Trade Costs and the Two Globalizations: 1827-2012

Jules Hugot*

This version: April 15, 2015

Abstract

This article provides the first assessment of the nineteenth century trade globalization based on a systematic collection of trade statistics. Drawing on a unique data set of more than 1.3 million bilateral trade observations for the 1827-2012 period, I show that trade costs began to fall in Europe in the 1840s. This finding questions the role played by late nineteenth century improvements in transportation and liberal trade policies in sparking the First Globalization. I use a theory-grounded measure to assess bilateral relative trade costs. I aggregate those trade costs to obtain a world index as well as indices along various trade routes. I further explore the geographical heterogeneity of trade cost dynamics by estimating a border and a distance effect. I find a dramatic rise in the distance effect for both the nineteenth century and the post-World War II era. This result shows that both modern waves of globalization have been primarily fueled by a regionalization of trade.

Keywords: Globalization, Gravity, Trade costs, Border effect, Distance effect
JEL classification: F14, F15, N70

*Ph.D. candidate, Sciences Po Paris: jules.hugot@gmail.com. I am deeply thankful to Michel Fouquin for initiating this research project and providing me with invaluable advice. I am grateful to Thierry Mayer, Kevin H. O'Rourke, Dennis Novy, Guillaume Daudin, Paul Sharp and Christopher M. Meissner for helpful comments. I thank Béatrice Dédinger and Guillaume Daudin for giving me access to the data from the RICardo project as well as Sylvie Leduc for outstanding assistance with the input of the data. This research was improved by the comments from the participants at the 2012 EHS conference in Oxford, the EEA conference in Malaga, the EHA meeting in Vancouver, the 2013 FRESH meeting in Edinburgh, the EGIT workshop in Berlin, the EHES conference in London, the macro seminar at UQAM, the 2014 EBES in Istanbul, the CIE in Salamanca, the EHA meeting in Columbus, the lunch seminar at Sciences Po and the LSE/CEP International Economics Workshop.

1 Introduction

The existence of two distinct periods of trade surge in the modern era – the First Globalization of the nineteenth century and the post-World War II Globalization – has been extensively documented. The precise chronology of the First Globalization, however, remains unclear. Yet understanding this timing is a necessary prerequisite to a proper analysis of the causes behind trade globalization. Some argue that the First Globalization is a late nineteenth century phenomenon, emphasizing the role of transportation technologies such as the steamship (Pascali, 2014), communication technologies such as the telegraph (Steinwender, 2014), and pro-trade policies such as the gold standard (Estevadeordal et al., 2003). Others argue that the First Globalization took off in the early nineteenth century, emphasizing the end of various trade monopolies as a trigger (O'Rourke and Williamson, 2002) or the role played by improvements in transportation already achieved in the late eighteenth century (Jacks, 2005).

I adopt a systematic approach to collecting trade statistics in order to explore the chronology and geographical pattern of both globalizations. Specifically, I compile a data set that gathers more than 1.3 million bilateral trade observations for the 186 years from 1827 to 2012. I also provide data on aggregate trade, aggregate and bilateral tariffs, GDP, exchange rates and various bilateral variables commonly used in the gravity literature.

I show that the First Globalization began in the 1840s for core European countries and in the late nineteenth century for the rest of the world. This result creates a new temporal perspective for the factors that are claimed to be the leading causes of nineteenth century globalization. Disentangling these factors, however, remains beyond the scope of this paper. The early onset for Europe is consistent with evidence on freight costs[1] and on the European movement of unilateral trade liberalization[2], but also with those studies demonstrating that the trade treaties of the 1860s were of limited impact[3]. My results, however, challenge the studies that argue that late nineteenth century technological improvements were the key driver behind the First Globalization[4].

I also show that both the First and the Second Globalization were associated with an increasing response of trade to distance. In other words, both globalizations were driven by an increased regionalization of trade patterns.

[1]Harley (1988) finds that before the 1840s, freight rates fluctuated dependent on the recurring wars that affected Europe. He documents a continuous reduction of freight rates from c.1840 to 1913.

[2]This movement towards free trade in core European countries is best documented in the case of the British repeal of the Corn laws in 1846 (Sharp, 2010) but it was in fact a broader phenomenon.

[3]Accominotti and Flandreau (2006) and Lampe (2009) find that the Cobden-Chevalier network of treaties did not contribute to expanding trade but merely substituted previous unilateral liberalizations. Lampe (2009), however, finds some evidence of a trade-enhancing effect for particular commodities.

[4]Pascali (2014) claims that "*the adoption of the steamship* [c.1870] *was the major reason for the first wave of trade globalization*" (p.23.).

The economic history literature has adopted two distinct approaches to assess the extent of trade globalization. The indirect approach looks at price-convergence. The direct approach relies on trade statistics.

The indirect approach builds on the intuition that, in the absence of trade costs, arbitrage should eliminate price gaps across countries. Empirically, this prediction has been tested by measuring price gaps across different markets, for the same commodity. This approach is particularly helpful to investigate market integration in the pre-modern era, i.e. when trade data is scarce[5]. Indeed, the first comprehensive customs reports were only drafted in the early eighteenth century, and for a limited number of countries[6].

Using data on various commodities, such as cloves, pepper and coffee, O'Rourke and Williamson (2002) observe price convergence in the early nineteenth century. These commodities, however exhibit a high value-to-weight ratio. This feature makes them particularly worth trading across continents. Reliance on specific products then, is one major limitation of the price-convergence approach. As a result, the conclusions of such studies are very dependent on the products that are chosen. For instance, using the same approach, O'Rourke and Williamson (1994) show that the transatlantic convergence of meat prices did not occur before the early twentieth century.

A more recent strand of the price gap literature claims that the conditions for the First Globalization were in fact already met in the late eighteenth century. Those conditions could not translate into a surge of trade due to the recurring disruptive shocks that plagued international relations until 1815. O'Rourke (2006) shows that international price gaps widened during the Napoleonic Wars. He takes this as a sign that world markets were already well connected in the late eighteenth century. Moreover, several authors find direct evidence of price convergence in the eighteenth century[7]. The causes behind this nascent market integration, however, remain vague. One notable exception is Solar (2013), who documents a steep reduction of shipping costs between c.1770 and c.1820. What is certain is that the Congress of Vienna, in 1815, marked the beginning of a century-long period of peace in Europe[8], associated with an unprecedented rise of trade.

The direct approach to assessing the timing of the First Globalization relies on observed trade flows. Most of these studies, however, focus on the 1870-1913 period[9] (Estevade-

[5]Sources for price data include the records of the Dutch East India Company (Bulbeck et al., 1998, Chaudhuri, 1978), the accounts of monasteries, hospitals and municipalities (Hamilton, 1934) and even Babylonian tablets (Földvári and van Leeuwen, 2000).

[6]I collected bilateral trade statistics starting in 1703 and 1720, respectively for the U.K. and France. This data will be exploited in future research.

[7]Sharp and Weisdorf (2013) and Dobado-González et al. (2012) focus on the British-American wheat trade, Rönnbäck (2009) uses data on eleven colonial commodities, traded along various routes, Jacks (2004) focuses on trade in the North and Baltic Seas.

[8]The Crimean War and the wars related to the German and Italian unification are the only exceptions.

[9]Lampe (2009) is an exception as he collected product-level bilateral trade data for seven countries, covering the 1857-1875 period.

ordal et al., 2003, Jacks et al., 2008). This may give the false impression that the First Globalization began later than it actually did. As opposed to previous studies, this article relies on a systematic collection of trade statistics before 1870.

Jacks et al. (2008) use trade statistics to infer trade costs. Their measure of trade costs is very much related to the Head and Ries index (2001), which is itself derived from the gravity equation. They find substantial trade cost reductions in the 1870-1913 period. Beyond the limitation in terms of temporal coverage, their study concentrates on three countries: France, the U.K., and the USA. I rely on a similar methodology but I use a sample that covers many more countries both before and after 1870[10].

I use trade costs as a tool for evaluating the timing of trade globalizations. Some authors have tried to measure individual components of trade costs[11]. This bottom-up approach has several drawbacks when it comes to tracking overall trade costs over time. Indeed, trade costs range from observable barriers – such as tariffs or freight costs – to a variety of unobservable features, such as communication costs. Using the gravity theory on data for recent years, Anderson and van Wincoop (2004) estimate that the representative rich country faces a 74% international trade cost. Of this aggregate figure, they find that observable trade barriers only account for a 20% tariff-equivalent cost[12]. Head and Mayer (2013) refer to these unobservable components as "dark trade costs". They find that they account for 72 to 96% of distance-related trade costs. These results cast a long shadow on the ability to obtain aggregate trade costs from a bottom-up approach.

In this paper, I choose a top-down approach as I use observed trade to infer trade costs. This method has the advantage of capturing all the possible components of trade costs without having to assume an *ad-hoc* specification for each of them. On the flip side, the top-down approach prevents me from identifying the components of trade costs.

The measure of trade costs I use takes its roots in the gravity literature. Specifically, I use the Head and Ries index to relate observed trade to the frictionless prediction that emerges from the structural gravity theory. I infer trade costs from this comparison. Over the last decade, economists have derived gravity equations from a variety of general equilibrium trade models (Anderson and van Wincoop, 2003, Krugman, 1980, Eaton and Kortum, 2002, Chaney, 2008, Melitz and Ottaviano, 2008). Head and Mayer (2014) review the various micro-foundations for the gravity equation and call the models that involve multilateral resistance terms "structural gravity"[13]. These multilateral factors reflect the fact that bilateral trade does not only depend on bilateral factors but also on the trade costs associated with all potential partners. Head and Mayer (2014) show that all structural gravity models yield the same macro-economic gravity equation.

[10]My results are consistent with Jacks et al. (2008) for the overlapping country pairs. See: Figure 30 (appendix C) for an example.

[11]Anderson and van Wincoop (2004) provide a survey of this literature.

[12]I define observable barriers to trade as freight costs and trade policies. Anderson and van Wincoop (2004) find that they respectively result in an 11% and a 8% tariff-equivalent cost: $1.11 \times 1.08 = 1.20$.

[13]Similarly, Allen et al. (2014) provide a unifying theory they call "universal gravity".

The generality of the gravity equation is of particular interest to this study. This feature allows the skeptical reader to remain agnostic as to which model best describes the fundamental reasons to trade at the micro-level. This becomes crucial when dealing with a time period of almost two centuries as it can be argued that the reasons to trade have changed dramatically[14]. Given the variety of the micro-founded models that lead to structural gravity equations, I am confident in the validity of the measure of trade costs I use throughout my period of interest.

Beyond its generality, the Head and Ries trade cost index presents several advantages. First, it perfectly controls for the country-specific determinants of trade emphasized by the structural gravity literature, including supply and demand but also multilateral resistance terms. Second, the Head and Ries index is bilateral-specific, which allows me to explore the dynamics of globalization across trade routes. Third, the Head and Ries index can be converted into a tariff-equivalent measure (Jacks et al., 2008), on the condition of imposing a value for the elasticity of trade with respect to trade costs (hereafter: trade elasticity).

In order to further understand the geographical dynamics of the two waves of globalization, I decompose trade costs into a border and a distance effect. The distance effect reflects the negative impact of distance on trade. The border effect is the average trade-reducing effect of international borders, once distance is taken into account. This decomposition, however, requires imposing an *ad-hoc* – although standard – functional form for trade costs. I show that both waves of globalization have been disproportionately fueled by an increase in short-haul trade. This feature has been documented for the Second Globalization by Combes et al. (2008) and Disdier and Head (2008), but this article is the first to my knowledge to find a similar result for the nineteenth century.

Finally, I relate the border effect to the distance effect to provide a distance-equivalent measure of the border effect. I take this measure of "border thickness" as an indicator of the degree of trade regionalization. I find that both the First and the Second Globalization have been associated with borders becoming "thinner", i.e. that distance-induced trade costs rose relative to border-related costs. This confirms the finding of an increased regionalization of trade patterns over the course of both globalizations.

In section 2, I discuss the Head and Ries index of trade costs. In section 3, I estimate the trade elasticity. Section 4 introduces the data set. In section 5, I estimate and comment on my index of world trade costs. Section 6 explores the heterogeneity of trade cost dynamics across trade routes. In section 7, I decompose trade costs into a border and a distance effect, and compute a measure of border thickness. Section 8 provides concluding remarks.

[14] It has notably been argued that economies of scale and product differentiation have become key micro-level drivers of trade in the twentieth century (Krugman, 1980).

2 The Head and Ries measure of trade costs

The empirical trade literature has mostly isolated particular components of international trade costs, such as distance or language barriers. This approach comes at the cost of imposing a somewhat arbitrary functional form for these trade barriers. Besides, as only a subset of the potential trade barriers are included in these regressions, omitted variable bias becomes a major source of concern[15].

On the contrary, Head and Ries (2001) derive a comprehensive index that infers trade costs from observed trade flows. The Head and Ries index captures both the observable components of trade costs – e.g. transport costs and restrictive commercial policies – and the unobservable components, such as contracting costs. This feature is particularly appealing since data on the individual components of bilateral trade costs is rarely available for the nineteenth century.

The Head and Ries index controls perfectly for the country-specific determinants of trade, including supply and demand for trade as well as multilateral resistance terms. In turn, the Head and Ries index precisely reveals bilateral relative to domestic trade costs, for each pair of country. Whereas atheoretical measures, such as the trade openness ratio, do not allow to disentangle changes in trade costs from changes in country-specific factors[16]. Eaton et al. (2011) emphasize that changes in trade patterns can also be due to internal factors. They document a steep reduction of trade openness during the trade collapse of the late 2000s. At the same time, they show that trade costs, as measured by the Head and Ries index, remained stable. In the end, they find that "*shocks to manufacturing demand, particularly for durables, account for the bulk of the decline in trade/GDP*"[17].

Head and Ries derive their micro-founded index of trade costs from both the monopolistic competition model of Krugman (1980) and a model of national product differentiation in a perfect competition setting, similar to Anderson and van Wincoop (2003)[18]. The Head and Ries index relates observed trade to the frictionless prediction that emerges from the models. The comparison of actual trade to the frictionless counterfactual yields a measure of the aggregate trade barriers associated with each country pair. Novy (2013) shows that the Head and Ries index can be derived from a broader range of models, including the Ricardian model (Eaton and Kortum, 2002) and heterogeneous firms models (Chaney, 2008, Melitz and Ottaviano, 2008). The Anderson and van Wincoop (2003) model takes production as a given and builds upon an Armington demand structure to yield a gravity equation. In this model, trade occurs because of consumers' taste for

[15] Omitted variable bias is a concern to the extent that the omitted components of trade costs are correlated with the variables included in the regression.

[16] Figure 18 (appendix B) reports export openness ratios for various constant country samples.

[17] Eaton et al. (2011), p.25.

[18] Equation (8), p.863.

variety. On the other hand, in the Ricardian model, trade occurs because of countries' comparative advantages in production. Similarly, in heterogeneous firms models, trade is related to firms' advantages in productivity. In the end, the Head and Ries index can be derived from any model that yields what Head and Mayer (2014) have coined a structural gravity equation. This feature is particularly helpful in the context of an analysis that spans two centuries as one can remain agnostic as to which have been the key drivers of trade over a period that long.

I now provide a derivation of the Head and Ries index in the general formulation of structural gravity from Head and Mayer (2014)[19]:

$$X_{ij} = \frac{Y_i \, X_j}{P_i \, \Pi_j} \, \tau_{ij}^{\epsilon} \tag{1}$$

Where $P_i = \sum_l \frac{\tau_{il}^{\epsilon} \, X_l}{\Pi_l}$ and $\Pi_j = \sum_l \frac{\tau_{lj}^{\epsilon} \, Y_l}{P_l}$. l indexes third countries.

The bilateral trade flow (X_{ij}) from country i to country j is positively related to production in the origin country (Y_i) and expenditure in the destination country (X_j). Bilateral trade is also negatively related to the exporter's outward multilateral resistance term (P_i) and the importer's inward multilateral resistance term (Π_j). Finally, trade decreases with bilateral trade costs (τ_{ij}). The response of trade to trade costs is given by the trade elasticity ($\epsilon < 0$).

The outward multilateral resistance term (P_i) captures the fact that bilateral trade does not only depend on bilateral factors but also on the trade costs associated with all the potential destination markets of country i. Conversely, the inward multilateral resistance term (Π_j) reflects the idea that country j's imports from country i are also affected by the trade costs of country j with all its potential partners[20].

The multilateral resistance terms cannot be solved for analytically. Head and Ries (2001) provide a simple solution to cancel out those terms. As a result, they are able to obtain a ratio of bilateral to internal trade costs. Multiplying equation (1) by its counterpart for the symmetric flow and assuming balanced trade at the country level ($Y_i = X_i$) yields:

$$X_{ij} \, X_{ji} = (Y_i \, Y_j)^2 \left(\frac{\tau_{ij}^{\epsilon} \, \tau_{ji}^{\epsilon}}{P_i \, P_j \, \Pi_i \, \Pi_j} \right) \tag{2}$$

For internal trade, the gravity equation writes:

$$X_{ii} = \frac{Y_i^2}{P_i \, \Pi_i} \tau_{ii}^{\epsilon} \tag{3}$$

[19]Equation (2), p.8. Arkolakis et al. (2012) also emphasize the generality of the gravity equation.

[20]In non-structural estimations of the gravity equation, multilateral resistance terms were often approximated by a measure of countries' remoteness from world markets, i.e. a weighted average of countries' distance to all potential foreign markets (see a discussion in Anderson and van Wincoop (2003), pp.173-174.). Baldwin and Taglioni (2006) refer to the omission of multilateral resistance terms as the "*gold medal mistake*" of the gravity literature (pp.7-10).

Rearranging equation (3) yields an expression for $P_i \, \Pi_i$ ($P_j \, \Pi_j$):

$$P_i \, \Pi_i = \frac{Y_i^2 \, \tau_{ii}^{\epsilon}}{X_{ii}} \tag{4}$$

Plugging the previous equation for $P_i \, \Pi_i$ and $P_j \, \Pi_j$ back into equation (2) yields:

$$X_{ij} \, X_{ji} = X_{ii} \, X_{jj} \, \left(\frac{\tau_{ij} \, \tau_{ji}}{\tau_{ii} \, \tau_{jj}} \right)^{\epsilon} \tag{5}$$

Rearranging and taking the geometric average of both directional relative trade costs yields the Head and Ries trade cost index:

$$\left(\frac{\tau_{ij} \, \tau_{ji}}{\tau_{ii} \, \tau_{jj}} \right)^{\frac{\epsilon}{2}} = \sqrt{\frac{X_{ij} \, X_{ji}}{X_{ii} \, X_{jj}}} \tag{6}$$

The Head and Ries index is a top-down measure as it makes use of theory to infer trade costs from the data. Indeed, the right hand side of equation (6) is directly observable. Specifically, the Head and Ries index evaluates the barriers to trading with a foreign partner, relative to internal trade barriers. The intuition is that the more countries trade internally[21] (denominator of the ratio in the RHS) as opposed to with foreign partners (numerator), the larger the international trade barriers must be relative to internal barriers.

Trade costs should *a priori* not be assumed to be symmetric. In this setting, however, only the geometric average of both directional trade costs can be identified. It is therefore impossible to properly relate the trade cost index to direction-specific explanatory factors such as trade policies. Moreover, it is important to note that the Head and Ries index is a measure of international relative trade costs. Any variation of the index can therefore equally reveal changes in international or intra-national trade costs.

Jacks et al. (2008) propose a tariff-equivalent interpretation of the Head and Ries index. In the general framework of structural gravity, their measure of trade costs writes:

$$TC_{ij} \equiv \sqrt{\frac{\tau_{ij} \, \tau_{ji}}{\tau_{ii} \, \tau_{jj}}} - 1 = \left(\frac{X_{ii} \, X_{jj}}{X_{ij} \, X_{ji}} \right)^{-\frac{1}{2\,\epsilon}} - 1 \tag{7}$$

To illustrate equation (7), let us consider two perfectly integrated markets. For this country pair, there are no international trade barriers. The tariff-equivalent trade cost (TC_{ij}) must therefore be equal to zero, i.e. the ratio in the right hand side of equation (7) must be equal to unity. In other words, in a frictionless world, the product of two countries' internal trade must be equal to the product of the two bilateral flows that relate them.

[21] I discuss the measure of internal trade I use in section 4.

Computing the Head and Ries measure of trade costs (equation 7) requires to set a value for the trade elasticity. In my benchmark results, I set ϵ to -3.78. Specifically, I draw on the meta-analysis from Head and Mayer (2014), restricted to the estimates based on structural gravity equations[22]. In the following section, I discuss the trade elasticity and explore the possibility that it may have changed over time.

3 Estimation of the trade elasticity

The trade elasticity is a key parameter that reflects the response of trade to trade costs in any structural gravity model. In these models, a small trade elasticity reveals large incentives to trade, as agents are ready to pay high costs to trade across borders. In the end, regardless of the reasons that push countries to trade at the micro level, the larger the potential gains from trade, the higher will be the Head and Ries measure of trade costs associated with any given level of trade.

