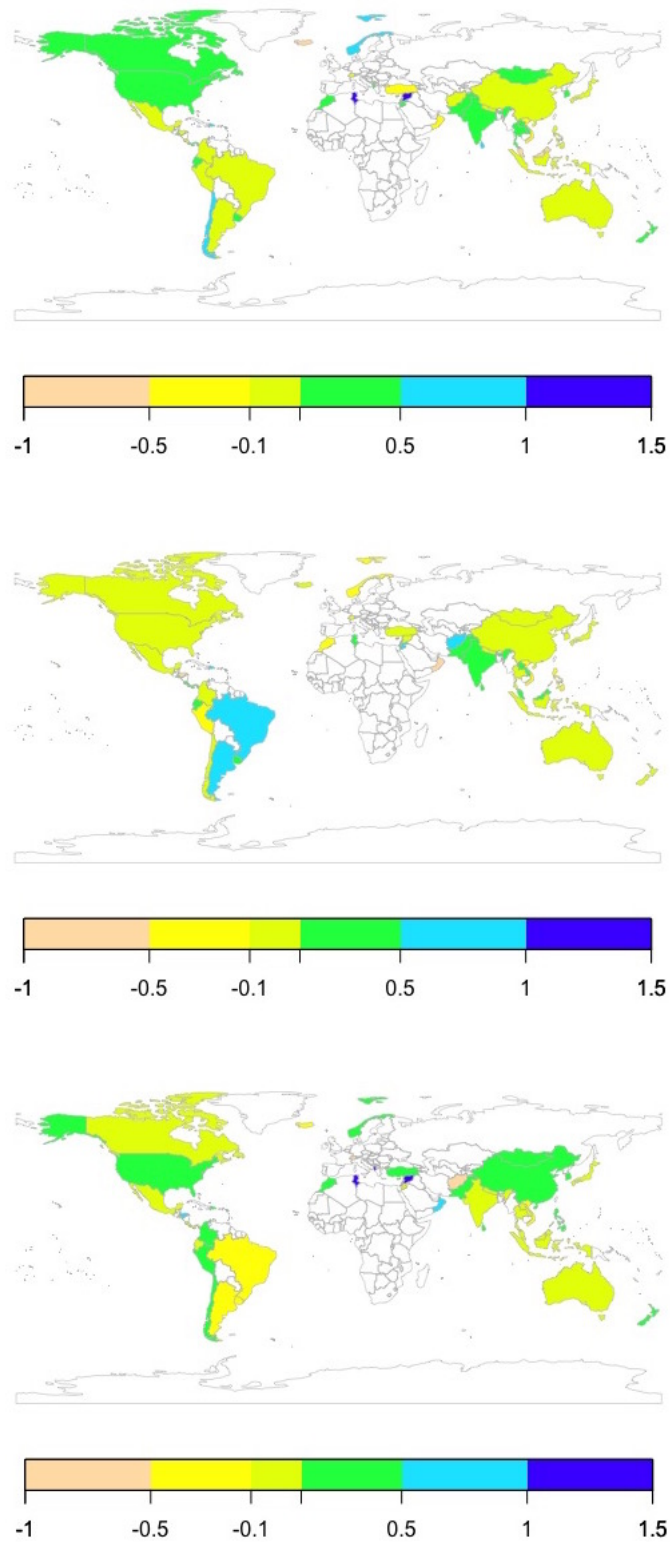


Fig. A1 Mean total effects (top), mean short-term effects (middle) and mean mid-term effects (bottom) by country.

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