REVISITING THE ‘COBDEN-CHEVALIER NETWORK’ TRADE AND WELFARE EFFECTS

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Jacopo Timini

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Jacopo Timini (*)

BANCO DE ESPAÑA

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Abstract

This study revisits the trade and welfare effects of 19th century bilateralism exploiting the latest developments in structural gravity models, including the consideration of domestic trade. Using bilateral trade data between 1855 and 1875, I show that the Cobden-Chevalier network, i.e. a system of bilateral trade agreements including the Most Favored Nation clause, had large, positive and significant effects on members' trade. These, however, were heterogeneous at the treaty-level. I then calculate its general equilibrium effects on total trade and welfare. They are considerable, while trade diversion effects are negligible. These results reshape the understanding of the Cobden-Chevalier network, helping in further rationalizing the "free trade epidemic" of the 1860s and 1870s.

Keywords: international trade, trade agreements, MFN, Cobden-Chevalier, structural gravity models.

JEL classification: F13, F14, F15, N30, N70.

Resumen

Este estudio revisa los efectos sobre el comercio y el bienestar del bilateralismo del siglo XIX aprovechando los últimos avances en los modelos de gravedad estructural, incluida la consideración del comercio doméstico. Utilizando datos de comercio bilateral entre 1855 y 1875, muestro que la red Cobden-Chevalier, es decir, un sistema de acuerdos comerciales bilaterales que también incluye la cláusula de la nación más favorecida, tuvo efectos importantes, positivos y significativos en el comercio entre sus miembros. Sin embargo, estos eran heterogéneos en cuanto a tratados. A continuación, calculo sus efectos de equilibrio general sobre el comercio total y el bienestar. Estos son considerables, mientras que los efectos de desviación del comercio son limitados. Los resultados modifican la comprensión de la red Cobden-Chevalier, lo que ayuda a racionalizar aún más la «epidemia del libre comercio» de las décadas de 1860 y 1870.

Palabras clave: comercio internacional, acuerdos comerciales, NMF, Cobden-Chevalier, modelos de gravedad estructural.

Códigos JEL: F13, F14, F15, N30, N70.

1. Introduction

Did the "free trade epidemic" (Lazer, 1999) of the 1860s and the 1870s, based on bilateral trade agreements with Most Favored Nation clauses, increase trade? If so, what effects it had on the welfare of nations?

Contemporary accounts described these two decades as the "golden age" of trade liberalization via trade agreements, whose proliferation was actively contributing to reduce tariffs, that constituted a relevant part of the impediments that weighted on international trade at the time (Stringher, 1889). Indeed, in 1860, Great Britain and France signed a landmark trade treaty, substantially reducing – even if not entirely eliminating – bilateral tariffs between the two countries. This agreement, named after the two negotiators, Richard Cobden and Michel Chevalier, also included the Most Favored Nation (MFN) clause, meaning that the tariff concessions agreed in the treaty would be automatically applied to all other trade partners with whom the countries had also stipulated a trade agreement with an MFN clause. Since the Cobden-Chevalier treaty, bilateral trade agreements proliferated among European countries (signing more than 50 bilateral MFN treaties in approximately 15 years, Lampe, 2009), as well as beyond the continent's borders (Tena-Junguito et al., 2013), thus creating a genuine trade network, i.e. the Cobden-Chevalier network.[1] As summarized by Lampe (Lampe, 2009, p. 1018), the Cobden-Chevalier network was a conglomerate of bilateral treaties but with a "multilateral quality".

While broad-ranging accounts of 19th century trade policy praise the Cobden-Chevalier network as a useful instrument for economic integration (Bairoch, 1989; Nye, 1991a; Nye, 1991b; Irwin, 1993a and 1993b; O'Rourke and Williamson, 1999), a series of quantitative assessments based on gravity models (with international trade only) questioned its real effectiveness in promoting trade. Accominotti and Flandreau (2008) argue that the Cobden-Chevalier trade effects is insignificant, downplaying its trade liberalization role. Lampe (2009) confirms Accominotti and Flandreau (2008) results on aggregate bilateral trade. However, exploiting sector-level data, he finds positive trade effects for some sectors. These findings would be in line with the focus of trade negotiators on achieving tariff concessions for specific products, and not overall trade liberalization.

[1] An in-depth discussion of the causes behind the spread of trade agreements during the 1860s and 1870s are beyond the scope of this paper, which focuses on the trade and welfare consequences. Interested readers may refer to Pahre (2007) and Lampe (2011).

However, despite negotiations of trade treaties were inevitably about the nitty-gritty of tariffs, i.e. detailed discussions on the size of tariff cuts and the products to be included (or not) in the tariff reduction/exemption list, the agreements comprised, at least in certain cases, "a large set of important products" (Becuwe et al., 2018) corresponding to substantial shares of pre-agreement bilateral trade. In light of the above, one would expect the Cobden-Chevalier network to have effects on aggregate bilateral trade.

Making use of a structural gravity model, this paper revisits the effects of the Cobden-Chevalier network on trade and welfare. I apply a poisson pseudo-maximum likelihood (PPML, Santos-Silva and Tenreyro, 2006), with theory-consistent fixed effects, and including domestic trade.

My contribution to the literature is threefold. First, I include domestic trade in a structural gravity model to estimate the effects of bilateralism in the 19th century. The inclusion of domestic trade is suggested by theory and crucial to avoid obtaining downward-biased estimations, by capturing the trade agreement-driven choice of selling internationally rather than domestically.[2] Second, I perform treaty-level estimates, i.e. I allow for heterogeneous effects across trade agreements. Third, I quantify the general equilibrium effects on total trade and welfare of the Cobden-Chevalier network at the country level.

First, I find that, on average, the Cobden-Chevalier network had large, positive, and significant effects on bilateral trade among members. Second, I document a substantial degree of heterogeneity of trade effects across treaties. Third, I show, using a general equilibrium framework, that the Cobden-Chevalier network had, on average, a positive impact on the welfare of nations. The general equilibrium calculations also indicate that the trade diversion effects of the Cobden-Chevalier network were very limited. Taken together, these results reshape the understanding of the Cobden-Chevalier network trade and welfare effects.