In the Anderson and van Wincoop (2003) framework, the potential gains from trade are determined by the elasticity of substitution across varieties (σ). The more differentiated the varieties (low σ), the larger the gains and the greater the resulting measure of trade costs will be. In the Ricardian framework (Eaton and Kortum, 2002), the potential gains from trade are determined by θ, the Fréchet parameter that governs the degree of heterogeneity of sectoral productivity. In heterogeneous firms models (Chaney, 2008, Melitz and Ottaviano, 2008), the potential gains from trade are related to γ, the Pareto parameter that governs the distribution of firms' productivity[23].

My benchmark results rely on a trade elasticity set to -3.78 and that remains constant over time. However, the trade elasticity may have changed over the two centuries of my period of interest[24]. For example, it can be argued that product varieties have become closer substitutes as more countries industrialized. Similarly, it can be argued that sectors or firms' productivity have become more homogeneous across countries due to convergence in production technology. Both these claims would result in larger trade elasticities: the reaction of trade to trade costs would increase as the potential gains from trade are reduced.

In order to check for long-run changes in the trade elasticity, I propose my own estimates, based on data for the 1829-1913 period. To do so I follow Romalis (2007) and use

[22]See: Table 5, p.33.

[23]Appendix A provides formulations of the Head and Ries measure of trade costs in the three abovementioned theoretical frameworks.

[24]I have no reason to believe, however, that there is much short-term volatility in the trade elasticity. In this respect, Broda and Weinstein (2006) estimate the elasticity of substitution for two recent periods: 1972-1988 and 1990-2001, at the dis-aggregated product level. They find a small and insignificant reduction in the median elasticity: from 2.5 to 2.2, at the 3-digit level (Table IV p.568).

bilateral tariffs to identify the response of trade to trade costs. The identifying assumption is that trade costs react one for one to a variation in tariffs, i.e. tariffs are pure cost shifters. Let us begin with the structural gravity equation:

$$X_{ijt} = \frac{Y_{it}\, X_{jt}}{P_{it}\, \Pi_{jt}}\, \tau_{ijt}^{\epsilon} \tag{8}$$

I specify trade costs as follows:

$$\tau_{ijt} = (1 + t_{ijt}) \times DIST_{ij}^{\alpha_1} \times \exp(\alpha_2\, COLO_{ijt}) \times \exp(\alpha_3\, LANG_{ij}) \times \eta_{ijt} \tag{9}$$

Where t_{ijt} is a measure of bilateral tariffs. $DIST_{ij}$ is the population-weighted great-circle distance between i and j[25]. $COLO_{ijt}$ is a dummy set to unity if the two countries are in a colonial relationship. $LANG_{ij}$ is a dummy set to unity if the two countries share an official language. η_{ijt} reflects the unobservable components of trade costs.

I estimate the trade elasticity using bilateral customs duties-to-imports ratios as a proxy for bilateral tariffs[26]. Ideally, I would need a tariff-equivalent measure of the overall level of bilateral protection. This would, however, force me to use a somewhat arbitrary technique to aggregate the various *ad-valorem* tariff lines. Worse, most tariffs in the nineteenth century were specific (per-unit) which would further require choosing a method to transform them into *ad-valorem* equivalents.

A major caveat to using bilateral duties-to-imports ratios to approximate bilateral tariffs should be noted. In fact, tariffs have an ambiguous effect on these ratios. First, higher tariffs increase the value of the customs duties that are collected. At the same time tariffs reduce imports by making imported goods more expensive[27]. The resulting duties-to-imports ratios may therefore underestimate the actual level of protection. In turn, the trade elasticities I estimate should be considered as lower bounds. In the end, duties-to-imports ratios can only be considered an appropriate approximation for average tariffs assuming that trade does not react to tariff-induced changes in prices. In practice, the extent to which these ratios are relevant proxies for actual tariffs depends on the price elasticity of import demand. The more inelastic the import demand, the better the ratios will reveal changes in actual tariffs.

I estimate the trade elasticity in both the cross-section and the time dimension using French duties-to-imports ratios for the 1829-1913 period.

I obtain the cross-section equation by plugging (9) into (8), taking logs and removing time subscripts. I estimate the resulting equation separately for each year, using OLS.

[25] For a discussion, see: appendix D.8.

[26] Appendix D.3 provides more details on these ratios.

[27] In particular, the prohibitive tariffs that were imposed on some products until the late nineteenth century result in an underestimation of the actual level of protection. See in this respect what has been referred to in the literature as the Irwin-Nye controversy (Nye, 1991, Irwin, 1993).

The notation explicitly specifies that France is always the destination country:

$$\ln X_{iFR} = \gamma \ln Y_i + \epsilon \ln(1 + t_{iFR}) + \beta_1 \ln DIST_{iFR} + \beta_2 COLO_{iFR} + \beta_3 LANG_{iFR} + \ln \eta_{iFR} \tag{10}$$

I use the notation $\beta_x = \alpha_x \times \epsilon$, $\forall\, x \in \{1, 2, 3\}$. Y_i is the GDP of country i. The error term η_{iFR} captures the bilateral components of trade costs that are not explicitly controlled for, as well as origin countries' outward multilateral resistance terms. As a result, the trade elasticities obtained from equation (10) cannot be considered as structural estimates.

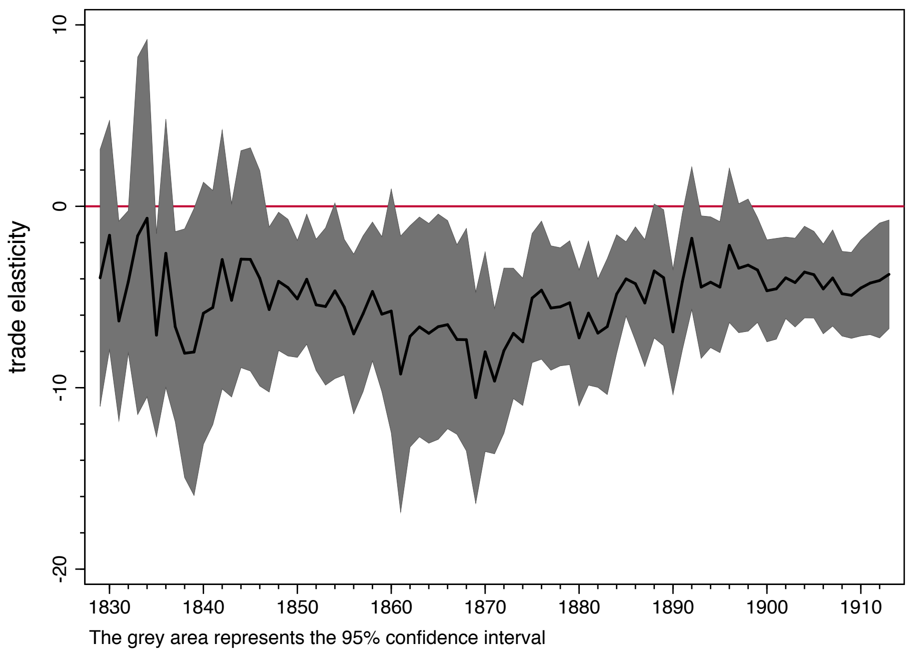

Figure 1: Cross-sectional estimation of the trade elasticity: 1829-1913

I also identify the trade elasticity in the time dimension, for each decade. This time, I keep the time subscripts in the estimated equation and I impose a set of origin-country fixed effects. All the identification therefore comes from the time dimension:

$$\ln X_{iFRt} = \epsilon \ln(1 + t_{iFRt}) + FE_{iFR} + \gamma_1 \ln Y_{it} + \gamma_2 \ln Y_{FRt} + \beta_2 COLO_{iFRt} + \ln \eta_{iFRt} \tag{11}$$

I use the notation $\beta_2 = \alpha_2 \times \epsilon$. The error term η_{iFRt} captures the time-varying unobservable components of trade costs, as well as origin countries' outward multilateral resistance terms. Similarly to equation (10), the coefficients estimated using equation (11) do not qualify as structural gravity estimates.

Figures 1 and 2 respectively plot the trade elasticities obtained from the cross-sectional equation (10) and the longitudinal equation (11). The limited amount of data and the

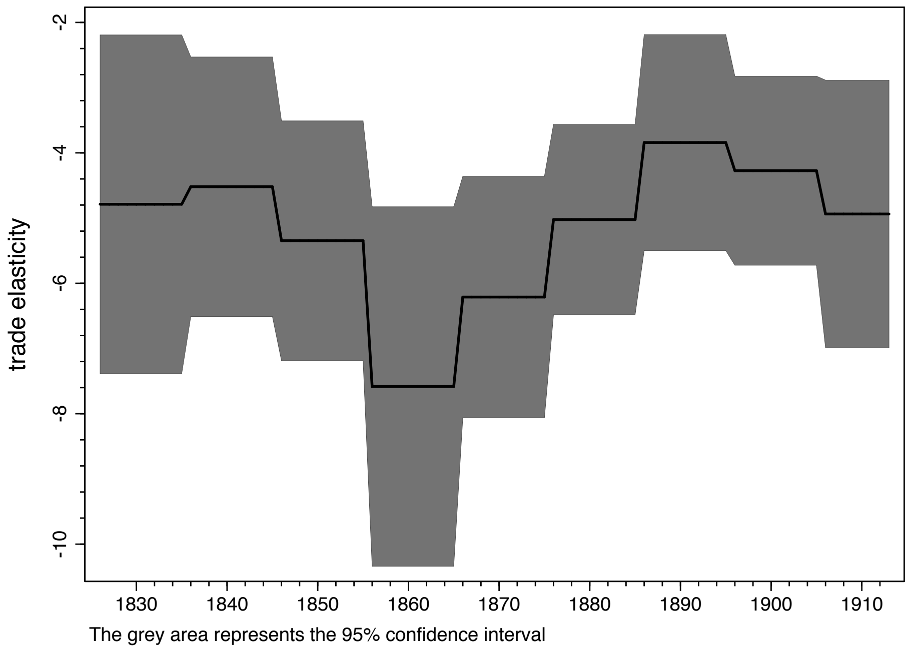

Figure 2: Longitudinal estimation of the trade elasticity, by decade: 1829-1913

measurement error associated with the usage of duties-to-imports ratios to proxy bilateral tariffs result in large confidence intervals. The estimated coefficients are never different from each other at the 95% confidence level which does not allow me to conclude that the trade elasticity changed significantly over the nineteenth century.

In the cross-section, I find a median elasticity of -4.84, with an associated standard error of 1.65. In the time-dimension, I find a median elasticity of -4.93, with an associated standard error of .79. None of these median estimates is statistically different at the 95% level from the median value found in the meta-study of Head and Mayer (2014). I take this as a sign that the trade elasticity did not substantially change between the early nineteenth and the late twentieth century. For my benchmark results I therefore use a trade elasticity of -3.78, as found in Head and Mayer (2014). I still use my own estimates in a robustness check where I impose a linear trend from -4.93 (median estimate from equation 11) to -3.78 (benchmark estimate, taken from Head and Mayer (2014)[28].

4 Data

One distinctive feature of this research has been to systematically collect bilateral and aggregate trade data as well as GDP and exchange rates, for the 1827-2012 period. A detailed description of the data set can be found in appendix D. Here I simply provide insights with respect to the key features of the data.

[28]Figure 26 (appendix C) illustrates the sensitivity of trade costs to the trade elasticity. Novy (2013) provides a discussion of the sensitivity of trade costs to the trade elasticity (p.115).

The data set has been constructed using current price information. Values have been converted to the British pound sterling in order to make data internationally comparable and suitable for gravity analysis. The trade data relies on various first-hand national sources as well as secondary sources. Overall, I report more than 1.3 million bilateral trade flows, from which I directly collected more than 90,000 observations. I incorporate an additional 34,000 observations from the unpublished RICardo data set. I also provide total exports and imports that I gather from similar sources. The GDP data comes mostly from the various studies that gravitate around the Maddison project which aims to reconstruct historical national accounts. I provide different measures of distances as well as some dummy variables that are commonly used in the gravity literature. Table 1 provides a summary of the data set.

	Bilateral trade	Bilateral tariffs	Total exports	Total imports	Aggregate Tariffs	GDP	Exchange rates
Dimensions	pair year	pair year	country year	country year	country year	country year	country year
# of observations	1,313,519	8,692	20,248	19,683	1,462	13,049	12,765
Total # of pairs	34,929	390					
Total # of entities	305	163	239	234	11	212	143

Table 1: Summary of the main variables of the data set

The use of bilateral trade data in the denominator of the Head and Ries measure of trade costs is straightforward but the results also depend on the measure of internal trade, in the numerator. Internal trade, as any measure of trade, is a gross notion as intermediary consumption is not subtracted. It should thus be measured as gross domestic tradable output, minus total exports[29]. The measure of internal trade I use to compute trade costs relies heavily on GDP data. Most gravity-oriented articles on trade in the nineteenth century use constant price GDP data from Maddison (2001), reflated using the U.S. CPI. Baldwin and Taglioni (2006) coined this adjustment of GDP series the "bronze medal mistake" in the gravity literature[30]. I follow their critique and rely on current price series.

Unfortunately, reconstructions of national accounts have concentrated on GDP series that are by definition net of intermediary consumption. My approach is to scale up current price GDP data to obtain an approximation of gross output. I use the average ratio of gross output to value added taken from the data set of de Sousa et al. (2012). Specifically, I aggregate their figures across industrial sectors to obtain an average ratio of 3.16 for the period 1980-2004. I then take the product of this ratio and the GDP data as a measure of

[29]Measuring internal trade as gross output minus exports is especially meaningful for countries that are very open to trade, such as Belgium or the Netherlands, as for some years, not adjusting GDP figures to gross output would result in negative observations for internal trade.

[30]"*Since there are global trends in inflation rates, inclusion of* [the U.S. price index] *probably creates biases via spurious correlations*", p.7.

gross output. I finally subtract total exports and use the resulting series as my benchmark measure of internal trade.

Whenever data is available, I also provide alternative results with internal trade measured as the tradable component of GDP, minus exports. To do so, I decompose GDP into a tradable component – agriculture and industry – and a non-tradable component: services. I then scale-up the data using ratios of value added to gross production. For the industrial sector, I use 3.16 (the ratio from de Sousa et al. (2012)). For agriculture, I use a factor of 2.4 taken from 2012 data for France[31]. This, of course, comes at the cost of restricting the sample to 58% of the benchmark sample. In Figure 31 (appendix C), I estimate my world trade cost index on identical samples using the alternative methods to approximate internal trade. The results show that taking into account changes over time in the share of tradables in output leads to a magnification of any trade cost reduction.

5 World trade costs

The trade costs I obtain are country-pair-year specific. Aggregating trade costs over country pairs is not trivial since the composition of the sample varies over time (Figure 3). In particular, the pairs in the sample may be endogenously determined as the available data for the most early years come from the most developed countries. Exchanges among these countries, in turn, are associated with structurally lower trade costs. Ignoring this sampling bias would thus result in an underestimation of any trade cost reduction.

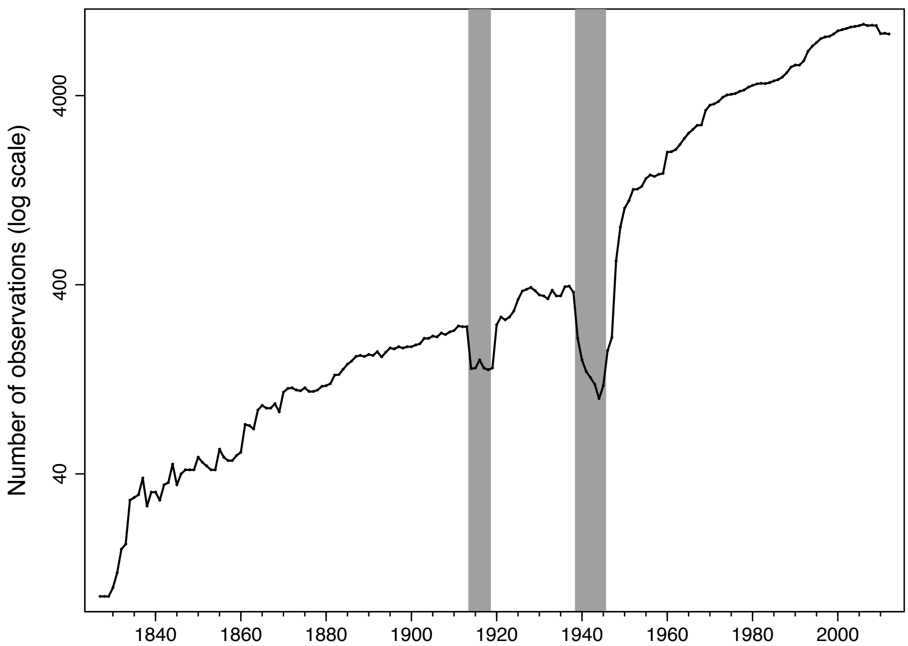

Figure 3: Number of computed bilateral trade costs

[31]INSEE, Compte provisoire de l'agriculture, May 2013.

I begin by restricting the sample to the country pairs for which I obtain trade costs on a continuous basis throughout the period. Figure 4 reports weighted mean trade costs for various constant samples[32]. Specifically, I weight trade costs by the sum of the two countries' internal trade. I use the same aggregation method to compare transatlantic and intra-European trade costs, and the trade costs affecting various parts of Europe (Figures 16 and 17, appendix B).

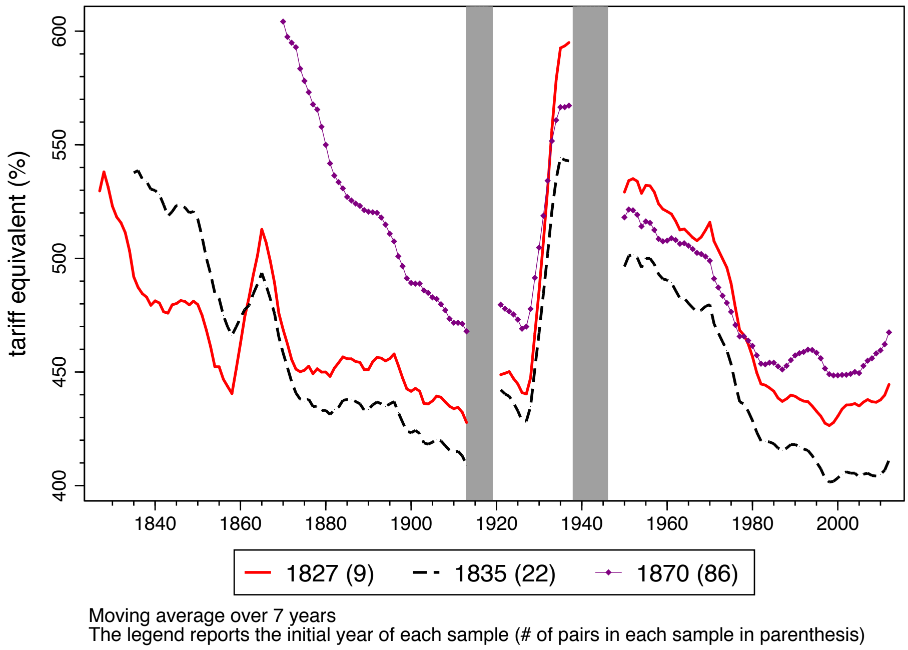

Figure 4: Internal trade-weighted mean trade costs computed on constant samples

Aggregating trade costs using constant samples considerably reduces the information from which conclusions can be drawn. For a large number of pairs, trade costs cannot be computed every year. Besides, a lot of countries simply appear and disappear during my two centuries of interest, which eliminates them from any constant sample. I propose an index of trade costs that makes use of all the information available and also partially controls for the sampling bias[33]. Specifically, I decompose trade costs into a bilateral component and a time effect. To do so, I regress the log of the trade costs obtained from equation (7) on bilateral and year effects:

[32]The 1827 sample covers the following pairs: CHL-FRA, CHL-USA, DNK-FRA, ESP-FRA, ESP-GBR, ESP-USA, FRA-GBR, FRA-USA, GBR-USA. The 1835 sample adds: BEL-DNK, BEL-ESP, BEL-FRA, BEL-GBR, BEL-NLD, BEL-SWE, BEL-USA, DEU-ESP, DEU-SWE, DEU-USA, DNK-SWE, ESP-SWE, FRA-NLD,FRA-NOR, FRA-SWE, GBR-SWE, NLD-SWE, NOR-SWE, SWE-USA. For details on country coding, see: appendix D.1. Figures 14 and 15 (appendix B) respectively provide aggregations using a simple mean and a bilateral trade-weighted mean.

[33]Eaton et al. (2011) use a similar aggregation method (p.6).

$$\ln TC_{ijt} = \alpha_{ij} FE_{ij} + \beta_t FE_t + \eta_{ijt} \tag{12}$$

The Head and Ries trade costs in the left hand side of equation (12) are obtained using a trade elasticity set to -3.78 throughout the period. Figure 5 plots the exponential of the year effects (β_t) that I take as my world trade cost index. The bilateral effects capture the factors that are both country-pair-specific and time-invariant (e.g. distance, long-run cultural ties, etc.). These fixed effects, however, do not control for the time-varying bilateral factors that affect trade costs. In particular, the error term (η_{ijt}) captures the bilateral time-varying components of trade costs. In other words, my trade cost index does not control for the fact that the changes over time of the trade costs that enter the sample may be endogenously determined. For instance, it could be claimed that country pairs enter the sample because their bilateral trade cost is falling faster than for other pairs. This would result in an overestimation of any actual trade cost reduction. I therefore also estimate equation (12) using constant country-pair samples. Figure 6 shows the resulting indices.

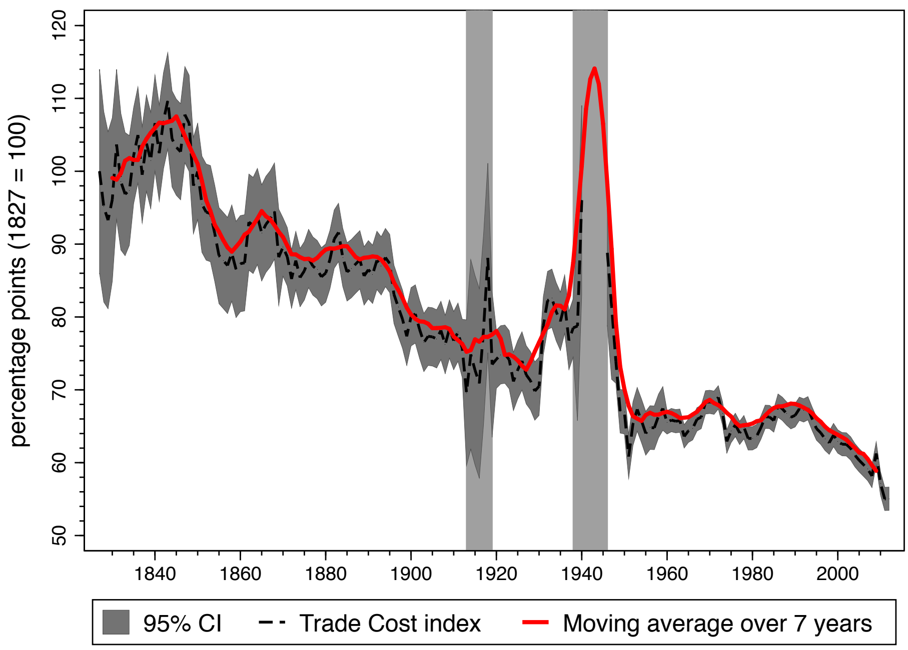

Figure 5: World trade cost index

The trade cost indices from Figures 5 and 6 show a dramatic fall of trade costs starting in the 1840s. This trade cost reduction lasts until the eve of World War I. Trade cost indices return to their 1913 levels in the 1920s. Not surprisingly, the Great Depression is associated with a rise of trade costs. They reach their peak during World War II. Figure 5 shows that immediately after the war, trade costs fall to levels that are lower than ever.

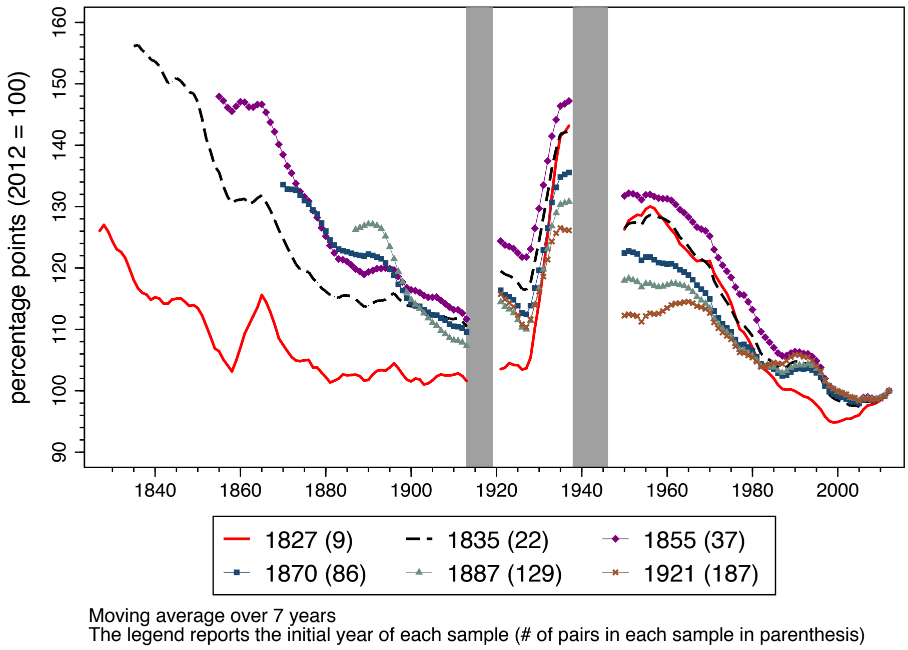

Figure 6: Trade cost indices estimated on various constant samples

Trade costs then remains flat until they start falling again in the 1990s. Figure 6 provides a different picture, where trade costs remain high after the war and start falling again in the late 1960s. This divergence is due to the composition of the samples. Figure 5 relies on all the available measures of trade costs, while Figure 6 reduces the sample to the pairs that are available for all years. The countries in these constant samples tend to be more developed economies that benefited from further trade cost reductions before others.

Overall, trade costs fall during the nineteenth century. However, they also rise during three short periods: the late 1830s, the 1860s and the early 1880s. Most of Europe and the United States were affected by a period of deflation from 1837 to 1843. In the U.K., a "*series of bad harvest failures* [...] *led to the importation of wheat from the continent and a drain on the Bank of England's gold reserves leading it to raise its discount rate and precipitate capital flight from periphery countries, especially the United State*" (Bordo et al., 2005). As most tariffs in the nineteenth century were based on quantities (specific tariffs), the contraction of prices resulted in a rise of the level of *ad-valorem* equivalent protection. Besides, the civil war that lasted from 1833 to 1839 in Spain also disrupted international trade patterns (see: Figure 19 in appendix B). The rise of trade costs during the early 1860s concentrates on the United States, which points to the disruptive effect of the U.S. Civil War on trade. Finally, the early 1880s rise of trade costs was also associated with a period of deflation that particularly affected the countries that joined the Gold Standard in the 1870s: Germany, the Netherlands, Belgium and Scandinavian countries.

The level of trade costs is sensitive to the value of the trade elasticity. As an illustration, I allow for a variation of the trade elasticity over time. Specifically, I impose both an increasing and a decreasing linear trend for the trade elasticity. I choose -4.93 (median estimate from equation 11) and -3.78 (taken from Head and Mayer (2014)) as extreme values for the first and the last year of the sample. Figure 27 (appendix C) reports the results of this sensitivity analysis. An increase of the absolute value of the trade elasticity reveals smaller scope for trade gains. Hence, for any given observed trade, the corresponding trade cost will be lower. In the end, any falling trend of trade costs is magnified by an increase of the trade elasticity.

6 Route-specific trade cost indices

I now estimate my trade cost index on various sub-samples to explore the heterogeneity across trade routes.

6.1 Country-specific indices

Figure 7 plots indices obtained by aggregating bilateral trade costs across all partners for France, the U.K. and the USA[34]. For the nineteenth century, the patterns for France and the U.K. are similar as the largest reduction of trade costs takes place between the late 1840s and the 1870s. Trade costs then remain flat until their steep rise with the onset of the Great Depression. In contrast, the trade cost indices for France and the U.K. diverge after World War II. While international relative trade costs fall for France until the 1980s, they start rising immediately after the war for the U.K. Again, the indices reflect the changes over time of international relative trade costs, not their absolute levels. The post-World War II increase in the trade cost index for the U.K. is simply the consequence of the very high level of British involvement in international trade prior to the war, in particular with its colonies. Besides, the British trading network with its former Empire disintegrated faster than in the French case.

The dynamics of trade costs affecting the USA is very different. There is no clear falling trend occurring before the late nineteenth century. The United States are heavily affected by the Civil War, and it takes about thirty years before trade costs fall back to their *antebellum* level. The USA also benefit from a reduction of international relative to intra-national trade costs during World War I. Figure 19 (appendix B) reports additional trade cost indices for Belgium, the Netherlands, Spain and Sweden.

[34]Note that for country-specific aggregations, equation (12) writes: $\ln TC_{it} = \alpha_i FE_i + \beta_t FE_t + \ln \eta_{it}$, where i indexes the trading partners of the country of interest.

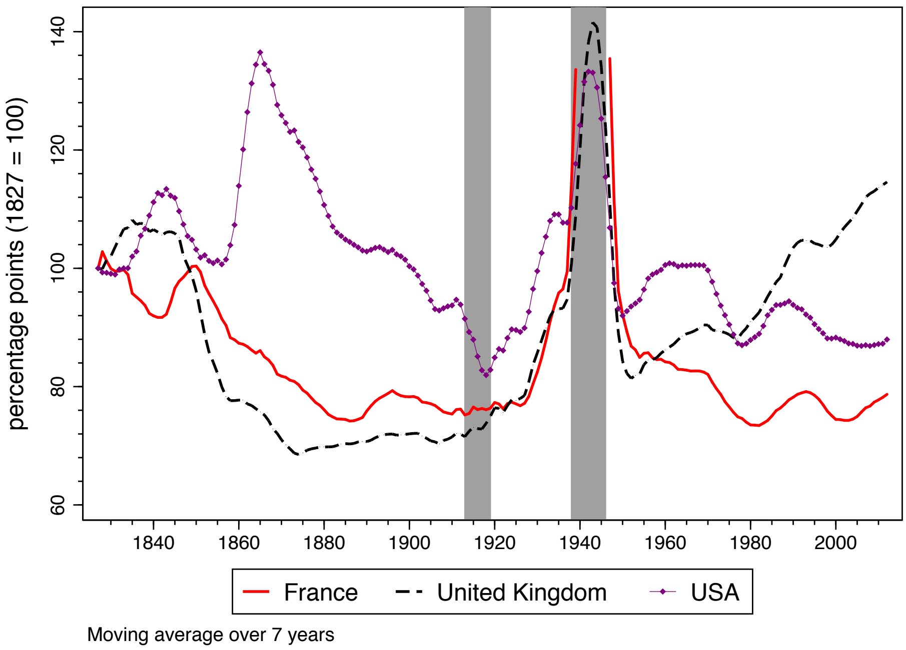

Figure 7: Country-specific trade cost indices

6.2 Region-specific indices

Figure 8 plots trade costs indices for three regions. Core Europe corresponds to Northwestern Europe and Scandinavia. Periphery Europe includes Central, Eastern and Southern Europe[35]. Specifically, I aggregate trade costs across all the country pairs that include at least one country of the region of interest. Figure 8 shows that trade costs start falling for core European countries in the late 1840s. In the European periphery and the rest of the world, on the other hand, trade costs do not fall steadily before late in the nineteenth century. This could be due to an asymmetric impact of the introduction of the steamship (Pascali, 2014), affecting more profoundly long-distance trade costs.

After World War II, trade cost reductions are most pronounced for the European periphery, and particularly Southern Europe (Figure 9). On the contrary, relative trade costs remain flat for core European countries. For the rest of the world, trade cost reductions steadily resume in the 1990s.

Figure 9 takes a closer look at the dynamics of trade costs within Europe. For all three regions, trade costs start to fall in the 1840s. But in Scandinavia and Southern Europe, they rise again during the protectionist backlash of the late nineteenth century. This points to the role played by the asymmetric protectionist policies adopted by most continental European countries between the late 1870s and the turn of the century. These restrictive trade policies were primarily designed to protect farmers and landowners from the "Grain Invasion" originating from the New World, but they also affected Southern Europe and Scandinavia (O'Rourke, 1997).

[35]See: sub-continental region coding in Table 3 (appendix D.1).

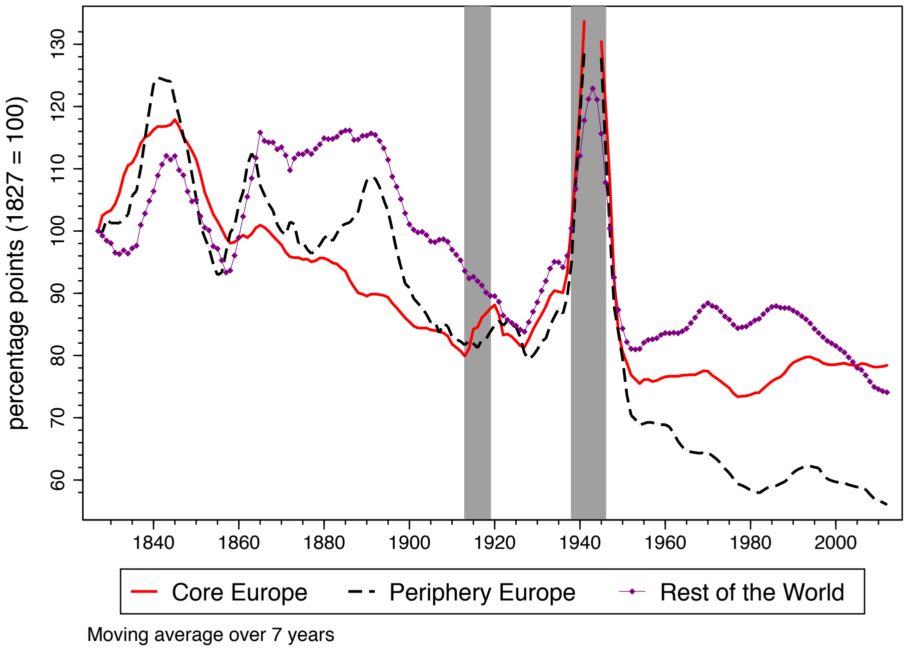

Figure 8: Trade cost indices for three groups of countries

6.3 Trade-route specific indices

Figure 10 shows that the nineteenth century fall of trade costs primarily affected intra-European trade. Transatlantic trade costs did not substantially fall before the turn of the twentieth century. However, the fall in the years immediately preceding World War I is dramatic whereas intra-European trade costs stabilize during the same period. After World War II, the greatest trade cost reductions occur along intra-European trade routes which is consistent with the policies implemented to stimulate European market integration. On the contrary, transatlantic trade costs remain stable, if not rising. This latter result implies that the scope for trade cost reductions between Europe and America in general, and the United States in particular remains high, even in the early twenty-first century.

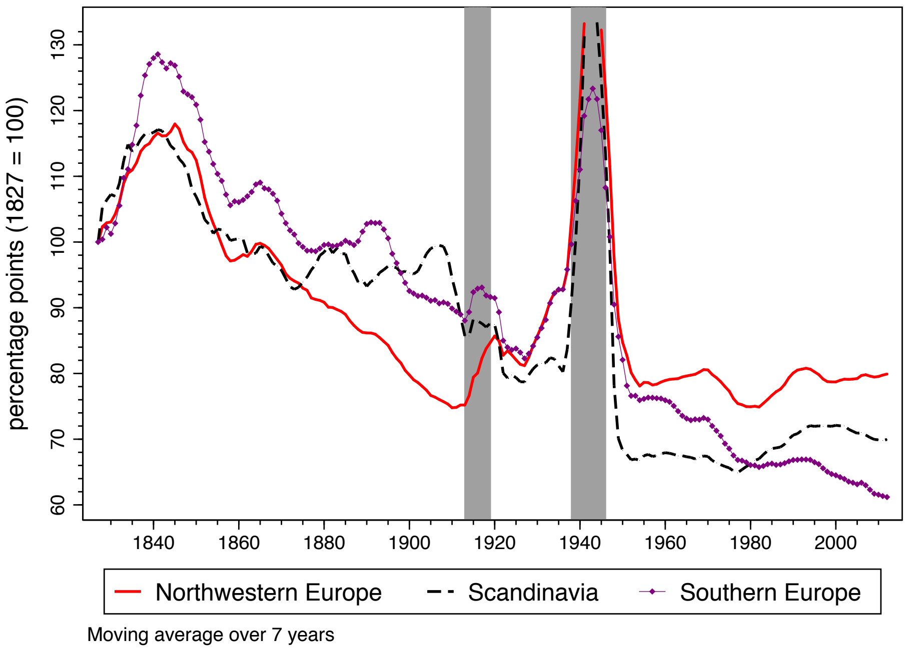

Figure 9: Trade cost indices for various parts of Europe

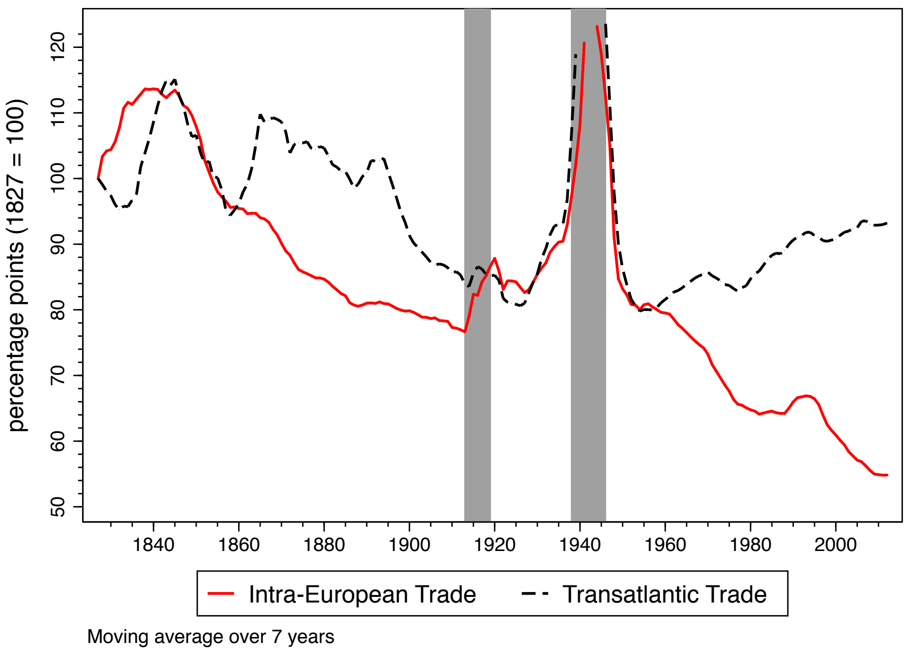

Figure 10: Trade cost indices along two trade routes

7 Trade cost decomposition

The disaggregated results from the previous section emphasize the heterogeneity of trade cost dynamics across trade routes. In particular, the fall of trade costs prior to the late-nineteenth century only affected Europe, and especially intra-European trade. In the following section, I make further use of the gravity equation to investigate the geographical pattern of trade cost dynamics. Specifically, I provide a decomposition of overall trade costs into a component that is independent of the distance between the trading partners – the border effect – and a distance effect. This exercise allows me to make use of the full potential of my data set as the regressions include all the trade flows available[36]. Let us consider one more time the structural gravity equation (Head and Mayer, 2014):

$$X_{ij} = \frac{Y_i \, X_j}{P_i \, \Pi_j} \, \tau_{ij}^{\epsilon} \tag{13}$$

I impose the following functional form for bilateral trade costs:

$$\tau_{ij} = \exp(a \, FOR_{ij}) \, \times \, DIST_{ij}^{b} \, \times \, \eta_{ij} \tag{14}$$

Where FOR_{ij} is a dummy variable set to unity if $i \neq j$. $DIST_{ij|i \neq j}$ is the population-weighted great-circle bilateral distance and $DIST_{ij|i=j}$ is internal distance[37]. a and b are respectively the elasticity of trade costs to international borders and distance. η_{ij} reflects the unobserved components of trade costs, including bilateral tariffs.

Plugging (14) into (13), taking logs and imposing origin and destination fixed effects to control for the monadic determinants of trade, I estimate equation (15), separately for each year, using OLS. The identification comes entirely from the cross-sectional variation[38]:

$$\ln X_{ij} = FE_i + FE_j + \beta_1 \, FOR_{ij} + \beta_2 \, \ln DIST_{ij} + \ln \eta_{ij} \tag{15}$$

Where $X_{ij|i \neq j}$ is bilateral trade and $X_{ij|i=j}$ is my benchmark measure of internal trade. FE_i and FE_j are vectors of origin and destination fixed effects. $\beta_1 = a \times \epsilon$ is the border effect and $\beta_2 = b \times \epsilon$ is the trade elasticity of distance. Note that the fixed effects perfectly control for the monadic determinants of trade, including multilateral resistance terms.

[36] On the other hand, the Head and Ries measure of trade costs requires data for the bilateral trade flows going in both directions as well as data on both countries' internal trade flows.

[37] For details on these variables, see: appendix D.8.