[2] Yotov et al. (2016) and Yotov (2021) describe in details all the advantages of considering domestic trade in structural gravity models. Despite its importance, only few papers explicitly take domestic flows into account. For the first globalization period, prominent examples are Jacks et al. (2010) and Jacks et al. (2011), studying the evolution and determinants of trade and trade costs. Another example is Karlsson and Hedberg (2021). However, Karlsson and Hedberg (2021) focus on the effect of wars on trade, and estimate domestic trade by using a handful of different sources. In some cases, however, these databases, have very accurate information on trade and openness, but GDP can only be estimated indirectly (e.g. Federico-Tena World Trade Historical Database, see Federico and Tena-Junguito, 2019), others have real GDP data that needs to be reflated using price indices, with the risk of introducing noise in the data (e.g. Maddison Project Database, see Bolt et al., 2018).

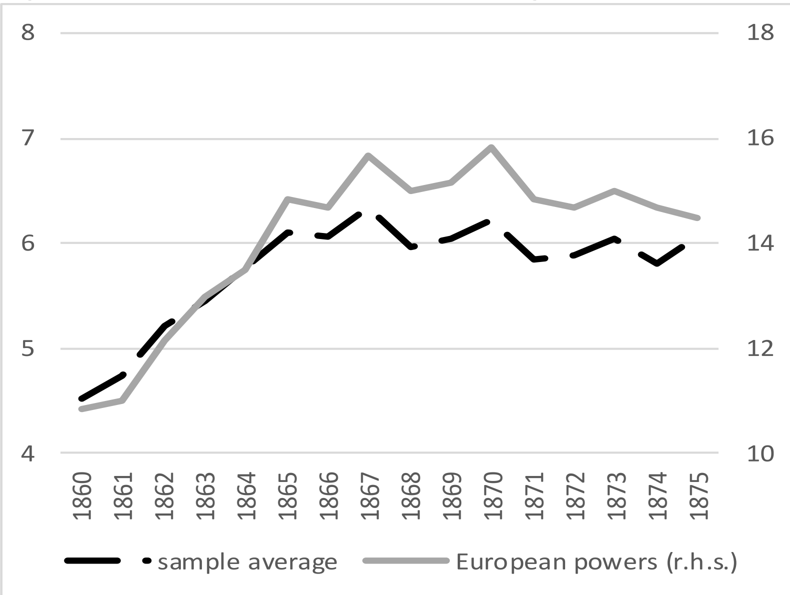
The reminder of the paper is organized as follows: Section 2 provides more details on the historical context and on the literature, Section 3 presents the theory, and describes the empirical strategy and data. Section 4 discusses the (partial equilibrium) results. Section 5 is dedicated to the general equilibrium analysis. Section 6 draws the conclusions.

2. Historical context and literature review

The 1860s and 1870s are regarded as the years where trade liberalization policies spread in Europe (and beyond) by the mean of bilateral trade agreements (see Figure 1). To this extent, the 1860 trade treaty between Great Britain and France – the so-called Cobden-Chevalier treaty, after the names of the trade negotiators – is often regarded as the inception of the bilateral agreement-based network that developed thereafter. Since then, more than 50 agreements were signed in less than two decades (Lampe, 2009). This corresponded with a period of sustained increase in world trade (see Figure 2, and Federico and Tena-Junguito, 2019).

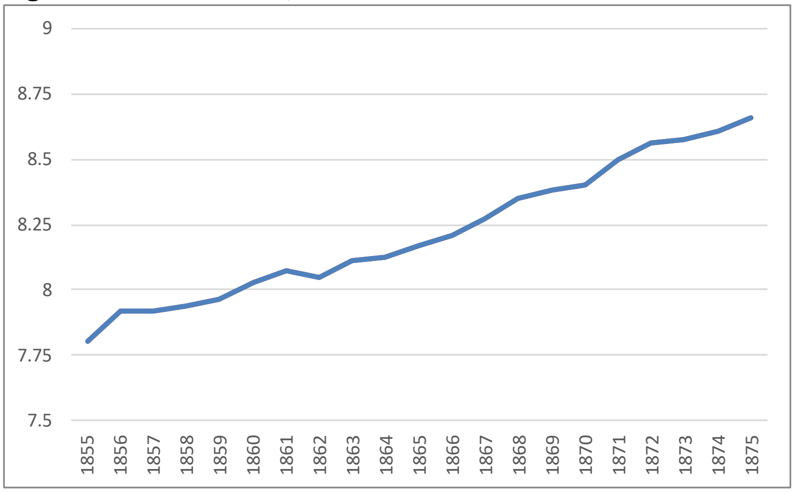
Traditional accounts of the first wave of globalization (Bairoch, 1989; Nye, 1991a; Nye, 1991b; Irwin, 1993a and 1993b; O'Rourke and Williamson, 1999) regard the Cobden-Chevalier treaty, and the subsequent network of bilateral trade agreements incorporating MFN clauses, as a catalyst for trade liberalization, by the mean of reducing

Figure 1: Post-Cobden-Chevalier trade agreements, 1860-1875.



Note: Sample average : average number of trade agreements in force per country. European powers : average number of trade agreements in force in Great Britain, France, Germany, Belgium, Austria-Hungary, Italy.
Source : Author's elaboration on Trade Agreements Database (Pahre, 2007).

Figure 2: World trade, 1855-1875.



Note: Logarithm of world imports, expressed in million 1913 US$.
Source : Author's elaboration on the World Trade Historical Database (Federico and Tena-Junguito, 2019).

tariff barriers. The role of the network in decreasing tariffs has been recently confirmed by Tena-Junguito et al. (2013), with a detailed analysis of tariff levels on manufacturing products. These findings are in line with Jacks et al. (2010) and Jacks et al. (2011) that, using a longer time period, point towards a decisive role of trade costs decline (of which tariffs would constitute a relevant part) in promoting trade integration during the first wave of globalization.

However, the cliometric efforts quantifying the trade effects of the Cobden-Chevalier trade network casted some doubts on its effectiveness. Accominotti and Flandreau (2008) use a gravity model (with international trade only) and find that the Cobden-Chevalier variable inserted in the model (a dummy equal to one if a MFN treaty is in force between the exporter and the importer) displays a not statistically significant coefficient. Consequently, they argue that the Cobden-Chevalier trade network did not promote bilateral trade, questioning its trade integration role.[3] Lampe (2009) suggests that the Cobden-Chevalier trade network did not affect aggregate bilateral trade, but indicates sector-level bilateral trade effects instead, mostly for manufacturing. These results would reflect the negotiators interest in reducing specific, product-level, tariffs rather than overall protection.