[38] The identification of the border effect relies on a comparison of internal trade with bilateral trade as in Wei (1996), who extended the methodology introduced by McCallum (1995) for cases in which bilateral intra-national trade flows are not available.

7.1 Border effect

β_1 can be interpreted as a border effect as it reflects the average trade-reducing effect of international borders, all monadic determinants of trade and distance being equal. I convert the border effect into a tariff equivalent using the pure cost-shifter property of tariffs[39]. Indeed, *ad-valorem* tariffs have a one for one relationship to trade costs. In turn, the error term of equation (15) can be decomposed as follows:

$$\eta_{ij} = (1 + t_{ij})^1 \times Z_{ij} \tag{16}$$

Where t_{ij} is the (unobserved) *ad-valorem* tariff imposed by j on imports from i. Z_{ij} is a vector of the other bilateral components of trade costs, together with their elasticities to trade costs.

The border effect I propose is equal to the tariff that would have the same trade-reducing effect as the average border. I thus use the β_1 coefficient estimated for each year via equation (15) to solve for the border effect (BE) in the following equation:

$$(1 + BE)^\epsilon = \exp(\beta_1) \tag{17}$$

The resulting tariff-equivalent border effect, converted to a percentage, writes:

$$BE = \left[\exp\left(\frac{\beta_1}{\epsilon}\right) - 1\right] \times 100 \tag{18}$$

Figure 11 reports the border effect, with ϵ set to -3.78, as in my benchmark trade cost index. I find an average tariff-equivalent border effect c.1830 of approximately 400% which means that trading with the average foreign country is about five times as costly as trading internally. For the most recent years, I find a border effect lying between 200 and 300%. The border effect falls steadily until World War I. During the interwar period, the border effect rises steeply before resuming its fall after World War II and ultimately coming back to its 1913 level in the early 2000s.

The measure of the border effect is of course sensitive to the value of the trade elasticity. In particular, the trade elasticity impacts both the level and the variability of the border effect. Figure 28 (appendix C) reports tariff-equivalent border effects obtained using various values for the trade elasticity.

[39] I also report the border effect as the exponential of β_1 in Figure 21 (appendix B). These figures read as the number of times countries trade more on average with themselves than with foreign partners, all monadic determinants of trade and distance being equal. For the recent period, the resulting values are consistent with those found by de Sousa et al. (2012).

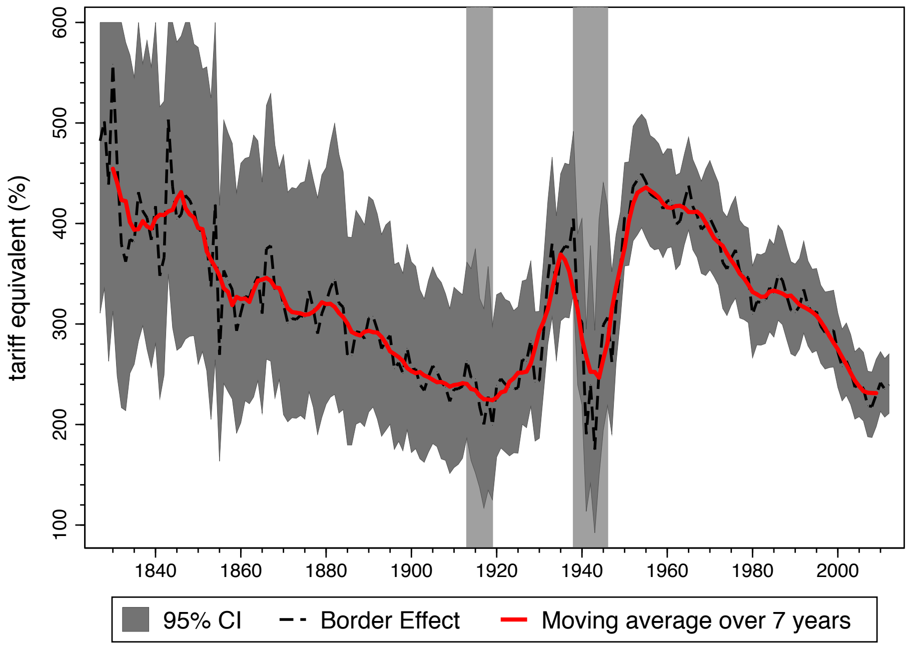

Figure 11: Tariff-equivalent border effect

7.2 Distance elasticity

The regressions based on equation (15) also provide estimates of the distance elasticity (β_2). These estimates capture the response of trade to the distance that separates trading partners. Figure 12 shows that the distance elasticity increased during both periods of globalization. This is congruent with the gravity-based results found by Combes et al. (2008) for the globalization of the twentieth century. In their meta-analysis of distance coefficients, Disdier and Head (2008) coin this phenomenon the "distance puzzle". However, this article is the first to my knowledge to document a significant rise of the distance elasticity for the nineteenth century[40].

In appendix C, I report distance elasticities estimated on various sub-samples. Figure 22 shows that the nineteenth century increase in the distance elasticity primarily affected the trade of Europe with third countries. The rise of the distance elasticity also materialized by a reallocation of European trade with third countries to intra-European trade. The distance elasticity was the largest for intra-European trade during the nineteenth century. The rise of the distance elasticity within Europe, however, was limited until the 1870s and stable, if not declining during the late nineteenth century until World War 1. Finally, as expected, Figure 23 shows that colonial trade reacted less to distance than other trades. Finally, the reduction of the distance elasticity during the interwar is associated with a relative rise of colonial trade (see: Figures 24 and 25 in appendix B).

[40]Figure 29 (appendix C) shows that the Correlates of War data set (Barbieri and Keshk, 2012) is too limited to reveal the increasing distance elasticity.

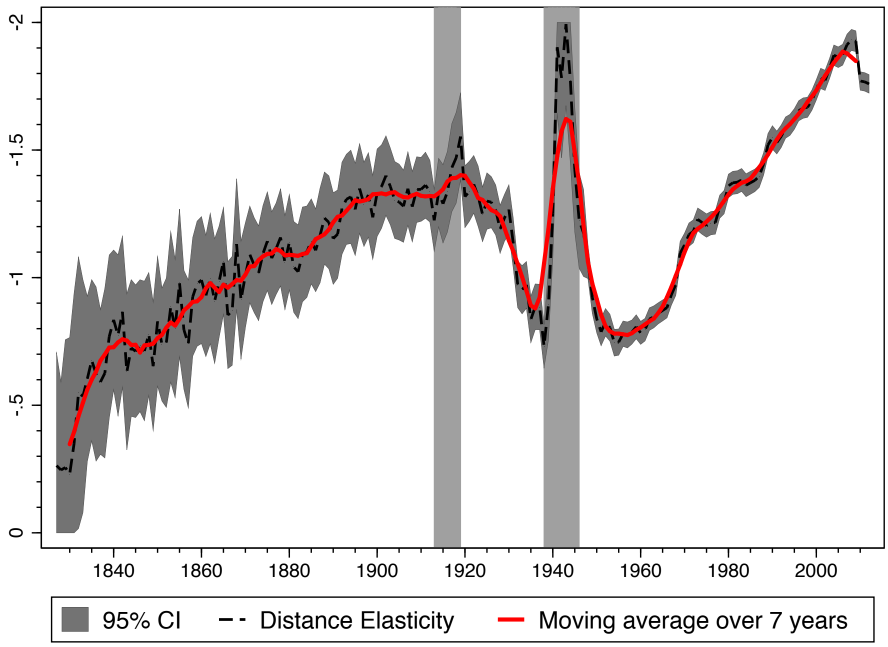

Figure 12: Distance elasticity

The distance elasticity (β_2) is itself the product of two elasticities: an elasticity of trade costs with respect to distance (b) and the trade elasticity (ϵ). Any change in the distance elasticity may come from either component, or both.

Let us first consider the response of trade costs to distance (b). It can be argued that trade liberalization has primarily targeted neighboring countries[41]. On the contrary, the fall of the distance elasticity during the interwar period can be linked to major European economies raising tariffs vis-à-vis neighboring countries and reallocating trade towards their (relatively distant) colonial empires.

The rise of the distance elasticity can also be attributed to a rise of the trade elasticity (ϵ). It is easy to think of plausible reasons why the response of trade to trade costs may have increased over time. In particular, if the scope for trade gains is reduced then trade costs become a steeper barrier to trade. As shown in Head and Mayer (2014), in structural gravity, the trade elasticity is directly related to the parameter that governs the scope for trade gains in the underlying model. It is thus necessary to look into the models to better understand the potential reasons for a rise in the trade elasticity.

In the demand-side models of Anderson and van Wincoop (2003) (perfect competition) and Krugman (1980) (monopolistic competition), the trade elasticity is directly linked to the elasticity of substitution across varieties ($\epsilon = 1 - \sigma$). In these models the underlying reason to trade is consumers' love of variety. In turn, when varieties are close substitutes (large σ), the incentives for trading narrow and the response of trade to trade costs (ϵ) increases. The rise of the distance elasticity can therefore be the result of an increased

[41]In this respect, the Cobden-Chevalier European network of trade treaties for the nineteenth century and the European Union for the post World War II period are probably the most striking examples.

similarity of the goods produced in different markets.

In supply-side models such as the Ricardian model (Eaton and Kortum, 2002) and heterogeneous firms models (Chaney, 2008, Melitz and Ottaviano, 2008), θ (γ) is the parameter that governs the degree of heterogeneity of industries' (Ricardo) or firms' productivity (heterogeneous firms models). The less heterogeneity on the production side (large θ or γ), the smaller the scope for trade gains and the larger the trade elasticity. The rise of the distance elasticity can thus also be understood as the result of an homogenization of industries' or firms' productivity.

7.3 Border thickness

I now relate the border effect to the distance effect to understand their relative significance in determining bilateral trade. To do so, I propose a measure of border thickness that reflects the distance equivalent of the average border. Using a regression similar to equation (15), Engel and Rogers (1996) propose a measure of border thickness equal to $\exp(\beta_1/\beta_2)$. Parsley and Wei (2001) point out that this measure is sensitive to the unit of measurement. The approach I take is to ask how much should bilateral distance increase to have the same negative impact on trade as crossing the average border. Using equation (15), the variation of trade associated with crossing a border writes:

$$\frac{\Delta X_{ij}}{X_{ij}} = \exp(\beta_1) - 1 \tag{19}$$

Solving for the border-equivalent rate of change of distance, I obtain:

$$\frac{\Delta DIST_{ij}}{DIST_{ij}} = \frac{\exp(\beta_1) - 1}{\beta_2} \tag{20}$$

Taking the product of the border-equivalent rate of change of distance and the average distance in the sample, I obtain my measure of border thickness:

$$THICK = \frac{\exp(\beta_1) - 1}{\beta_2} \times \overline{DIST_{ij}} \tag{21}$$

Figure 13 plots the resulting measure of border thickness. The figures on the y-axis correspond to the distance equivalent of the average border in terms of trade-reducing effect. Hence, the thinner the border, the more important distance is relative to borders. In other words, thin borders (upper part of the graph) reveal regionalized trade patterns. Figure 13 thus shows that both the First and the Second Globalization have been associated with an increased regionalization of trade. On the contrary, the interwar de-globalization was associated with a de-regionalization of trade patterns.

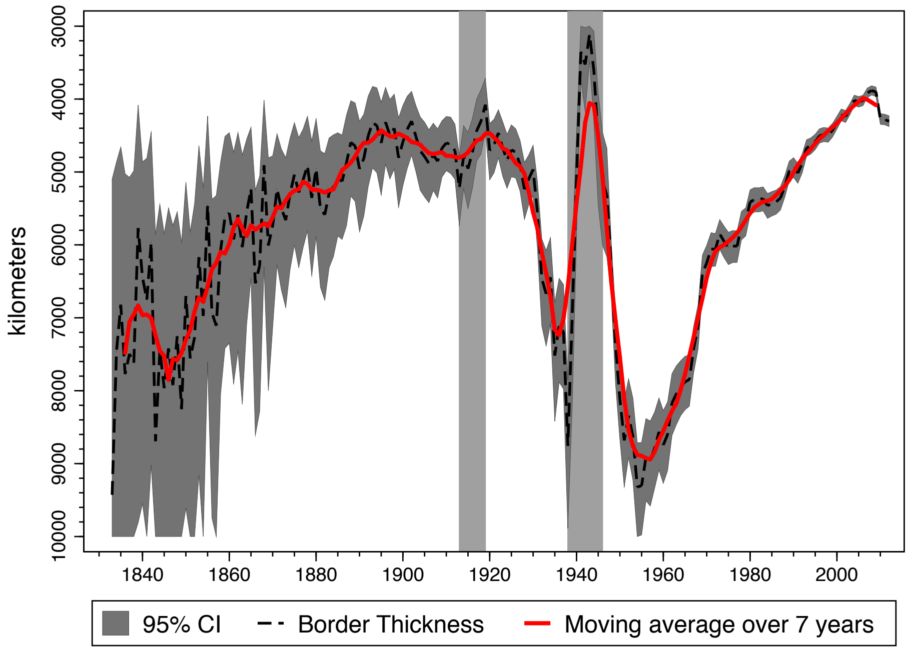

Figure 13: Border thickness (Distance-equivalent of the average border)

8 Conclusion

Using systematically-collected trade and GDP data for a 186-year period ranging from 1827 to 2012, I have shown that the First Globalization began in Europe c.1840. This early start contradicts the studies that claim that late nineteenth century technological improvements in shipping, refrigeration and communication were responsible for sparking the First Globalization. This result also contradicts the theories that attribute the leading cause of this globalization to the trade treaties that bloomed after 1860.

Indeed, the early trade cost reduction in Europe points to the role played by the unilateral trade liberalization policies that were implemented in the late 1840s. These open trade policies should be associated with the unprecedented period of peace that begins with the Congress of Vienna in 1815 and only comes to an end with the First World War[42]. Another potential reason for the early onset of the First Globalization may be early nineteenth century improvements in shipping technology.

Decomposing trade costs into a border effect and a distance effect, I have shown that both the First and the Second Globalization have been primarily fueled by an intensification of short-haul trade. In other words, it appears that the two waves of globalization have not been so global.

These conclusions have implications in terms of trade policy. First, the increase in the distance elasticity shows that the scope for economic integration across distant markets remains wide and largely unexploited. Second, as trade costs fall and world trade intensifies, the externalities associated with the production of merchandise become less easy to track. This calls for improved international cooperation, particularly in terms of environmental policies.

This article raises several questions for future research. The most obvious is to understand the causes behind the early onset of the First Globalization. Another direction would be to explore the evolution over time of the elasticity of trade to trade costs, which is key in both the theoretical and the empirical trade literature. Indeed, in any structural trade model, this elasticity reflects the scope for trade gains associated with changes in factors such as trade policies and transportation technologies. In particular, this could help disentangle the reasons behind the increase in the distance elasticity over both periods of globalization. A first step would be to collect additional bilateral tariff data in order to estimate the trade elasticity more precisely. Finally, a recent theoretical literature has developed tools that can be used to relate trade to welfare[43]. This emerging literature could help quantify the impact of the First Globalization on economic development in general and the so-called "Rise of the West" in particular.

[42] There are of course some exceptions, including the Opium Wars, the Boer Wars, the Russo-Japanese War, as well as wars related to the German and Italian unification (Franco-Prussian War, Austro-Prussian War, Schleswig Wars, Italian Wars of Independence). But none of these conflicts was comparable in terms of magnitude to either the Napoleonic Wars or World War I.

[43] See: Arkolakis et al. (2012) and Head and Mayer (2014).

9 References

Accominotti, Olivier and Marc Flandreau, "Does Bilateralism Promote Trade? Nineteenth Century Liberalization Revisited," working paper 5423, CEPR Jan. 2006.

Allen, Treb, Costas Arkolakis, and Yuta Takahashi, "Universal Gravity," working paper, Yale and Northwestern University Oct. 2014.

Álvarez-Nogal, Carlos and Leandro Prados de la Escosura, "The Rise and Fall of Spain (1270-1850)," *Economic History Review*, Dec. 2013, *66* (1), 1–37.

Anderson, James E. and Eric van Wincoop, "Gravity with Gravitas: A Solution to the Border Puzzle," *American Economic Review*, Mar. 2003, *93* (1), 170–192.

Anderson, James E. and Eric van Wincoop, "Trade costs," *Journal of Economic Literature*, Sep. 2004, *42* (3), 691–751.

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez Clare, "New Trade Models, Same Old Gains?," *American Economic Review*, Aug. 2012, *102* (1), 94–130.

Baldwin, Richard and Daria Taglioni, "Gravity for Dummies and Dummies for Gravity Equations," working paper 5850, CEPR Sep. 2006.

Bordo, Michael, Andrew Filardo, Andrés Velasco, and Carlo A. Favero, "Deflation and Monetary Policy in a Historical Perspective: Remembering the Past or Being Condemned to Repeat It?," *Economic Policy*, Oct 2005, *20* (44), 801–844.

Broadberry, Stephen N., Bruce M. S. Campbell, Alexander Klein, Mark Overton, and Bas van Leeuwen, "British Economic Growth, 1270-1870: An Output-based Approach," School of economics discussion paper KDPE 1203, University of Kent Dec. 2011.

Broda, Christian and David E. Weinstein, "Globalization and the Gains from Variety," *Quarterly Journal of Economics*, May 2006, *121* (2), 541–585.

Bulbeck, David, Anthony Reid, Lay Cheng Tan, and Yiqu Wu, *Southeast Asian Exports since the 14th Century: Cloves, Pepper, Coffee, and Sugar*, Leiden, The Netherlands: KITLV Press, 1998.

Chaney, Thomas, "Distorted Gravity: The Intensive and Extensive Margins of International Trade," *American Economic Review*, Sep. 2008, *98* (4), 1707–1721.

Chaudhuri, Kirti Narayan, *The Trading World of Asia and the English East India Company 1660-1760*, Cambridge, United Kingdom: Cambridge University Press, 1978.

Combes, Pierre-Philippe, Thierry Mayer, and Jacques-François Thisse, *Economic Geography: The Integration of Regions and Nations*, Princeton, N.J., USA: Princeton University Press, 2008.

de Sousa, José, Thierry Mayer, and Soledad Zignago, "Market Access in Global and Regional Trade," *Regional Science and Urban Economics*, Nov. 2012, *42* (6), 1037–1052.

Disdier, Anne-Célia and Keith Head, "The Puzzling Persistence of the Distance Effect on Bilateral Trade," *Review of Economics and Statistics*, Feb. 2008, *90* (1), 37–48.

Dobado-González, Rafael, Alfredo García-Hiernaux, and David E. Guerrero, "The Integration of Grain Markets in the Eighteenth Century: Early Rise of Globalization in the West," *Journal of Economic History*, Sep. 2012, *72* (3), 671–707.

Eaton, Jonathan and Samuel Kortum, "Technology, Geograpy and Trade," *Econometrica*, Sep. 2002, *70* (5), 1741–1779.

Eaton, Jonhatan, Samuel Kortum, Brent Neiman, and John Romalis, "Trade and the Global Recession," working paper 16666, NBER Jan. 2011.

Engel, Charles and John H. Rogers, "How Wide is the Border?," *American Economic Review*, 1996, *86* (5), 1112–1125.

Estevadeordal, Antoni, Brian Frantz, and Alan M. Taylor, "The Rise and Fall of World Trade: 1870-1939," *Quarterly Journal of Economics*, May 2003, *118* (2), 359–407.

Földvári, Péter and Bas van Leeuwen, "Markets in Ancient Societies? The Structural Analysis of Babylonian Price Data," working paper 2000.

Hamilton, Earl J., *American Treasure and the Price Revolution in Spain, 1501-1650*, Cambridge, M.A., USA: Harvard University Press, 1934.

Harley, C. Knick, "Ocean Freight Rates and Productivity, 1740-1913: The Primacy of Mechanical Invention Reaffirmed," *Journal of Economic History*, Dec. 1988, *48* (4), 851–876.

Head, Keith and John Ries, "Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade," *American Economic Review*, Sep. 2001, *91* (4), 858–876.

Head, Keith and Thierry Mayer, "What Separates Us? Sources of Resistance to Globalization," *Canadian Journal of Economics / Revue canadienne d'Economie*, Nov. 2013, *46* (4), 1196–1231.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse, Toolkit, and Cookbook," in Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, eds., *vol. 4 of the Handbook of International Economics*, Amsterdam, The Netherlands: Elsevier, 2014, pp. 131–195.

Irwin, Douglas A., "Free Trade and Protection in Nineteenth-Century Britain and France Revisited: A Comment on Nye," *Journal of Economic History*, Mar. 1993, *53* (1), 146–152.

Jacks, David S., "Market Integration in the North and Baltic Seas, 1500-1800," *Journal of European Economic History*, 2004, *33* (3), 285–329.

Jacks, David S., "Intra- and International Commodity Market Integration in the Atlantic Economy, 1800-1913," *Explorations in Economic History*, 2005, *42*, 381–413.