Trade negotiations are often a matter of product-specific negotiations concerning the corresponding changes to tariff barriers to be included in the agreement. Two

[3] While focusing on the gold standard during the 1870-1913 period, Lopez-Cordova and Meissner (2003) found similar results for the control variable chosen to identify the trade network in the 1870s.

considerations are relevant here. First, product-level negotiations are also a characteristic of 20th and 21st century trade agreements, which have been found to have positive effects on aggregate bilateral trade (Dai et al., 2014; Baier et al., 2019). Second, and perhaps more importantly, at least in some cases, the trade agreements of the Cobden-Chevalier network included tariff cuts for a large list of important products, corresponding to substantial shares of pre-agreement bilateral trade.[4] For example, tariff exemptions, tariff cuts, MFN or other preferential treatments agreed in the treaties between Italy and France (1863), and Italy and Austria-Hungary (1867) covered more than two thirds (≈70%) of Italian bilateral export value (to France and to Austria-Hungary, respectively). The preferential treatments conceded in the 1860 Anglo-French Treaty of Commerce itself comprised "a large set of important products" (Becuwe et al., 2018). Were these number to be true on a wider scale, one would expect the Cobden-Chevalier network to have effects on aggregate bilateral trade.

3. Theory, empirical strategy and data

3.1. Theory

My partial equilibrium empirical framework is based on a structural gravity model,[5] as formulated by Anderson and van Wincoop (2003), Head and Mayer (2014) and Yotov et al. (2016). As shown by Arkolakis et al. (2012), this well-known general theoretical framework embodies a wide set of distinct models, and can be summarized by the following set of equations:

[4] In the text I report some (anecdotal) evidence based on publicly available bilateral product-level trade data (Federico et al., 2012) and tariff cuts included in some treaties of the period. While I would ideally rely on properly structured database including information on trade flows and tariff changes allowing a cross-country comparison, the collection of such information is cumbersome for the period under analysis. Bilateral trade flow data has been digitalized for a number of countries in recent years (for an exhaustive list, see Timini, 2020). However, Federico et al. (2012) is, to the best of my knowledge, the only publicly available database including bilateral product-level trade information. It contains Italian product-level trade. Data on bilateral tariff changes included in the treaties are even more scattered and difficult to gather, and I had to rely on the analysis of both primary and secondary sources. Non-exhaustive lists of products that received tariff preferences (either exemptions, cuts, MFN or other preferential treatments) were available for the following treaties: Italy-France (1863), and Italy-Austria-Hungary (1867). The information was gathered from the following publications: Camera dei Deputati (1867); Corbino (1929). These publications report the names of the products as per tariff lines. As Federico et al. (2012) report the original tariff-line name, the match between the two lists is a relatively straightforward exercise. I use 1862 and 1865 trade data for Italy-France and Italy-Austria-Hungary calculations, respectively.

[5] The general equilibrium framework is explained in section 5.

$$X_{ijt} = \frac{Y_{it}E_{jt}}{Y_t}\left(\frac{\tau_{ijt}}{\Omega_{it}\Pi_{jt}}\right)^{1-\sigma} \qquad (1)$$

$$\Omega_{it}^{1-\sigma} = \sum_j \left(\frac{\tau_{ijt}}{\Pi_{jt}}\right)^{1-\sigma} \frac{E_{jt}}{Y_t} \qquad (2)$$

$$\Pi_{jt}^{1-\sigma} = \sum_i \left(\frac{\tau_{ijt}}{\Omega_{jt}}\right)^{1-\sigma} \frac{Y_{it}}{Y_t} \qquad (3)$$

Here, X_{ijt} identifies bilateral trade flows from exporter *i* to importer *j* at time t. When $i = j$, X_{ijt} denotes domestic trade flows, and when $i \neq j$, X_{ijt} denotes international trade flows. Exporter's *i* production value is Y_{it}, and importer's *j* expenditure is E_{jt}. The variable Y_t denotes the value of world output. The element τ_{ijt} captures bilateral trade costs. The terms Ω_{it} and Π_{jt} are the outward and inward multilateral resistances (Anderson and van Wincoop, 2003). They correspond to measures of exporter's *i* access to export markets, and competition in the importer's *j* domestic market (Fally, 2015). σ is interpretable as a trade elasticity. Therefore, as explained in detail in Yotov et al. (2016), equation (1) shows the relation between bilateral trade flows on one side and economic size and trade costs on the other.

The explicit consideration of domestic trade is one of the latest advances in structural gravity models (Yotov, 2012; Dai et al., 2014; Yotov et al., 2016). In general, the inclusion of domestic trade is very important for two main reasons. First, it is theory-consistent, and, second, it allows to capture the domestic-to-international "diversion" effect of bilateral trade policy, driven by changes in the relative costs of selling in the domestic rather than in the other members' (international) markets. In other words, with international flows only, the trade agreement coefficient is likely to be biased downwards. The inclusion of domestic flows allows to compare the relative change of domestic to international flows.

3.2. Empirical strategy

I implement the theoretical approach empirically by using the Poisson pseudo-maximum likelihood (PPML) estimation technique (Santos Silva and Tenreyro, 2006), computing standard errors by clustering on exporter, importer, and time (Egger and Tarlea, 2015). This methodology allows to properly account for the presence of "zeros" and heteroscedasticity, two relevant features of bilateral trade data.

In the first specification, I follow the existing literature, and use international trade only:

$$X_{ijt} = \exp(\beta_0 + \beta_1 TA_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}) + \varepsilon_{ijt} \quad (4)$$

In this case, X_{ijt} are exports from country *i* (the exporter) to country *j* (the importer) at time t. The variable TA_{ijt} identifies trade agreements, and corresponds to a dummy variable equals to one when the exporter *i* and the importer *j* have a trade agreement in force at time t, and zero otherwise. The variables δ_{it} and γ_{jt} are exporter-time and importer-time dummies, and represent the theory-consistent way to incorporate the multilateral resistance terms described in equation (2) and (3). The variable ω_{ij} identifies exporter-importer dummies. In this way, in line with the literature, I allow for asymmetric trade costs and trade imbalances (Waugh, 2010), and address possible trade policy endogeneity, as in the approach of Baier and Bergstrand (2007).[6] The error term is ε_{ijt}.

As an intermediate step, in the second specification, I consider both international and domestic trade:

$$X_{ijt} = \exp(\beta_0 + \beta_1 TA_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}) + \varepsilon_{ijt} \quad (5)$$

Here, X_{ijt} includes both domestic (X_{iit}) and international trade flows ($X_{ijt}, \forall$ *i≠j*). The inclusion of domestic trade is important for having theory-consistent estimates and to capture trade diversion from domestic to international.

In the preferred specification, I implement Bergstrand et al. (2015) approach to disentangle broader economic integration processes from the bilateral trade agreement effects, by including a "globalization trend":

$$X_{ijt} = \exp(\beta_0 + \beta_1 TA_{ijt} + \rho_t INTL\_BRDR_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}) + \varepsilon_{ijt} \quad (6)$$

The new variable in equation (6), $INTL\_BRDR_{ijt}$, is the result of the interaction of a dummy ($INTL\_BRDR_{ij}$) that identifies an international border (i.e. $INTL\_BRDR_{ij}$=1 if *i≠j*), with year dummies. In this way, the evolution of the coefficients ρ_t over time can be interpreted as the general effect of globalization. In this specification, therefore, I can better capture the "trade agreement" effects, by disentangling the effect of any other factor affecting differently international and domestic trade. For example, using this strategy, I control for the widespread reduction in transport costs, dictated by the expansion of railroads and steamships (Jacks et al., 2010; Pascali, 2017). Additionally,

[6] These batteries of dummy variables absorb standard gravity variables with exporter-time, importer-time and country-pair variation, such as GDP, GDP per capita, population, distance, contiguity, common language, colonial relationship, etc.., preventing their estimation.

this approach is in line with a number of previous economic history contributions arguing that international borders mattered for trade and market integration during the first globalization (see, e.g., Jacks, 2005; Wolf, 2009; Schulze and Wolf, 2009; Wolf et al., 2011; Schulze and Wolf, 2012; Liu and Meissner, 2015).

Finally, I exploit the advances in econometrics and in data availability to estimate treaty-level trade effects, i.e. the effect of each trade agreements included in the database. Formally, I estimate the following equation:

$$X_{ijt} = \exp\left(\beta_0 + \sum_{n=1}^{N} \beta_n \, TA_{ijt}^{n} + \rho_t INTL\_BRDR_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}\right) + \varepsilon_{ijt} \quad (7)$$

Here, the new element is $\sum_{n=1}^{N} \beta_n \, TA_{ijt}^{n}$, where n=1,…,N, and N indicates the number of agreements in the sample.

3.3. Data

International bilateral trade data, in British pound sterling, are from the TRADHIST Database (Fouquin and Hugot, 2017), that gathers together bilateral nominal trade flows both directly from primary sources and from other well-known historical trade databases such as RICardo (Dedinger and Gerard, 2017).[7] Data on domestic trade flows are not readily available. Theory consistent estimates of domestic trade data rely on input-output tables or gross production.[8] However, information available for the first globalization period is very limited, at best. I therefore follow Yotov (2012) and El-Dahrawy and Timini (2021), and calculate domestic trade flows (X_{ijt}, ∀ *i=j*) as the difference between nominal GDP and total nominal exports, both directly available from the same source used for bilateral trade flows, i.e. the TRADHIST database. The theoretical limitations of this approach are thoroughly described in Head and Mayer (2014). However, Campos et al. (2021) recently show empirically that the estimations of the impact of trade policy on trade and welfare are very robust to different ways of calculating domestic trade.[9]

Information on trade agreements has been retrieved from the Trade Agreements Database (Pahre, 2007). In line with other studies on the Cobden-Chevalier network, the

[7] TRADHIST provides information on the original source of each trade flow reported in the database.

[8] Input-output tables allow to construct domestic trade by exploiting information on intermediate and final consumption (see Timmer, 2015, for more information, and Larch et al., 2018, for an application). Gross output data allows to estimate domestic trade as "apparent consumption", by substracting gross exports from gross production (see Dai et al., 2014, or Borchert and Yotov, 2017, for an application).

[9] I also recall that, due to the set of fixed effects included in the regressions (i.e. exporter-time, importer-time, and directional pair fixed effects), estimates are influenced by the change of domestic trade relative to international trade, and not by their levels.

period of analysis is 1855-1875.[10] Bilateral distance, which is used in robustness checks, is taken from CEPII. The sample includes 24 countries (sample selection is based on the availability of sufficient data for domestic trade calculations).

4. Results and discussion

The main results, based on the structural gravity model described in the previous sections, are presented in Table 1.

Table 1: Effects of the Cobden-Chevalier network – Structural gravity estimates

Agreement	w/o domestic trade (1)	with domestic trade (2)	with domestic trade & "globalization" (3)
TA	0.0125	0.270***	0.241***
	(0.054)	(0.060)	(0.041)
Observations	5,232	5,638	5,638
Domestic trade	NO	YES	YES
Intl.bord*year	NO	NO	YES
Exp.-time & imp.time FEs	YES	YES	YES
Dir. pair FEs	YES	YES	YES

Note: PPML regressions. Fixed effects, control variables and constants not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level.
***p < 0.01, **p < 0.05, *p < 0.1.

In Column 1, I replicate the approach of Accominotti and Flandreau (2008) and Lampe (2009) by using international trade data only. In line with their contributions, I find that the effect of the Cobden-Chevalier trade agreements on total bilateral trade are small and insignificant.[11] However, once I account for domestic trade (Column 2 and 3) the

[10] This choice is motivated by three intertwined reasons. First, by a historical reason: the economic conditions surrounding the Cobden-Chevalier trade network drastically changed by the end of the 1870s – beginning of the 1880s, with the return of protectionist policies. The increasing protectionism drastically changed the existing trade treaties and the MFN clauses contained therein. In some cases, bilateral trade treaties were repealed, in some others they were modified (including less favorable preferential treatments). Therefore, historically, the Cobden-Chevalier trade network coincided with the period under analysis. Second, by an empirical reason: the substantial and frequent bilateral trade policy changes (i.e. repeal, or change in preferential treatments contained in the trade agreements) make the estimation of the "trade agreement effect" more complicated. Third reason is related to comparability purposes, as the studies on the Cobden-Chevalier trade effects focused on this period.