Jacks, David S., Christopher M. Meissner, and Dennis Novy, "Trade Costs: 1870-2000," *American Economic Review: Papers and Proceedings*, 2008, *98* (2), 529–534.

Krugman, Paul, "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, Dec. 1980, *70* (5), 950–959.

Lampe, Markus, "Effects of Bilateralism and the MFN Clause on International Trade: Evidence for the Cobden-Chevalier Network, 1860-1875," *Journal of Economic History*, 2009, *69* (4), 1012–1040.

Ma, Ye, Herman de Jong, and Tianshu Chu, "Living Standards in China between 1840 and 1912: A New Estimation of Gross Domestic Product per capita," GGDC research memorandum 147, Groningen Growth and Development Centre Jul. 2014.

McCallum, John, "National Borders Matter: Canada-U.S. Regional Trade Patterns," *American Economic Review*, Jun. 1995, *85* (3), 615–623.

Melitz, Marc J. and Gianmarco I. P. Ottaviano, "Market Size, Trade, and Productivity," *Review of Economic Studies*, 2008, *75* (1), 295–316.

Novy, Dennis, "Gravity Redux: Measuring International Trade Costs with Panel Data," *Economic Inquiry*, Jan. 2013, *51* (1), 101–121.

Nye, John Vincent, "The Myth of Free-trade Britain and Fortress France: Tariffs and Trade in the Nineteenth Century," *Journal of Economic History*, Mar. 1991, *51* (1), 23–46.

O'Rourke, Kevin H.., "The European Grain Invasion, 1870-1913," *Journal of Economic History*, Dec. 1997, *57* (4), 775–801.

O'Rourke, Kevin H., "The Worldwide Economic Impact of the French Revolutionary and Napoleonic Wars: 1793-1815," *Journal of Global History*, Mar. 2006, *1* (1), 123–149.

O'Rourke, Kevin H. and Jeffrey G. Williamson, "Late Nineteenth-Century Anglo-American Factor-Price Convergence: Were Heckscher and Ohlin Right?," *Journal of Economic History*, Dec. 1994, *54* (4), 892–916.

O'Rourke, Kevin H. and Jeffrey G. Williamson, "When did globalisation begin?," *European Review of Economic History*, Feb. 2002, *6*, 23–50.

Parsley, David C. and Shang-Jin Wei, "Explaining the Border Effect: The Role of Exchange Rate Variability, Shipping Costs and Geography," *Journal of International Economics*, 2001, *55* (1), 87–105.

Pascali, Luigi, "The Wind of Change: Maritime Technology, Trade and Economic Development," working paper 1049, Warwick economic research papers Jun. 2014.

Romalis, John, "NAFTA's and CUFTA's Impact on International Trade," *The Review of Economics and Statistics*, Aug. 2007, *89* (3), 416–435.

Rönnbäck, Klas, "Integration of Global Commodity Markets in the Early Modern Era," *European Review of Economic History*, 2009, *13*, 95–120.

Sharp, Paul, "'1846 and All That': The Rise and Fall of British Wheat Protection in the Nineteenth Century," *Agricultural History Review*, 2010, *58* (1), 76–94.

Sharp, Paul and Jacob Weisdorf, "Globalization Revisited: Market Integration and the Wheat Trade between North America and Britain from the Eighteenth Century," *Explorations in Economic History*, Jan. 2013, *50* (1), 88–98.

Solar, Peter M., “Opening to the East: Shipping between Europe and Asia,1770-1830,” *Journal of Economic History*, Sep. 2013, *73* (3), 625–661.

Steinwender, Claudia, “Information Frictions and the Law of One Price: "When the States and the Kingdom Became United",” working paper, London School of Economics Apr. 2014.

Toutain, J.-C., *Le Produit Intérieur Brut de la France de 1789 à 1982*, Grenoble, France: Presses Universitaires de Grenoble, 1987.

Wei, Shang-Jin, “Intra-national versus International Trade: How Stubborn are Nations in Global Integration?,” working paper 5531, NBER Apr. 1996.

A Theoretical foundations for the Head and Ries (2001) measure of trade costs

In section 2, I use the formulation of the Head and Ries (2001) measure of trade costs in the general framework of structural gravity (Head and Mayer, 2014). Here, I provide the formulations of the Head and Ries measure of trade costs in a demand side model (Anderson and van Wincoop, 2003) and in three supply side models: Eaton and Kortum (2002), Chaney (2008), Melitz and Ottaviano (2008). These model-specific formulations are taken from Novy (2013)[44].

In the perfect competition model of national product differentiation developed in Anderson and van Wincoop (2003), the Head and Ries measure of trade costs writes:

$$TC_{ij}^{AvW} \equiv \sqrt{\frac{\tau_{ij}\ \tau_{ji}}{\tau_{ii}\ \tau_{jj}}} - 1 = \left(\frac{X_{ii}\ X_{jj}}{X_{ij}\ X_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{22}$$

Where σ is the elasticity of substitution across varieties.

In the Ricardian model developed by Eaton and Kortum (2002), the Head and Ries measure of trade costs writes:

$$TC_{ij}^{EK} \equiv \sqrt{\frac{\tau_{ij}\ \tau_{ji}}{\tau_{ii}\ \tau_{jj}}} - 1 = \left(\frac{X_{ii}\ X_{jj}}{X_{ij}\ X_{ji}}\right)^{\frac{1}{2\theta}} - 1 \tag{23}$$

Where θ governs the sector-level dispersion of productivity.

In the heterogeneous firms models developed by Chaney (2008) and Melitz and Ottaviano (2008), the Head and Ries measure of trade costs writes:

$$TC_{ij}^{HET} \equiv \sqrt{\frac{\tau_{ij}\ \tau_{ji}}{\tau_{ii}\ \tau_{jj}}} - 1 = \left(\frac{X_{ii}\ X_{jj}}{X_{ij}\ X_{ji}}\right)^{\frac{1}{2\gamma}} - 1 \tag{24}$$

Where γ governs the firm-level dispersion of productivity.

In the Ricardian model (Eaton and Kortum, 2002) as well as in the heterogeneous firms models of Chaney (2008) and Melitz and Ottaviano (2008), a low θ (γ) reflects much variation in productivity at the sectoral (firm) level. In turn, this means a larger scope for gains from trade. Hence, other things being equal, trade costs are larger when θ (γ) is smaller (more potential benefits to trade). In these models, the trade elasticity is negatively related to the degree of heterogeneity of sectors' (firms') productivity: $\epsilon = -\theta$ ($\epsilon = -\gamma$) Intuitively, it means that trade flows will be more sensitive to trade costs when there is not much variability in sectors' (firms') productivity. Finally, it is worth noting that in the heterogeneous firms framework, τ is a combination of fixed and variable trade costs. Hence τ cannot be interpreted as an iceberg trade cost in these models.

[44] pp.104-107.

B Additional figures

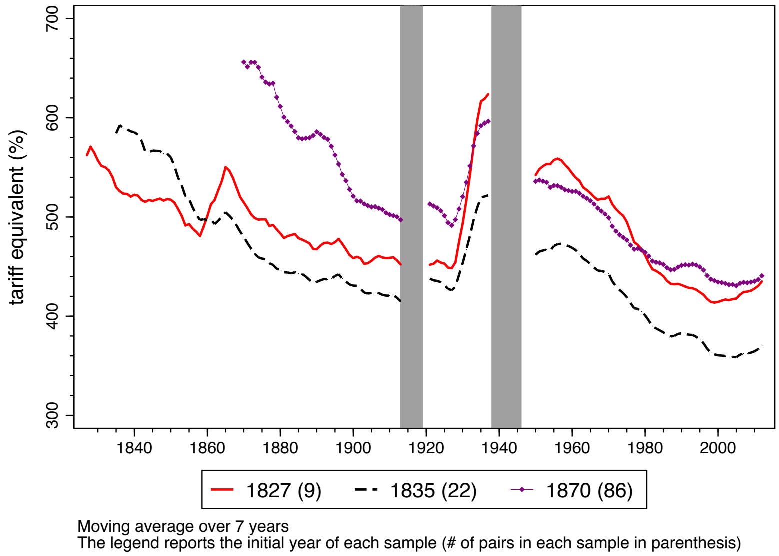

Figure 14: Mean trade cost computed on constant samples

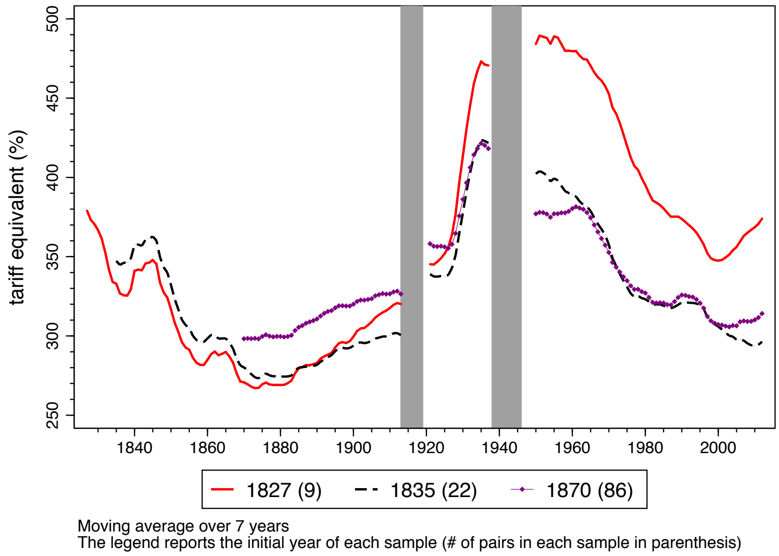

Figure 15: Bilateral trade-weighted mean trade cost computed on constant samples

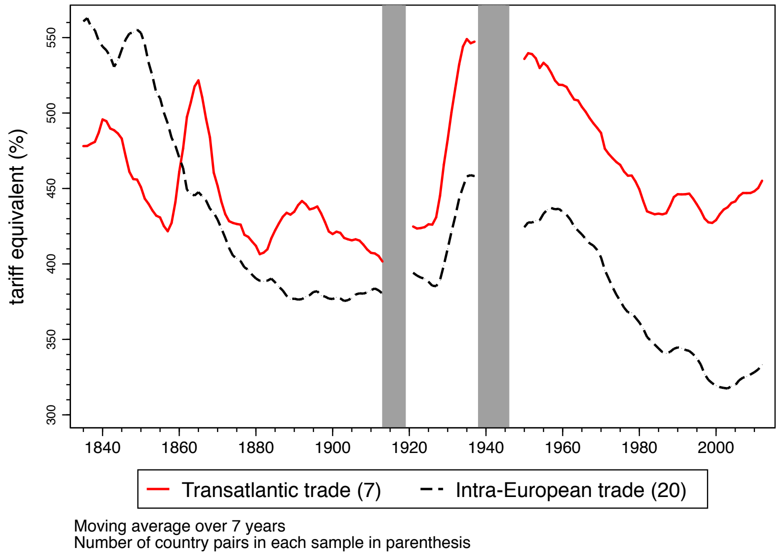

Figure 16: Internal trade-weighted mean trade cost computed on constant samples

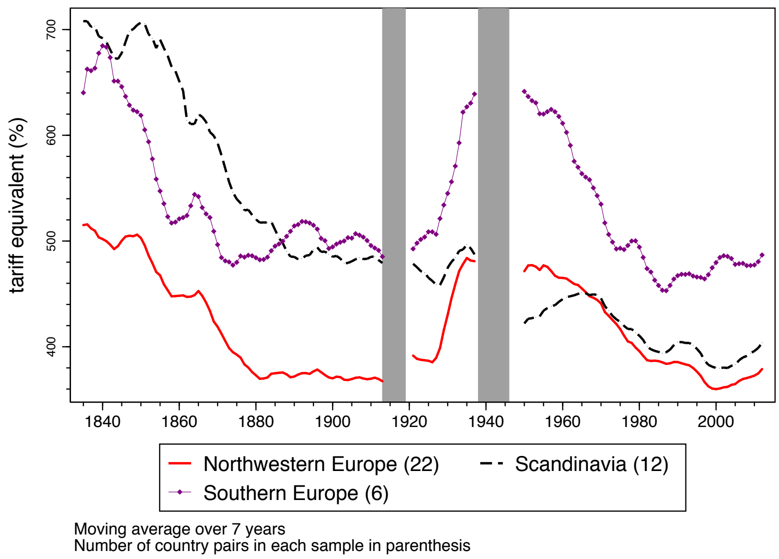

Figure 17: Internal trade-weighted mean trade cost computed on constant samples

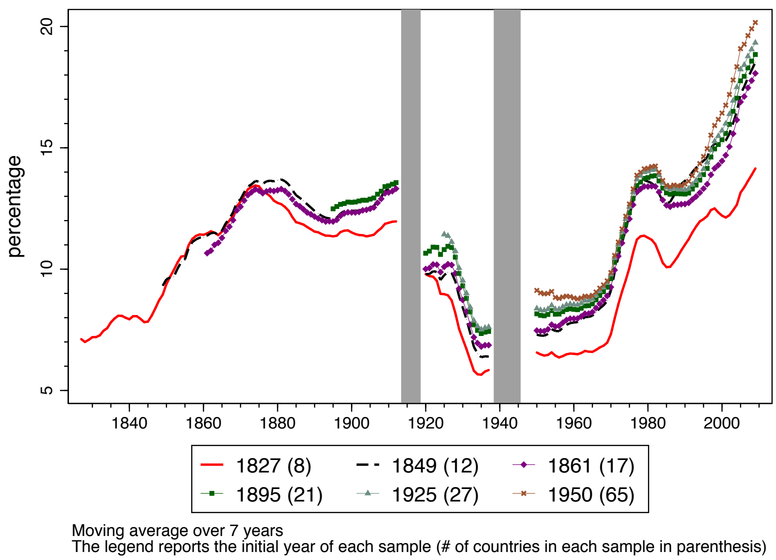

Figure 18: Aggregate export openness computed on constant country samples i.e. Sum of countries' exports, divided by the sum of their GDPs

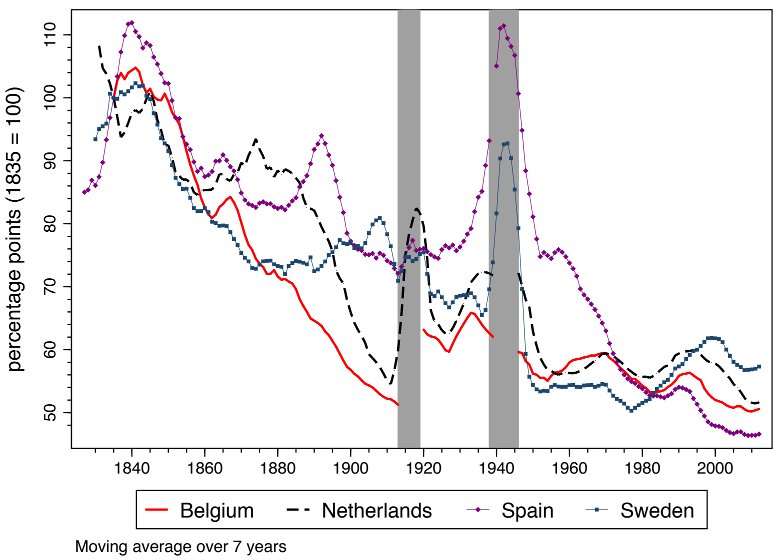

Figure 19: Trade cost indices for various European countries

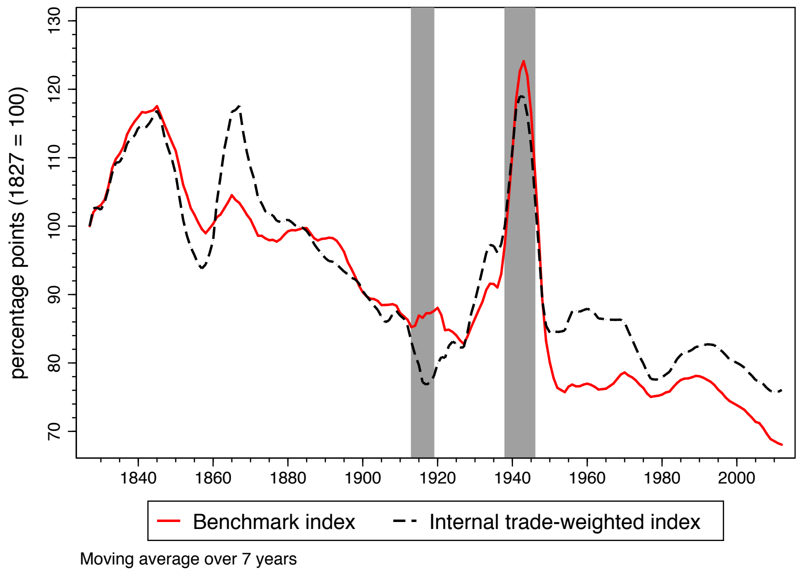

Figure 20: Benchmark and internal trade-weighted indices of world trade costs

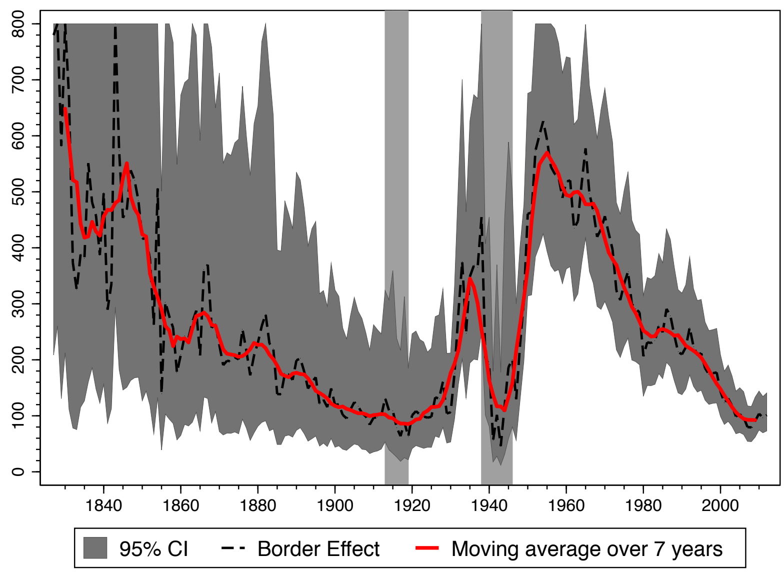

Figure 21: Border effect (exponentiated β_1 coefficient, from equation (15))

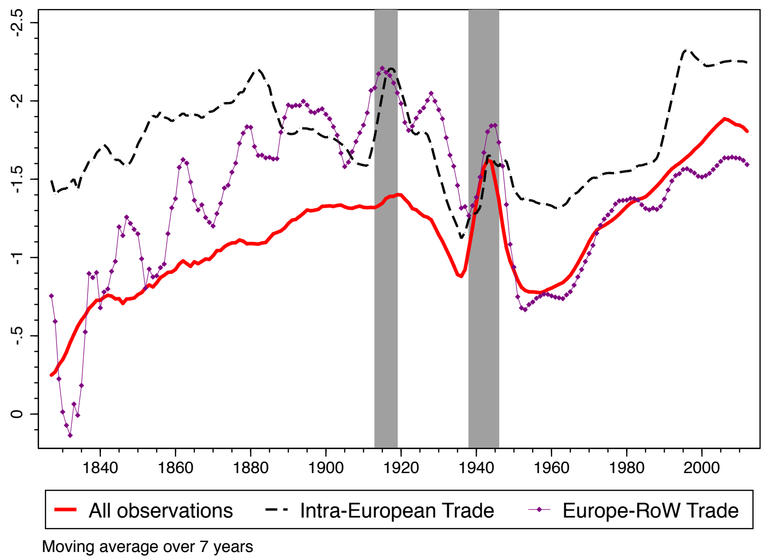

Figure 22: Distance elasticity estimated on sub-samples

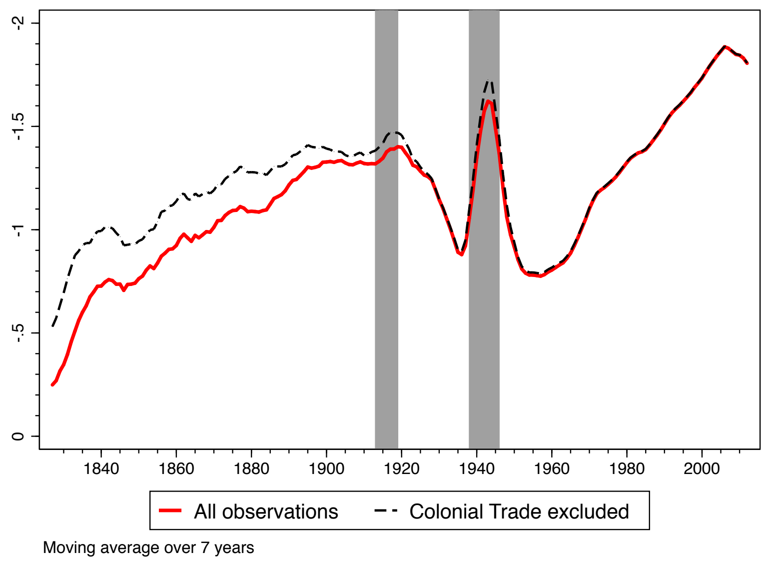

Figure 23: Distance elasticity estimated on sub-samples

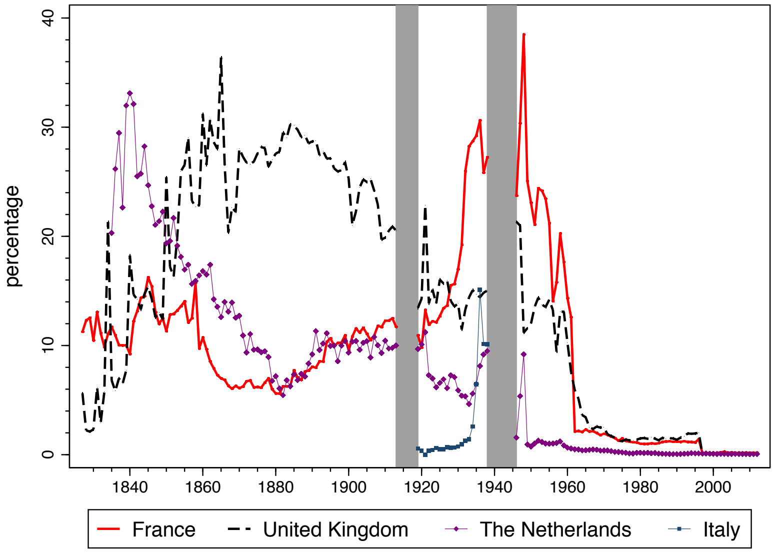

Figure 24: Share of colonial trade in countries' aggregate trade
(Aggregate trade computed as the sum of each country's total imports and exports)