[11] In my main specification the sample is restricted to those countries with sufficient data for domestic trade calculations. However, in the Appendix (Table A.1), I replicate Table 1 adapting the sample to the one used in Accominotti and Flandreau (2008) and Lampe (2009), as well as Lopez-Cordova and Meissner (2003). The latter contribution focuses on the gold standard (1870-1913), but include the existence of a bilateral trade agreements as a control variable. Accominotti and Flandreau (2008) report the list of treaties used in their regressions, based on Lazer (1999). In one set of regressions I also adapt the TA definition. Results are not sensible to any of these changes in the data.

coefficient becomes positive, large, and significant. In my preferred specification (Column 3), I disentangle econometrically broader globalization trends from the "pure" trade agreement effects, as in Bergstrand et al. (2015). In this case, the results indicate that the Cobden-Chevalier network lead to a 27% increase in bilateral trade flows (i.e. 100*$[e^{\beta^{TA}} - 1]$). The Cobden-Chevalier network effect on trade is very close to the value for 20th and 21st century trade agreements indicated by Head and Mayer (2014) as a result of a meta-analysis of the literature. Including domestic trade in the regressions is of crucial importance for the understanding of the "true" effect of the Cobden-Chevalier network: the inclusion of domestic trade captures the trade diversion effect from domestic to international trade (Dai et al., 2014).

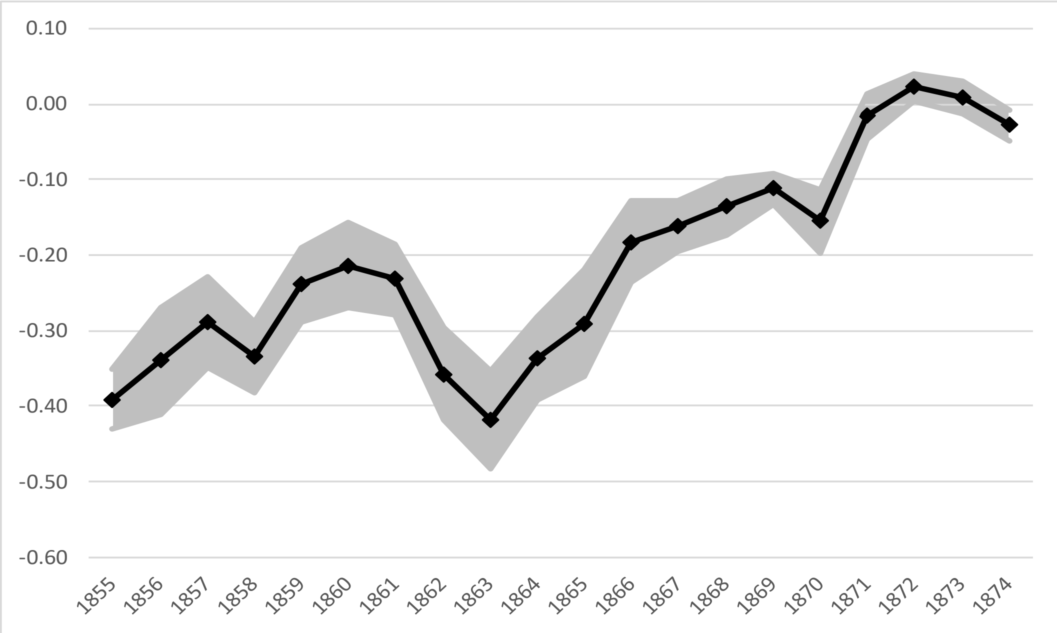
Figure 3 complements the information reported in Table 1 (that focuses on trade agreements), by plotting ρ_t, the coefficients (and correspondent confidence intervals) of the variable $INTL\_BRDR_{ijt}$, i.e. the interaction between the international border dummy and year dummies. $INTL\_BRDR_{ij1875}$ is omitted given the inclusion of a constant.[12] The evolution of these coefficients, as portrayed in Figure 3, can be interpreted as a "globalization trend". The value estimated for ρ_{1855}, -0.391, denotes that "thicker" international borders in 1855 were reducing international relative to domestic trade by 32% with respect to 1875 conditions (i.e. 100*$[e^{-0.391} - 1]$). The declining ρ_t coefficients match well with the historical account of a widespread reduction in trade costs, e.g. falling transport costs due to the expansion of railroads and steamships (Jacks et al., 2010; Pascali, 2017).

The estimations presented in Table 1 are robust to a series of alternative specifications, reported in Table 2, where I disentangle potential confounding factors to reduce concerns for possible omitted variable bias.

In Column 1, I follow Bergstrand et al. (2015), and add to my main specification (equation (6)) a time-varying distance effects (the logarithm of bilateral distance interacted with year dummies), a stricter way of controlling for other sources of (bilateral) integration. In Column 2, I control for fixed exchange rate arrangements, such as the Gold Standard and the Latin Monetary Union (LMU), by inserting a dummy equal to one in case both the exporter and the importer are part of the arrangement. In both cases the coefficient

[12] As explained in Bergstrand et al. (2015), given the set of fixed effects included in the structural gravity model, it is not possible to interpret the constant as the estimated of the omitted international border-year variable. The initial level of the international border effect is captured by the pair fixed effects, and therefore can vary across pairs.

Figure 3: The declining effect of international borders, 1855-1875.



is not statistically different from zero. The LMU results confirm its insignificant "average effect" on trade (Flandreau, 2000; Timini, 2018). The Gold Standard results are to be treated with caution as I only capture its very early years in the sample and the dummy has very limited variation (very few entries and exits). Indeed, Accominotti and Flandreau (2008) and Lampe (2009) do not consider the gold standard in their regressions. In Column 3, to address the Cheng and Wall (2005) concerns of a possibly sluggish response of trade to trade agreements, I follow Baier and Bergstrand (2007) approach and use 5-year intervals. Column 4 and Column 5 provide a test for strict exogeneity by including leads of the trade agreement dummy (Baier and Bergstrand, 2007; Kohl, 2014; Yotov et al., 2016). The small and not statistically significant coefficients of the leads (together with the positive and significant coefficient of the contemporaneous trade agreement dummy) suggest the absence of reverse causality. The higher point estimate of the lead in Column 4 (with respect to Column 5) may be explained by the presence of some anticipation effects in the very short run (Yotov et al., 2016). In Column 6, I separately consider aggregate tariffs (different from bilateral tariffs, captured by the trade agreement dummy). The TRADHIST database contains a measure of "customs duties-to-imports" ratio, at the country level. Despite being only a crude proxy of tariffs (Tena-Junguito et al., 2013), it has been widely used in the historical literature, particularly in the absence of valid alternatives (e.g. Accominotti and Flandreau, 2008). Apart from disentangling multilateral tariff reductions, the tariff coefficient can be expressed in terms of trade elasticity of substitution $\sigma=-\beta(\ln(1+\text{tariff}))$. The value of σ (4.6) that can be extracted from the regression in Column (6) lies within the “likely range” ($2.5<\sigma<5.1$) indicated by Bajzik et al. (2020) as a result of a meta-analysis of the literature, and is very close to Simonovska and Waugh (2014) estimation results ($\sigma = 4$).

To summarize, my main results of a large, positive, and significant Cobden-Chevalier network trade effect do not change across specifications.

Table 2: Effects of the Cobden-Chevalier network – Robustness tests

Agreement	ln(dist)*year (1)	GS, LMU (2)	5-year intervals (3)	TA lead (1-year) (4)	TA lead (5-year) (5)	Tariffs (6)
TA	0.196***	0.253***	0.332***	0.180***	0.333***	0.130***
	(0.058)	(0.041)	(0.075)	(0.062)	(0.072)	(0.046)
GS		-0.115				
		(0.092)				
LMU		-0.005				
		(0.072)				
TA_Lead				0.079	-0.006	
				(0.068)	(0.083)	
ln(1+tariff)						-4.625***
						(0.703)
Observations	5,638	5,638	1,391	5,638	1,391	2,186
Dir. pair FEs	YES	YES	YES	YES	YES	YES
Exp.-time & imp.time FEs	YES	YES	YES	YES	YES	YES
Intl.bord*year	YES	YES	YES	YES	YES	YES
ln(dist)*year	YES	NO	NO	NO	NO	NO
Year intervals	NO	NO	YES (5-year)	NO	YES (5-year)	NO

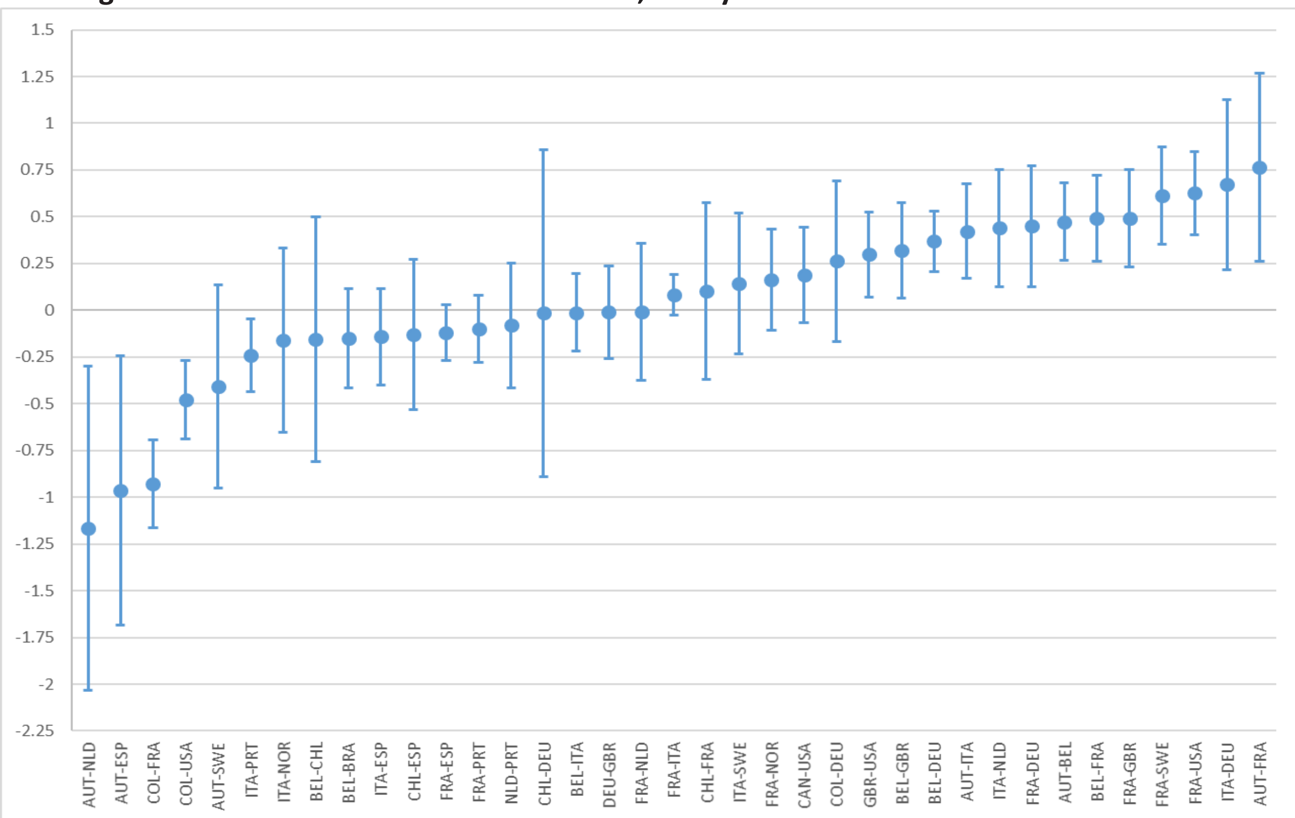
Note: PPML regressions. Fixed effects, additional control variables and constants not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level.
***p < 0.01, **p < 0.05, *p < 0.1.

Figure 4 displays agreement level estimates derived from a structural gravity model (equation (7)) for 37 different trade agreements. Out of these 37 estimated coefficients, 14 (38%) are positive and significant, 18 (49%) are not statistically significant, and only 4 (13%) are negative and significant. The distribution of the treaty-level coefficient is very heterogeneous. Such heterogeneity across trade agreements is similar to what have already been documented for the second globalization wave (Kohl et al., 2016; Baier et al., 2018; Baier et al., 2019; Freeman and Pienknagura, 2019).