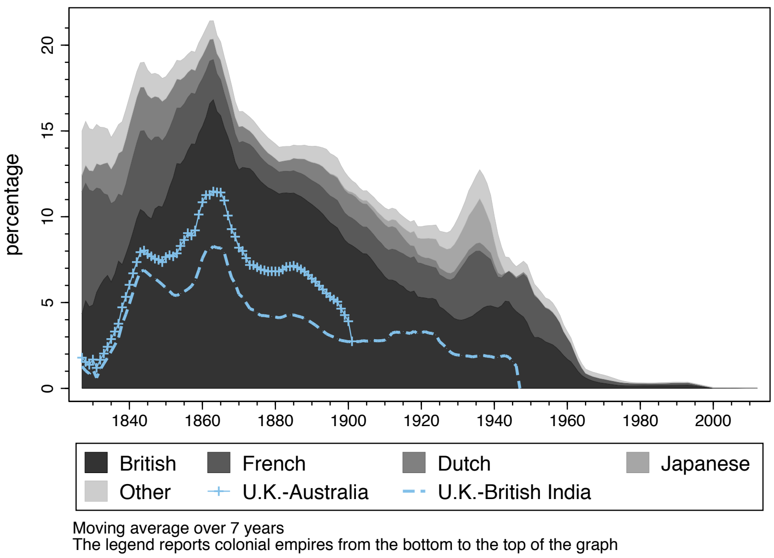

Figure 25: Cumulative share of colonial trade in the data set, by colonizer

C Robustness checks

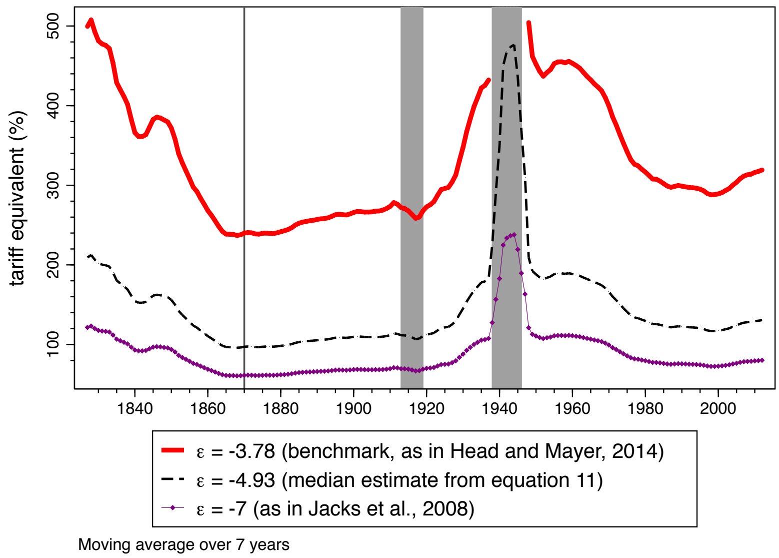

Figure 26: Franco-British trade costs for various values of the trade elasticity (ϵ)

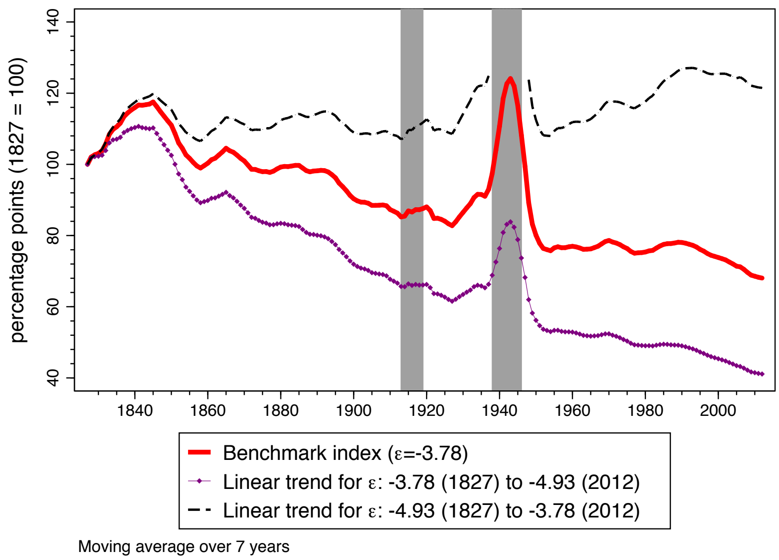

Figure 27: World trade cost indices with linear trends for the trade elasticity (ϵ)

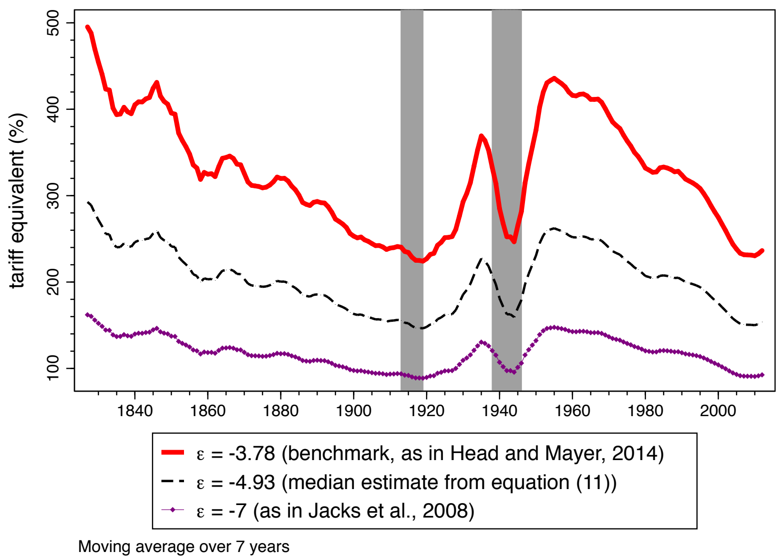

Figure 28: Tariff-equivalent border effect obtained using various values of the trade elasticity (ϵ)

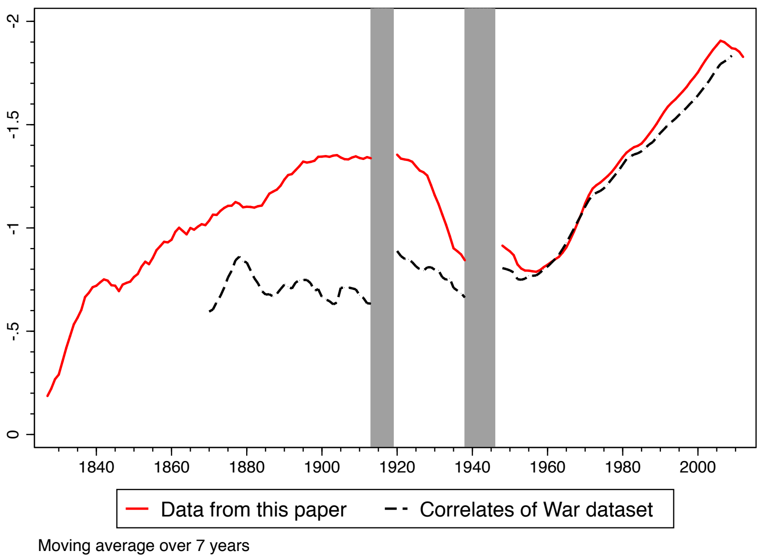

Figure 29: Distance elasticity estimated on my data set and the Correlates of War data set (Barbieri and Keshk, 2012)

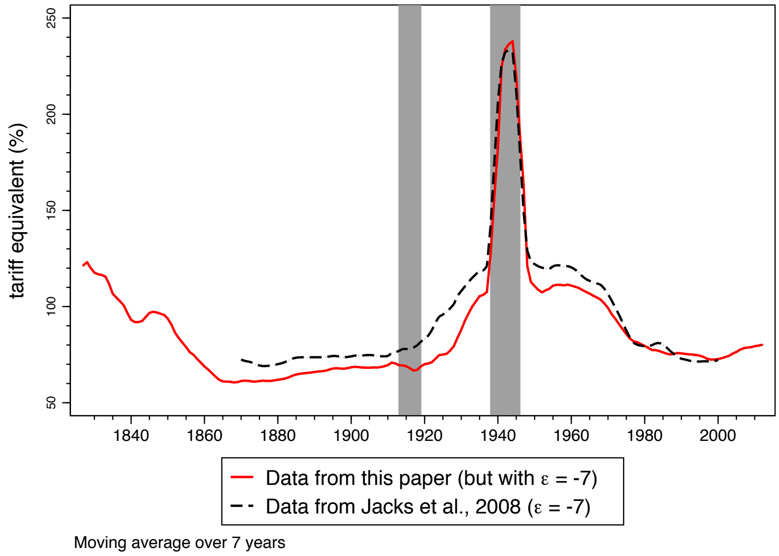

Figure 30: Bilateral Head and Ries tariff-equivalent trade cost: France-United Kingdom

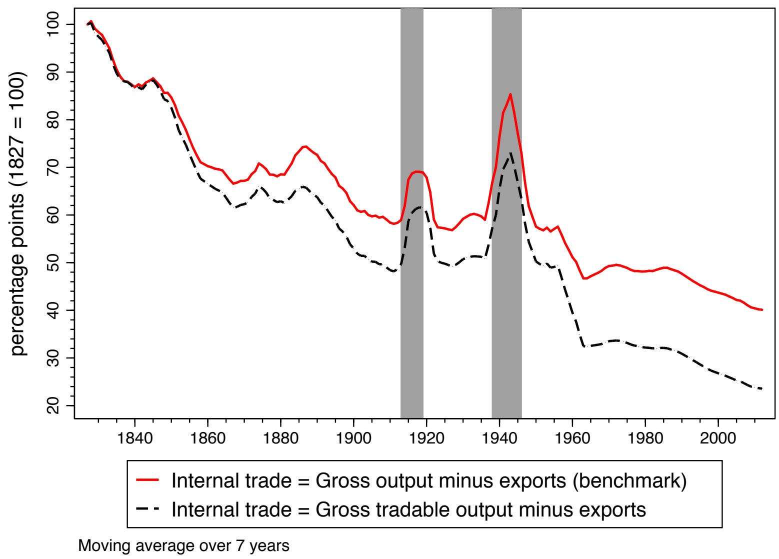

Figure 31: World trade cost indices estimated on identical (restricted) samples using two measures of internal trade

D Data appendix

This appendix provides a detailed description of the data set that I put together. The data set covers the 1827-2012 period and it is particularly suited for gravity-type analysis. I provide data on bilateral trade flows, aggregate exports and imports, bilateral tariffs, aggregate tariffs, GDP, exchange rates as well as other gravity-related variables, including distance and dummies reflecting bilateral commonalities. The data set has been constructed using current price information, converted to the British pound sterling. Table 9 provides a succinct description of the variables.

D.1 Bilateral trade

D.2 Sources

I provide 1,313,519 bilateral trade observations, of which I directly collected 91,208 points. I also integrate 34,000 observations from the RICardo data set[45] (Accominotti et al., unpublished, 2010). The left hand side chart of Figure 32 reports the share of each source in the data set. The right hand side chart focuses on the pre-1948 period (before the first observation reported in the DoTS data set).

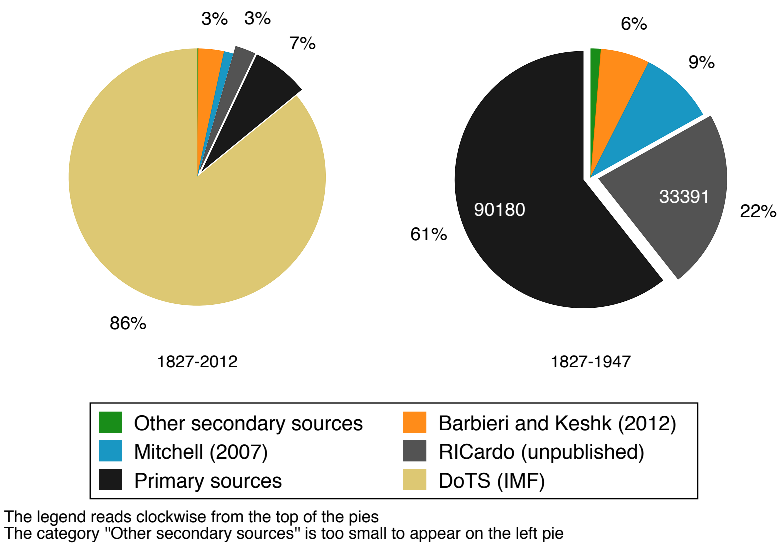

Figure 32: Share of each source in the bilateral trade data set

Figure 33 details the sources of the bilateral trade data. For some country pairs and years, several sources overlap. Whenever possible, I choose to report the primary source, preferably from the destination country. The dashed line represents the share of the data that was previously available through existing secondary sources. In the end, I bring 57% of novel data points for the pre-1948 period.

[45] I am particularly grateful to Béatrice Dédinger and Guillaume Daudin for sharing this data.

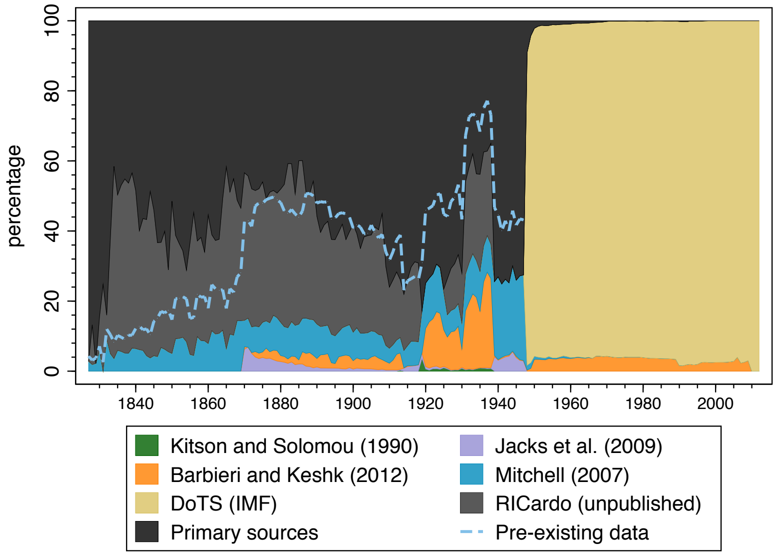

Figure 33: Cumulative share of each source in the bilateral trade data set

Figure 35 reports for each year the countries for which national customs statistics are included in the data set. This includes the data I directly collected as well as data from the RICardo project. Figure 34 lists for each year the reporting countries that are identified in any of the sources.

I provide a source variable (SOURCE_TF) that indicates the source of each observation. Table 2 reports the correspondence between the codes I use and the actual source. For national sources, the first three letters correspond to the iso3 code of the reporting country (e.g. "FRA TABLEAU GAL" means that I use a French source). Whenever there may be a doubt about the reporting country, I add a suffix to the source variable to make it explicit: "_IP" when the reporter is the importer and "_XP" when it is the exporter[46]. Table 2 also provides the number of observations taken from each source as well as the initial and the last year of observation.

Type of trade

Whenever possible, I report data on merchandise trade, excluding trade in services as well as trade of bullion and species. Similarly, I favor special trade over general trade data[47].

Choice of the reporting country

Any trade flow is in principle reported by both the exporter and the importer. Whenever possible, I use the source from the importer. Indeed, the importing country has a greater incentive to properly assess the value of trade flows due to widespread use of imports as a tax base. Figure 36 reports the composition of the data by reporter. Some of the secondary sources I use do not indicate the reporting country hence the "Unknown reporter" category. Those sources are: Mitchell (2007a,b,c), Jacks et al. (2008) and Barbieri and Keshk (2012).

[46]This applies to the following values of the SOURCE_TF variable: DOTS, FRACOLO, GBRCOLO, ITW, MITC and RIC as those sources report trade flows for several countries.

[47]Special import flows have the importing country as their final destination, whereas general trade is composed of special trade, together with transit trade. For export data, I exclude re-exports.

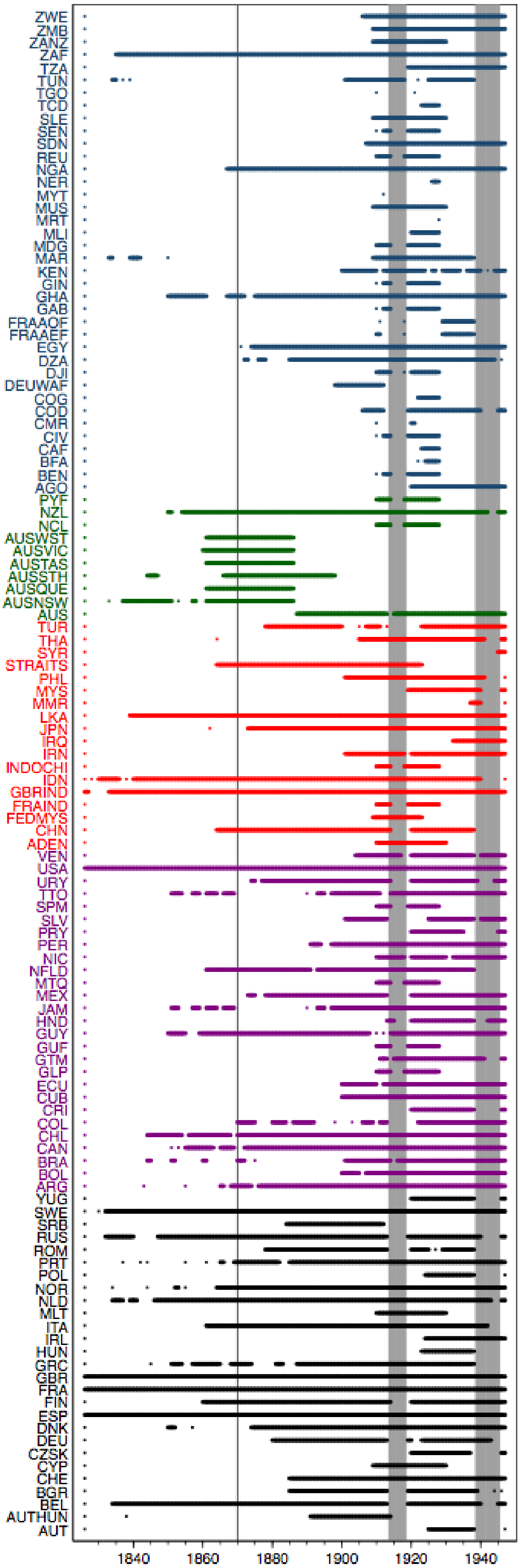

Figure 34: Reporters from any source in the bilateral trade data: 1827-1947

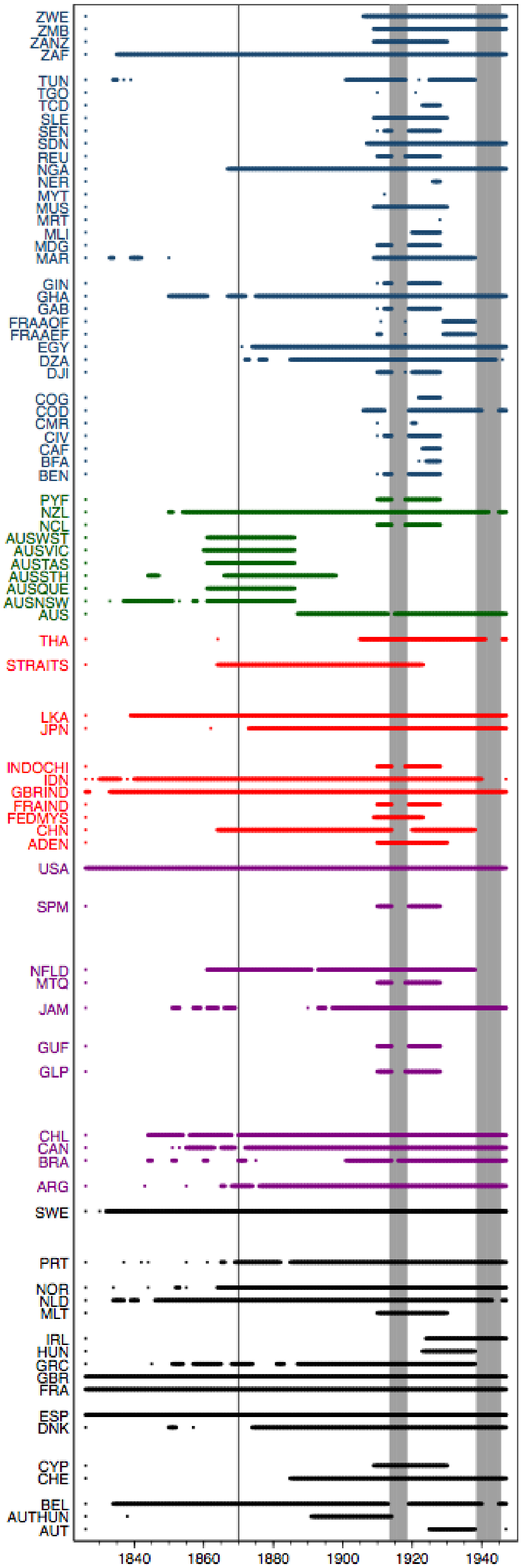

Figure 35: Reporters from primary sources in the bilateral trade data: 1827-1947

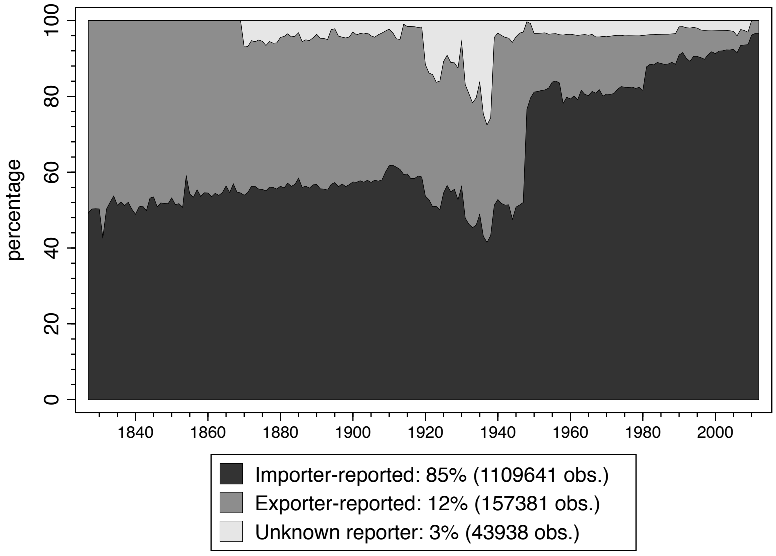

Figure 36: Cumulative share of each reporter in the bilateral trade data set

Representativeness of world trade

Figure 37 plots the sum of the bilateral trade data against various estimations of overall world trade. I also use the sum of countries' aggregate exports as a benchmark for evaluating the representativeness of my data. Figure 37 shows no significant gap between the sum of the bilateral trade flows and the estimates of world trade. For some years, the sum of bilateral trade flows is even larger than the current estimates of world trade, which suggests that the existing statistics may be underestimating the actual level of world trade. For the very first years of the sample, however, the gap is wider suggesting that I am missing a significant part of the bilateral trade flows.

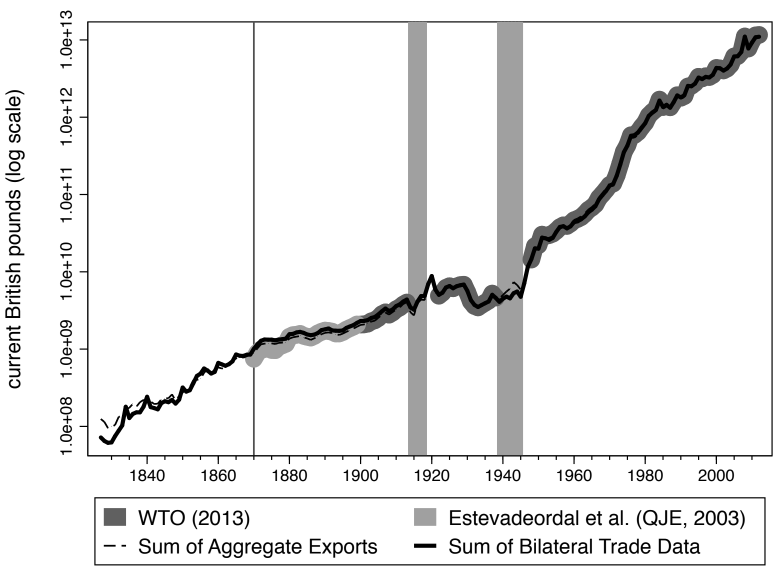

Figure 37: Bilateral data in the data set and estimates of total world trade

SOURCE_TF	First year	Last year	Observations	Source
DOTS	1948	2012	1,126,089	International Monetary Fund (2002 and 2013)
COW	1870	2009	42,384	Barbieri and Keshk (2012)
RIC	1828	1938	33,391	Accominotti et al. (unpublished, 2010)
MITC	1827	2000	14,616	Mitchell (2007a,b,c)
GBRCOLO	1909	1930	12,963	Board of Trade (1920-1932)
FRA TABLEAU GAL	1827	1948	11,762	Ministère des finances (1827-1948)
GBR ANNUAL STMT	1854	1947	8,338	Houses of Parliament (1855-1949)
IND ANNUAL STMT	1867	1949	8,255	Government of India (1872-1898)
				Government of India (1904-1949)
NLD STAT	1846	1950	8,021	Departement van financien (1847-1876)
				Departement van financien (1877-1916)
				Centraal-bureau voor de statistiek (1920-1944)
				Centraal-bureau voor de statistiek (1951)
BEL TABLEAU GAL	1876	1947	6,815	Ministère des finances (1881-1913)
				Ministère des finances (1920-1921)
				Ministère des finances (1922)
				Ministère des finances (1923-1931)
				Ministère de l'intérieur (1934-1939)
				Ministère des affaires économiques (1942-1944)
				Ministère des affaires économiques (1945-1949)
ESP ANUARIO ESTAD	1849	1948	5,544	Junta general de estadistica (1858-1943)
				Ministerio de hacienda (1944-1948)
FRACOLO	1910	1928	3,387	Ministère des colonies (1910-1928)
GBR YEARBOOK	1870	1913	3,200	Houses of Parliament (1870-1913)
USA MSCF	1827	1932	3,017	Treasury department (1896-1901)
AUT STAT HANDELS	1891	1930	2,695	Handelsministerium (1891-1917)
				Staatsamtes für handel etc. (1919-1930)
ESP TENA JUNGUITO	1827	1997	2,675	Tena Junguito (unpublished, 2012)
DZA DOCS STAT	1901	1930	2,610	Gouvernement géneral de l'Algérie (1902-1930)
IND STABSTRACT	1841	1903	2,269	Houses of Parliament (1867-1905)
USA HIST STAT	1827	1970	1,980	Carter et al. (2006)
CHN RETURNS TRADE	1864	1935	1,837	Imperial maritime customs (1867)
				Imperial maritime customs (1871-1909)
				Maritime customs (1913-1924)
				Chinese Maritime customs (1934)
USA FRGN COMMERCE	1896	1915	1,804	Department of commerce and labor (1906-1908)
				Department of commerce (1913-1915)
JACKS	1870	1947	1,554	Jacks et al. (2008)
AUS TRADE CUST	1887	1907	1,457	Bureau of census and statistics (1906-1907)
SWE HIST STAT	1905	1969	1,440	Statistika centralbryån (1972)
COD STAT COMMERCE	1919	1930	857	Ministère des colonies (1918-1930)
CHL EST COMERCIAL	1872	1911	824	Oficina central de estadistica (1888-1911)
ITW	1913	1938	348	Kitson and Solomou (1990)
MAR STAT COMMERCE	1913	1930	295	Service du commerce et de l'industrie (1913-1930)
TUN DOCS STAT	1914	1930	248	Régence de Tunis (1914-1930)
GBR MITC BRITSTAT	1833	1945	189	Mitchell (1988)
USA GAZETEER	1840	1840	55	Haskel (1844)
USA ANNUAL REPORT	1884	1884	41	Treasury department (1884)
	1827	**2012**	**1,720,445**	

Table 2: Correspondence table for the bilateral trade source variable
(Sorted by the number of observations in the data set)

Countries and administrative entities

The country coding relies as much as possible on the iso 3166-1 alpha-3 three-letter country codes. When the borders of the entity reported in the original document are close enough to present-day borders, I use the corresponding iso3 code (e.g. I use "DEU" to identify Germany from 1871 to 1888, even though Hamburg, Lübeck and Bremen only joined the German Empire in 1888). I create my own codes for the entities that cannot not be matched with any present-day country. Those codes can be identified by the fact that they have more than three letters. Table 3 lists all these additional country codes.

Country code	Corresponding entity
2SICIL	Kingdom of the two Sicilies, Kingdom of Naples
ADEN	Aden
ALASKA	Alaska
AOFAEF	French Western and Equatorial Africa
AUSNSW	New-South Wales
AUSQUE	Queensland
AUSSTH	Southern Australia
AUSTAS	Tasmania
AUSVIC	Victoria
AUSWST	Western Australia
AUTHUN	Austria-Hungary
AZORES	Azores
BARBAR	Barbary States
BREMEN	Bremen
CANARY	Canary islands
CANPRINCED	Prince-Edward island
CANQBCONT	Quebec-Ontario
CANQUEBEC	Quebec
CHANNELISL	Channel islands
CZSK	Czechoslovakia
DANTZ	Dantzig
DEUAFRI	German West Africa
DEUNEWGUI	German New Guinea
DEUWAF	German West Africa
ESPWAFRI	Spannish West Africa
FEDMYS	Federated Malay States
FIUME	Fiume
FRAAEF	French Equatorial Africa
FRAAFRI	French Africa, French possessions in Africa
FRAAOF	French Western Africa
FRAEAFRI	French Eastern Africa
FRAIND	French East Indies
FRAOCEA	French Oceania
FRAWINDIES	French West Indies
GBRAFRI	British Africa
GBRBORNEO	British Borneo, North Borneo
GBRIND	British India
GBRMEDI	British possessions in the Mediterranean
GBRNEWGUI	British New Guinea
GBRSOM	British Somalia
GBRWAFRI	British West Africa
GBRWINDIES	British West Indies
HAMBG	Hamburg
HANOV	Hanover
HANS	Hanseatic cities, Hanseatic League
INDOCHI	French Indochina
ITAEAFRI	Italian East Africa
KWANTU	Kwantung
LUBECK	Lubeck
MADEIRA	Madeira
MANCHU	Manchuria, Manchukuo
MARESP	Spannish Marocco
MECKL	Mecklenburg
NFLD	Newfoundland
PRTAFRI	Portuguese Africa
PRTIND	Portuguese India
PRTWAFRI	Portuguese West Africa
PRUS	Prussia
RHOD	Rhodesias
ROME	Rome
RWABDI	Rwanda-Urundi
SARD	Sardinia
SARRE	Sarre
SCHLES	Schleswig, Schleswig-Holstein
STRAITS	Straits Settlements
SWENOR	United Kingdoms of Sweden and Norway
TANGER	Tangiers, Tangiers International Zone
TEXAS	Texas
TGOCMR	Togo-Cameroon
TRIEST	Trieste
TUSC	Tuscany
UKNLD	United Kingdom of the Netherlands
UNFEDMYS	Unfederated Malay States
ZAFCAP	Cape Colony
ZAFNAT	Natal
ZAFORA	Orange River Colony, Orange Free State
ZAFTRA	Transvaal
ZANZ	Zanzibar
ZOLL	Zollverein

Table 3: Additional country codes

Country pair availability

Figure 38 reports for each year the number of bilateral trade observations in the data set. The increasing number of pairs available over time can be attributed to three factors. It can reflect the increasing number of country pairs that were actually trading. Second, it can reflect the increasing number of existing countries: as countries break up, some internal trade flows become cross-border[48]. Third, I have been more successful at finding sources for more recent years due to the difficulties in locating historical statistics far back in time and the inherent fragility of paper.

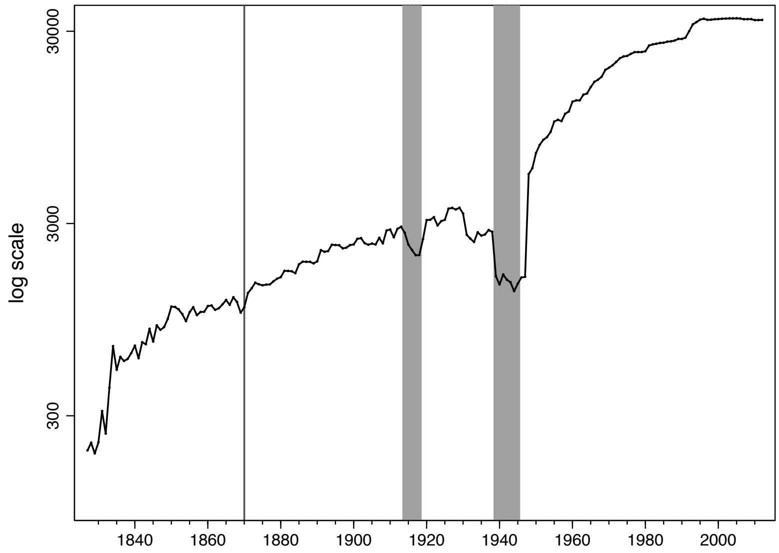

Figure 38: Number of country pairs with available bilateral trade data

Figure 39 reports the number of bilateral trade flows in the data set for the 1827-1947 period. Note that contrary to Figure 38, Figure 39 does not use a logarithmic scale. No major trend break can be observed in 1870. This comforts the impression that the data set provides a reasonable picture of pre-1870 trade patterns.

D.3 Bilateral tariffs

I also collected bilateral customs duties. In the data set, I report the ratios of customs duties to imports. Those data can be used to proxy bilateral tariff protection[49].

Figure 40 displays the number of country pairs for which customs duties-to-imports ratios are available. The legend reports the reporting (destination) country. I do not provide a source variable because the sources are always identical to those used for the bilateral trade data.

[48]In particular, the break up of the Austro-Hungarian and the Ottoman Empires significantly increase the number of countries in the sample. Similarly, the break in the early 1990s can largely be attributed to the break up of the Soviet Union.

[49]See: comments on the link between duties-to-imports ratios and actual tariffs in section 3.

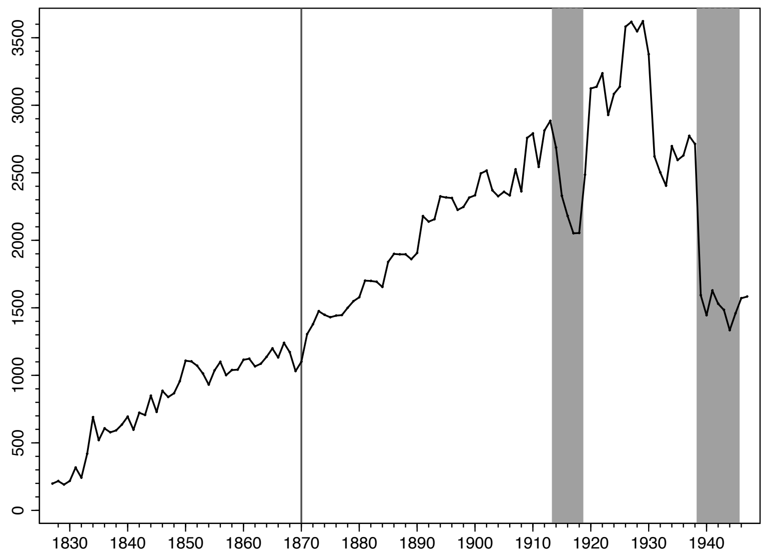

Figure 39: Number of country pairs with available bilateral trade data: 1827-1947

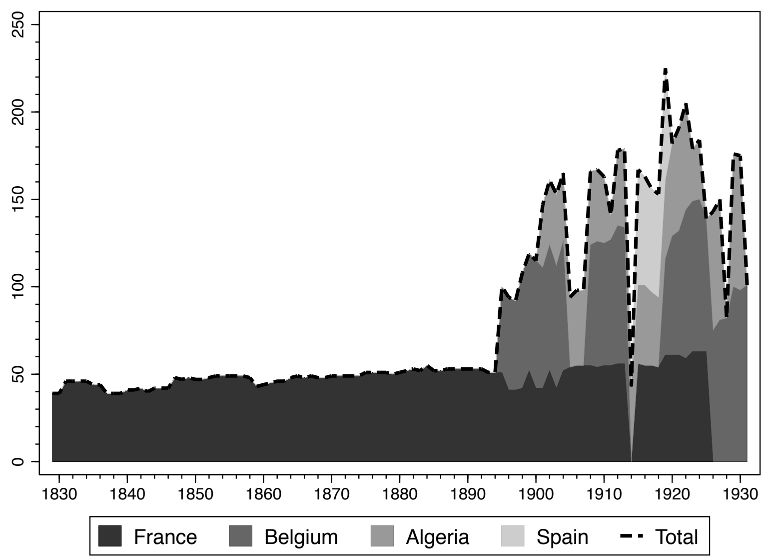

Figure 40: Number of country pairs with available bilateral tariff observations: 1829-1931

D.4 Aggregate trade

I provide two variables (SOURCE_IPTOT / _XPTOT) that show for each observation the source from which it is extracted. Table 4 shows how the source variable should be understood. Whenever possible, I report information on special imports and exclude re-exports and trade of bullion and species. Figures 41 and 42 respectively report the availability of aggregate exports and imports data for each country for the 1827-1947 period. Figure 43 reports the number of aggregate imports and exports observations I collected for each year.