I note that the point estimates corresponding to the treaties used as examples of "important reductions" in Section 2, i.e. the 1860 Anglo-French Treaty of Commerce (FRA-GBR in Figure 4), the treaty between Italy and Austria-Hungary (AUT-ITA), and between Italy and France (FRA-ITA), are all positive, and for the two former cases also very large. Indeed, point estimates suggest that the 1860 Anglo-French Treaty of Commerce increased trade by 64% (100*$[e^{0.494}-1]$), more than twice the average effect. The treaty between Italy and Austria-Hungary increased trade by 53% (100*$[e^{0.423}-1]$). In the case of the treaty between Italy and France, the estimation procedure rely on very few pre-treatment observations, however the point estimate indicates a 8% increase in bilateral trade (100*$[e^{0.087}-1]$).

However, treaty-level estimations should be interpreted with the caveats mentioned in Baier et al. (2019): the more granular are the estimates, the fewer data points to rely on, the wider the confidence bands of the coefficient, the higher the likelihood of incurring in an omitted variable bias or reverse causality. These issues may be exacerbated by the unbalanced nature of the database, i.e. by missing data points or short pre-treatment periods.

Figure 4: Cobden-Chevalier network effect, treaty-level estimations.



5. General equilibrium

Exploiting the partial equilibrium estimates (reported in Section 4), I compute the general equilibrium trade and welfare effects of the Cobden-Chevalier network.

To do so, it is necessary to complement and expand the system of gravity equations presented in Section 2 (eq. (1)-(3)). Indeed, within this theoretical context,[13] by assuming labor as the only factor of production, and imposing a market clearing condition,[14] it is possible to express the gains from trade following the Arkolakis et al. (2012) formula:

$$\hat{G} = \hat{\lambda}_{ii}^{1/(1-\sigma)}$$

This means that to obtain the gains from trade ($\hat{G}$), the necessary inputs are only two ("sufficient statistics"). First, $\hat{\lambda}_{ii}$, the change in the exporter's *i* domestic trade share (before and after the "shock", i.e. in this case the change in bilateral trade costs deriving from the entry into force of a trade agreement). Second, a measure of trade elasticity. In this context, the changes in exports, imports and welfare[15] (as reported in Table 3) should be interpreted as medium-to-long-term static effects,[16] and are the result of the

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[13] I implement a one sector constant elasticity of substitution (CES) trade model, which corresponds to a fairly standard version of general equilibrium structural gravity. This version of the model is very transparent and it fits the purpose of, and it is well equipped for, performing "benchmark trade and welfare estimates" of the Cobden Chevalier network. The model does not consider, however, other factors such as input-output linkages, dynamic effects, trade in intermediates, etc., whose inclusion in the model is usually considered as welfare-augmenting. The model also does not allow for tariff revenue effects related to the elimination of tariffs following the implementation of a trade treaties. These effects however are composed by two effects with opposite sign: a tariff revenue loss, corresponding to a transfer from the State to consumers, and a tariff revenue gain, derived from the enlargement of the tax base. The sign of the overall effect is therefore uncertain, and possibly even more so in a 19th century context, where tariff revenues constituted an important part of the revenues of the state, but the extent of its transformation to transfers to consumers is subject of debate, given the state expenditure structure. I therefore prefer to keep it equal to zero, in line with the extant literature (e.g. Baier et al., 2019). This model, with the same features, has been applied to estimate general equilibrium trade and welfare effects of trade agreements during the second globalization wave, and of the GATT/WTO (see, e.g., Baier et al., 2019; Felbermayr et al., 2020), and, generally, it is widely accepted as an appropriate benchmark for computing general equilibrium effects of trade policies.

[14] In their handbook chapter, Head and Mayer (2014) report the step-by-step procedure to calculate partial and general equilibrium trade and welfare effects caused by a change in bilateral trade frictions. See in particular, equations (32) to (36), and the explanation thereafter. Yotov et al. (2016) and Campos and Timini (2021) also provide thorough discussions of the specifics of general equilibrium gravity models. I thus refer to those publications for further details because, as demonstrated by Arkolakis et al. (2012), these are irrelevant for the final results.

[15] As explained in Yotov et al. (2016), in this class of models the term welfare can be interpreted as real GDP. Arkolakis et al. (2012), as explained in Campos and Timini (2021), show that "welfare" is interpretable as the consumption of a representative agent.

[16] Given a variety of reasons analyzed in the literature (e.g. phase-in periods, economic adjustments, structural transformations, etc.), trade agreements do not achieve their "full potential" instantaneously. Bergstrand et al. (2015) suggest the full potential is achieved only after 8-12 years since the entry into force of the treaty.

difference between the values those variables take in a "baseline" and in a "counterfactual" scenario. In this case, these two situations correspond to a situation without and with the Cobden-Chevalier trade network.

Thus, using this model, I am able to estimate how the Cobden-Chevalier network influenced total exports, total imports, and the welfare of nations during the 1860s-1870s. To do so, I insert in the general equilibrium model a "shock" correspondent to the reduction in bilateral trade costs attributable to the Cobden-Chevalier network. That is to say, the "TA" coefficient (β_1) estimated in equation 6 (i.e. β_{TA}≈0.241), my preferred specification.[17] This shock affects bilateral trade flows and the other variables of the model (e.g. production, expenditure, multilateral resistances, wages).[18]

To perform the general equilibrium analysis, I need a balanced dataset, and to assume zero effect of our treatment at the reference year of choice. Therefore, to avoid missing data and to have reasonable level of bilateral trade, I averaged trade flows for all directional country pairs in the database during the period 1855-1870. For the existence of a trade agreement between the country pair, I took 1870 as the reference year. The trade elasticity parameter is set at σ=4, as estimated by Simonovska and Waugh (2014), and very close to the median value indicated by Bajzik et al. (2020) in their meta-analysis.

Table 3 display the results of the general equilibrium analysis. Overall, general equilibrium trade and welfare effects of the Cobden-Chevalier network are large. On average, the Cobden-Chevalier network increased total exports by 9.6%, total imports by 9.9%, and welfare by 0.3%. However, here too, there is a substantial degree of heterogeneity. Trade gains of large European countries, that signed a large number of trade agreements, are well above average. For example, Great Britain increases exports and imports by 16 and 13% respectively; France by 22 and 24%, Italy by 28 and 19%. Consequently, their welfare gains are also above average. In terms of welfare gains, however, small open economies are those that benefited the most, given the reduced size of their domestic (relative to international) trade. The general equilibrium

[17] Given the concerns expressed while discussing granular estimates (i.e. wider confidence bands for the coefficients and higher risks of omitted variable bias or endogeneity), I prefer to use the "average effect" for capturing general equilibrium. While using granular estimates will augment the heterogeneity of general equilibrium effects, it is comforting to see that the model is able to capture and report heterogeneity even with a "average" reduction in bilateral trade costs, mirroring the different exposure of each country to the network (both in terms of agreements signed and share of trade involved).

[18] In this context, the model provides a general equilibrium solution to an endowment economy, and correspond to a "general equilibrium" model (as opposed to "modular") in Head and Mayer (2014) classification, as "wages (and therefore GDPs) also adjust to trade costs" (p.166).

calculations also indicate that the Cobden-Chevalier network had some trade diversion effects that, despite exceeding trade creation effects in certain cases (mostly for non-members; the negative numbers for exports, imports, and welfare in Table 3), were very limited in size.

Table 3: Cobden-Chevalier trade network general equilibrium effects.

COUNTRY	Δ% EXPORTS	Δ% IMPORTS	Δ% WELFARE
AUS	-1.32	-1.06	-0.05
AUT	19.41	27.77	0.14
BEL	16.91	18.61	0.80
BRA	-0.08	-0.09	-0.01
CAN	8.65	10.75	0.34
CHL	19.23	21.09	0.61
CHN	-0.75	-1.67	0.00
COL	23.39	24.36	0.76
DEU	19.38	19.48	0.46
DNK	-0.73	-0.76	-0.04
ESP	10.84	7.47	0.13
FIN	-1.14	-0.74	-0.01
FRA	22.50	23.92	0.49
GBR	15.85	13.08	0.74
GRC	-1.41	-1.44	-0.08
ITA	27.55	18.70	0.46
JPN	-0.91	-1.24	0.00
NLD	7.00	8.15	0.97
NOR	3.28	3.53	0.16
NZL	-0.83	-0.51	-0.01
PRT	18.36	14.96	0.22
SWE	1.41	1.71	0.05
URY	6.99	8.59	0.81
USA	17.99	24.10	0.26

6. Conclusions

This paper exploits econometric methods at the frontier of the empirical trade literature to reassess the trade effects of the "free trade epidemic" during the 1860s and 1870s. Additionally, it also provides the correspondent general equilibrium trade and welfare effects.

Using a PPML estimation strategy (Santos-Silva and Tenreyro, 2006) and crucially including domestic trade flows, I find that the trade agreements included in my sample have, on average, a large, positive, and significant effect (+27%) on members' bilateral trade. Treaty-level estimates reveal a considerable degree of heterogeneity across trade agreements. For example, the famous Anglo-French treaty of 1860, the Cobden-

Chevalier network milestone, had an effect more than two times larger than the average (+64%).

The quantification of trade and welfare general equilibrium effects show important insights. The Cobden-Chevalier network notably affected total trade and the welfare of nations, by increasing total exports by 9.6%, total imports by 9.9%, and welfare by 0.3% on average. There is a substantial degree of heterogeneity here too. Countries with a considerable number of trade agreements (such as Great Britain, France, or Italy) perform 1.5 to 3 times as well as the average effect. Small open economies tend to report larger welfare gains. The general equilibrium calculations also indicate that the trade diversion effects of the Cobden-Chevalier network were very limited.

These results reshape the understanding of the trade and welfare effects of the Cobden-Chevalier trade network.

My results – identifying positive, large, and significant trade and welfare gains stemming from the Cobden-Chevalier trade network – do not shed light on the distributional or structural (e.g. composition of trade, evolution of the economic structure and complexity, etc.) consequences of trade integration during the 1860s and 1870s, issues that can be investigated with more granular data, nor on the causes of the heterogeneity of treaty-level estimates, for which further information on the content of trade agreements would be needed. These questions deserve further research and consideration.

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Appendix

Table A.1: Effects of the Cobden-Chevalier network – Structural gravity estimates

Agreement	A&F (2008)	A&F (2008)	A&F (2008)	A&F (2008)	A&F (2008)	A&F (2008)
	w/o dom. trade (1)	with dom. trade (2)	with dom. trade & "globalization" (3)	w/o dom. trade (1)	with dom. trade (2)	with dom. trade & "globalization" (3)
TA	0.0130	0.276***	0.244***			
	(0.0566)	(0.0589)	(0.0434)			
TA_Lazer				-0.0641	0.382***	0.249***
				(0.0589)	(0.0187)	(0.0881)
Observations	5,078	5,408	5,408	5,078	5,408	5,408
Domestic trade	NO	YES	YES	NO	YES	YES
Globalization	NO	NO	YES	NO	NO	YES
Exp.-time & imp.time FEs	YES	YES	YES	YES	YES	YES
Dir. pair FEs	YES	YES	YES	YES	YES	YES

Agreement	L_"core" (2009)	L_"core" (2009)	L_"core" (2009)	L_"ext." (2009)	L_"ext." (2009)	L_"ext." (2009)
	w/o dom. trade (1)	with dom. trade (2)	with dom. trade & "globalization" (3)	w/o dom. trade (1)	with dom. trade (2)	with dom. trade & "globalization" (3)
TA	-0.0274	0.304***	0.292***	-0.000997	0.288***	0.254***
	(0.0851)	(0.0787)	(0.0558)	(0.0625)	(0.0573)	(0.0425)
Observations	783	915	915	3,063	3,315	3,315
Domestic trade	NO	YES	YES	NO	YES	YES
Globalization	NO	NO	YES	NO	NO	YES
Exp.-time & imp.time FEs	YES	YES	YES	YES	YES	YES
Dir. pair FEs	YES	YES	YES	YES	YES	YES

Agreement	LC&M (2003)	LC&M (2003)	LC&M (2003)
	w/o dom. trade (1)	with dom. trade (2)	with dom. trade & "globalization" (3)
TA	0.00623	0.274***	0.242***
	(0.0579)	(0.0582)	(0.0442)
Observations	6,519	6,877	6,877
Domestic trade	NO	YES	YES
Globalization	NO	NO	YES
Exp.-time & imp.time FEs	YES	YES	YES
Dir. pair FEs	YES	YES	YES

Note: PPML regressions. A&F: Accominotti and Flandreau (2008). L_"core" and L_"extended": Lampe (2009). LC&M: Lopez-Cordova and Meissner (2003). "TA_Lazer" definition reported in footnote 12. Fixed effects, control variables and constants not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level.
***p < 0.01, **p < 0.05, *p < 0.1.

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