SOURCE_IPTOT SOURCE_XPTOT	First year	Last year	Observations	Source
DOTS	1948	2012	16,391	International Monetary Fund (2002 and 2013)
MITC	1827	2004	12,962	Mitchell (2007a,b,c)
WDI	1960	2009	4,601	World Bank (2012)
RIC	1833	1938	1,107	Accominotti et al. (unpublished, 2010)
GBRCOLO	1909	1930	859	Board of Trade (1920-1932)
FRACOLO	1899	1929	846	Ministère des colonies (1910-1928)
FRA ANNUAL STAT	1889	1931	702	Présidence du conseil (1932)
NOR HIST STAT	1830	1947	224	Grytten (2004)
PRT HIST STAT	1827	1947	190	Nuno (2001)
GBR ANNUAL STMT	1854	1947	188	Houses of Parliament (1855-1949)
SWE EDVINSSON	1827	1904	156	Edvinsson (2005)
FRA TABLEAU GAL	1827	1927	152	Ministère des finances (1827-1948)
OWN G11	1827	1947	139	Own computations
IPOLATE	1837	1993	128	Aggregate trade data interpolated for missing periods inferior or equal to five years, if the difference between the last and the next available observations is less than 30%
CHL DIAZ	1827	1947	121	Díaz and Wagner (2004)
CHL LUDERS	1827	1947	121	Lüders (1998)
USA HIST STAT	1829	1947	118	Carter et al. (2006)
CHN RETURNS TRADE	1864	1935	116	Imperial maritime customs (1867) Imperial maritime customs (1871-1909) Maritime customs (1913-1924) Chinese Maritime customs (1934)
BEL TABLEAU GAL	1876	1947	110	Ministère des finances (1881-1913) Ministère des finances (1920-1921) Ministère des finances (1922) Ministère des finances (1923-1931) Ministère de l'intérieur (1934-1939) Ministère des affaires économiques (1942-1944) Ministère des affaires économiques (1945-1949)
NLD STAT	1846	1947	95	Departement van financien (1847-1876) Departement van financien (1877-1916) Centraal-bureau voor de statistiek (1920-1944) Centraal-bureau voor de statistiek (1951)
IND STABSTRACT	1841	1903	86	Houses of Parliament (1867-1905)
SWE HIST STAT	1905	1947	86	Statistika centralbryån (1972)
IND ANNUAL STMT	1877	1947	83	Government of India (1872-1898) Government of India (1904-1949)
COD STAT COMMERCE	1889	1930	76	Ministère des colonies (1918-1930)
GBR MITC BRITSTAT	1827	1853	54	Mitchell (1988)
DZA DOCS STAT	1901	1930	54	Gouvernement géneral de l'Algérie (1902-1930)
AUT STAT HANDELS	1891	1914	48	Handelsministerium (1891-1917)
ARG TENA JUNGUITO	1870	1913	44	Tena Junguito and Willebald (2013)
AUS TRADE CUST	1887	1906	40	Bureau of census and statistics (1906-1907)
NLD SMITS	1827	1845	19	Smits et al. (2000)
TUN DOCS STAT	1921	1929	7	Régence de Tunis (1914-1930)
US SENATE	1828	1836	6	United States Senate (1891)
ITW	1919	1919	2	Kitson and Solomou (1990)
	1827	**2012**	**39,931**	

Table 4: Correspondence table for aggregate trade source variables (Sorted by the number of observations in the data set)

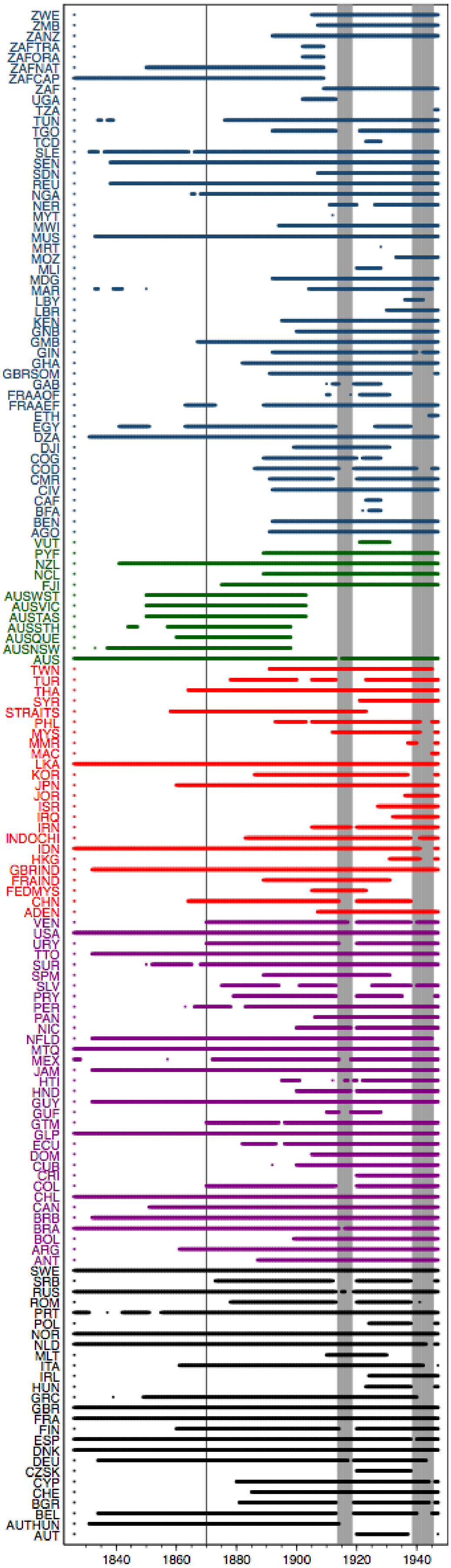

Figure 41: Available aggregate export data: 1827-1947

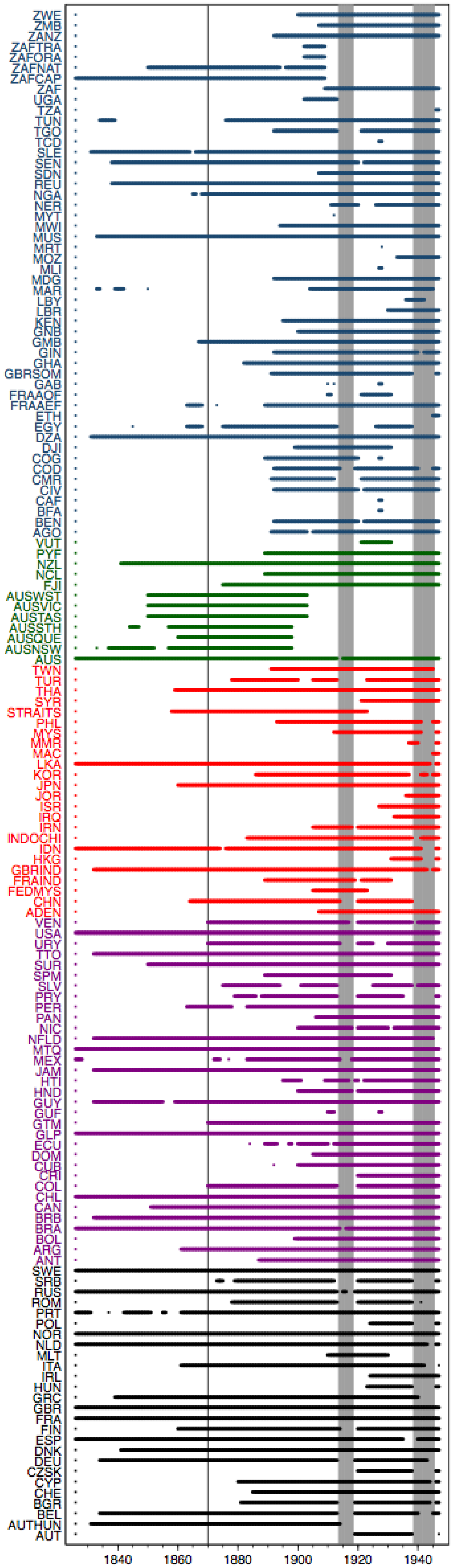

Figure 42: Available aggregate import data: 1827-1947

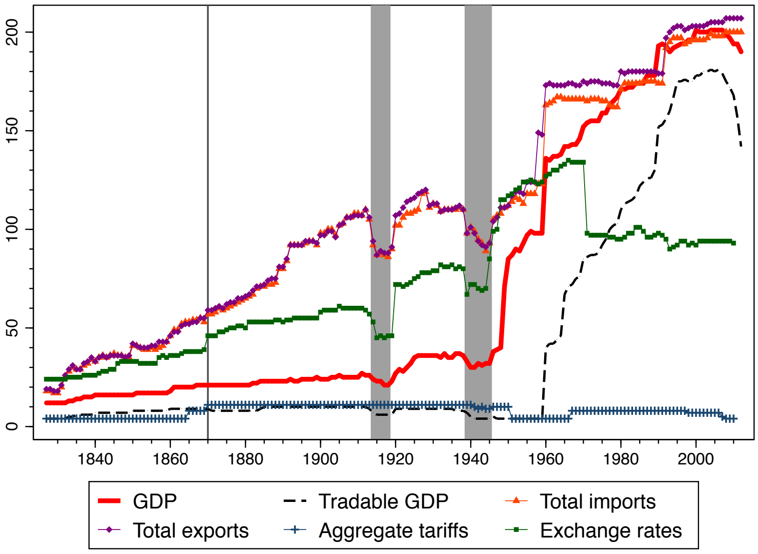

Figure 43: Number of countries with available GDP, aggregate trade, tariffs and exchange rate data

D.5 Aggregate tariffs

I provide ratios of customs duties to imports at the country level. I take this measure as a proxy for countries' aggregate tariff protection. Table 5 shows how the source variable should be understood. Figure 43 also reports the number of countries for which my measure of aggregate tariff protection is available.

SOURCE_TARIFF	First year	Last year	Observations	Source
CLEMENS	1865	1950	658	Clemens and Williamson (2004)
OECD	1946	2010	374	OECD (2014)
USA HIST STAT	1827	1955	129	Carter et al. (2006)
NLD SMITS	1827	1913	87	Smits et al. (2000)
FRA VILLA	1890	1964	75	Villa (1993)
FRA LEVY	1827	1889	63	Lévy-Leboyer and Bourguignon (1985)
GBR MITC BRITSTAT	1827	1864	38	Mitchell (1988)
MITC	1914	1954	38	Mitchell (2007a,b,c)
	1827	**2010**	**1,462**	

Table 5: Correspondence table for aggregate tariff source variables (Sorted by the number of observations in the data set)

D.6 GDP

I provide GDP data in current prices, converted to the British pound sterling using my exchange rate data. Most of the data before 1960 comes from a recent literature which aims to reconstruct historical national accounts. Table 6 shows how the source variable attached to GDP observations should be understood. Figure 43 also reports the number of countries for which I provide GDP data.

SOURCE_GDP	First year	Last year	Observations	Source
WDI	1960	2012	8,379	World Bank (2012)
MITC	1827	1998	1,685	Mitchell (2007a,b,c)
GRAVITY	1949	2011	1,061	Head et al. (2010)
GGDC	1827	1959	532	Smits et al. (2014)
USA MEASURING	1827	1959	133	?
GBR BROADBERRY	1827	1959	133	Broadberry et al. (2011)
NOR HIST STAT	1830	1959	124	Grytten (2004)
PRT HIST STAT	1837	1959	118	Nuno (2001)
CHL DIAZ	1827	1941	115	Díaz and Wagner (2004)
CHE STOHR	1851	1959	109	Stohr (2014)
GRC KOSTELENOS	1833	1939	107	Bitzis and Kostelenos (2008)
FRA TOUTAIN	1827	1938	106	Toutain (1987)
ARG ECHIARG	1884	1962	79	Della Paolera and Taylor (2003)
CHN MA	1840	1912	73	Ma et al. (2014)
JACKS	1871	1945	68	Jacks et al. (2008) – Constant price data chosen when no other source available, and when figures were very similar to current price figures for surrounding years
MADGOOD	1827	1869	68	Maddison (2001) – Constant price data interpolated for missing years using population data reflated using the GDP deflator of the relevant country
MEX HIST STAT	1895	1959	55	Instituto nacional de estadistica (1985)
IPOLATE	1845	1988	38	GDP data interpolated for missing periods inferior or equal to five years, if the difference between the previous and the following available observation is inferior to 15%, World War I and II excluded
MADPURE	1850	1949	36	Maddison (2001) – Constant price data reflated using country GDP deflator
FRA VILLA	1914	1959	27	Villa (1993)
ESP ALVAREZ	1827	1849	23	Álvarez-Nogal and Prados de la Escosura (2013)
RUS MARKEVICH	1913	1928	14	Harrison and Markevich (2011)
BGR IVANOV	1892	1924	6	Ivanov (2006)
	1827	**2012**	**13,089**	

Table 6: Correspondence table for the GDP source variable
(Sorted by the number of observations in the data set)

I also provide two variables, $SH\_PRIM_{o(d)}$ and $SH\_SECD_{o(d)}$, that respectively report the share of the primary and the secondary sector in the origin (destination) country. Table 4 reports the correspondence between the source variables and the actual source. Figure 43 also reports the number of countries for which I was able to compute tradable GDP as the cumulative share of the primary and secondary sectors in GDP.

D.7 Exchange rates

I report Exchange rates vis-à-vis the British pound sterling. The figures correspond to the number of British pounds that are worth one local currency unit. Figure 43 shows for each year the number of countries for which I report exchange rate data. Table 7 shows how the source variables should be understood. Figure 45 reports for each year the countries for which I provide exchange rate data.

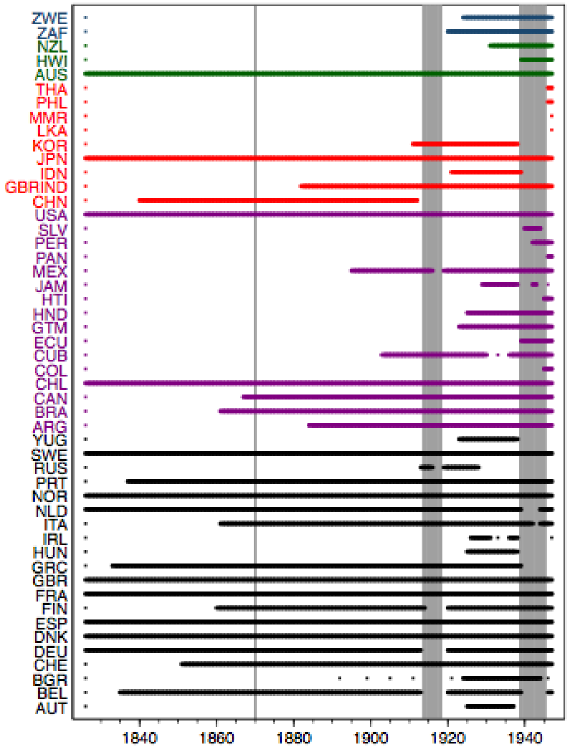

Figure 44: Available GDP data: 1827-1947

SOURCE_XCH	First year	Last year	Observations	Source
IFS	1948	2012	3,588	International Monetary Fund (2012)
COW	1870	1992	2,196	Barbieri and Keshk (2012)
WIKI	1827	2010	2,179	Extracted from Wikipedia
LAWR	1827	2011	1,817	Officer (2014)
HDBK	1827	1914	1,724	Denzel (2010)
IPOLATE	1827	2005	356	Linear interpolation: used to fill holes in series for which the difference between the last and the next data point is less than 20%
WAHR	1827	1920	276	Schneider et al. (1991)
NOR HIST STAT	1827	2003	177	Klovland (2004)
ESP TENA	1827	1959	125	Tena Junguito (unpublished, 2012) – Exchange rate Pesetas corriente/Pesetas oro deduced from data reported in both units
GRC KOSTELENOS	1833	1938	106	Bitzis and Kostelenos (2008)
SVER	1827	1944	96	Edvinsson et al. (2008)
PRT HIST STAT	1891	1950	60	Nuno (2001)
RIC	1837	1938	43	Accominotti et al. (unpublished, 2010)
ECB	1999	2012	14	European Central Bank (2014)
CHL DIAZ	1915	1947	8	Díaz and Wagner (2004)
	1827	**2012**	**12,765**	

Table 7: Correspondence table for the exchange rate source variable (Sorted by the number of observations in the data set)

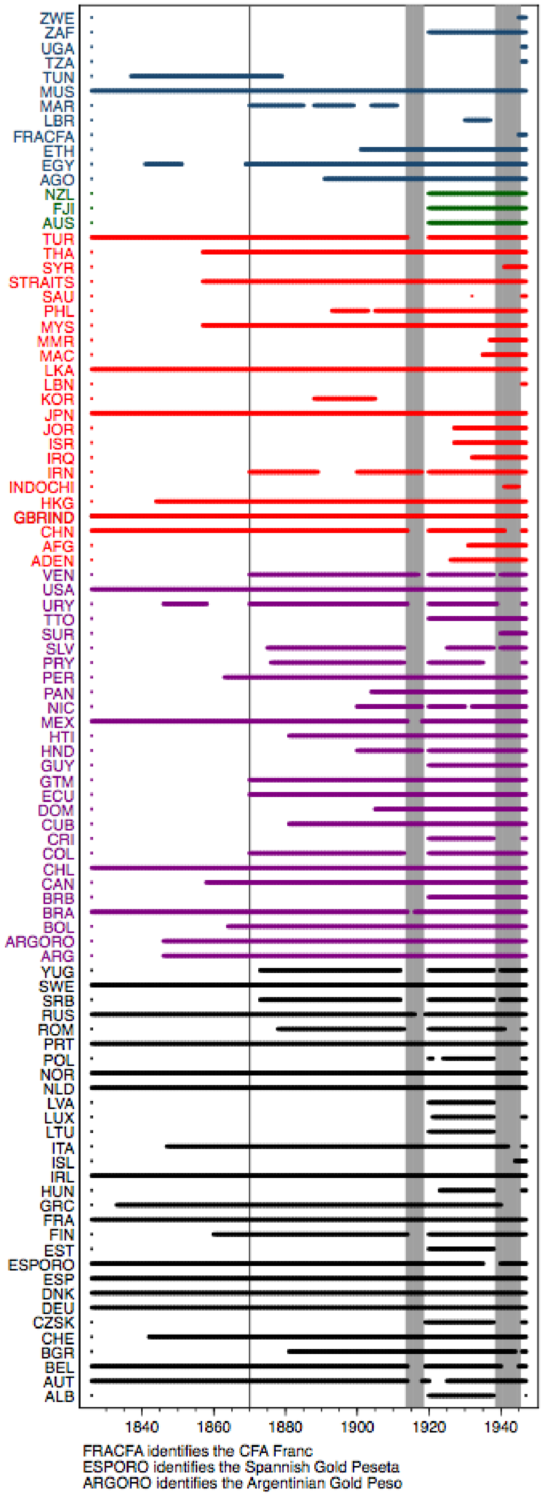

Figure 45: Available exchange rate data vis-à-vis the British pound sterling: 1827-1947

D.8 Distance variables

I provide seven different measures of bilateral distance. *Dist* is a city population-weighted average of the great-circle distance between each pair of countries. For the reporting entities that no longer exist, I use the population-weighted distance from the closest present-day country. $Dist_{o(d)}$ is a measure of countries' internal distances set to $.67\sqrt{area/\pi}$[50]. Figure 46 breaks down the bilateral trade data using the $Dist$ variable.

$SeaDist$ is a measure of the shortest maritime distance. This variable is set to $Dist\_nocanal$ before 1870, to $Dist\_suezonly$ for 1870-1920, $Dist\_twocanals$ for 1921-1966, $Dist\_panaonly$ for 1867-1975, and $Dist\_twocanals$ for 1976-2012. The 1967-1975 period corresponds to the closing of the Suez canal, consecutive to the Six-Day War. All maritime distances have been extracted from the website Vesseltracker.com (2014). I first selected the largest port of each country (two ports when the country borders two different oceans). Then, for each country-pair, I chose the shortest maritime distance between any of the ports of both countries. For landlocked countries, I chose the nearest port. For the country pairs that share a border and for which one of the countries is landlocked (e.g. Paraguay-Argentina), I do not report any value.

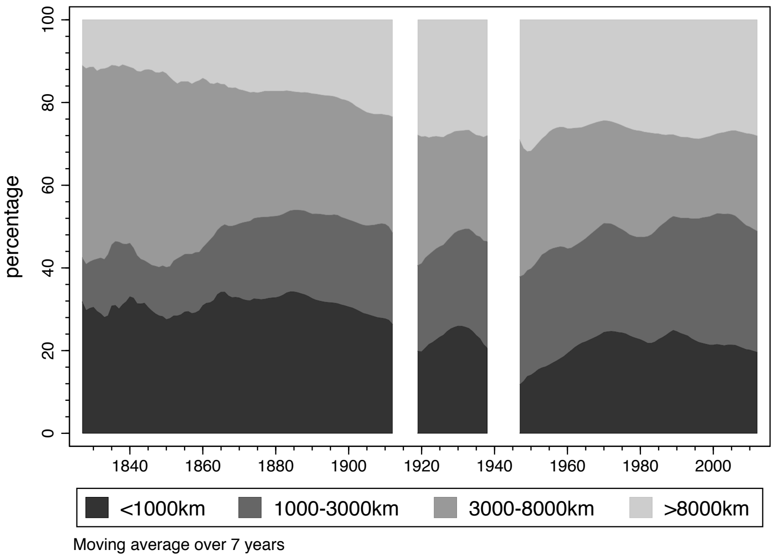

Figure 46: Cumulative share of trade in the data set, by population-weighted great-circle distance

D.9 Other gravity variables

Population

Variables POP_o and POP_d respectively provide information on the population of the origin and the destination country. The population data is extracted from Maddison (2001) and reported in thousands of people.

Geographic location

I provide variables identifying the continent and the sub-continental region of each origin and destination entity. Table 8 summarizes the values taken by those four variables: $CONTI_{o(d)}$ and $REGIO_{o(d)}$. In Figure 47, I use this information to break down the bilateral trade data by trade route.

[50]Both these variables are extracted from the website of CEPII. A detailed description of the variables can be found in Head and Mayer (2002) and Mayer and Zignago (2011).

CONTI_o(d)	*REGIO_o(d)*	Description	# of entities
AFRI		**Africa**	**83**
	NORAFR	North Africa	11
	STHAFR	Sub-Saharan Africa	72
AMERI		**America**	**58**
	CARIB	Caribbean	25
	CTRAM	Central America	9
	NORAM	North America	9
	STHAM	South America	15
ASIA		**Asia**	**69**
	CTRASI	Central Asia	9
	ESTASI	Eastern Asia	9
	MIDEST	Middle East	19
	STHASI	Southern Asia	32
EUROP		**Europe**	**78**
	CTREUR	Central Europe	7
	ESTEUR	Eastern Europe	13
	NWEUR	Northwestern Europe	24
	SCANDI	Scandinavia	8
	STHEUR	Southern Europe	26
OCEA	OCEA	**Oceania**	**30**
			318

Table 8: Correspondance table for geographic location variables

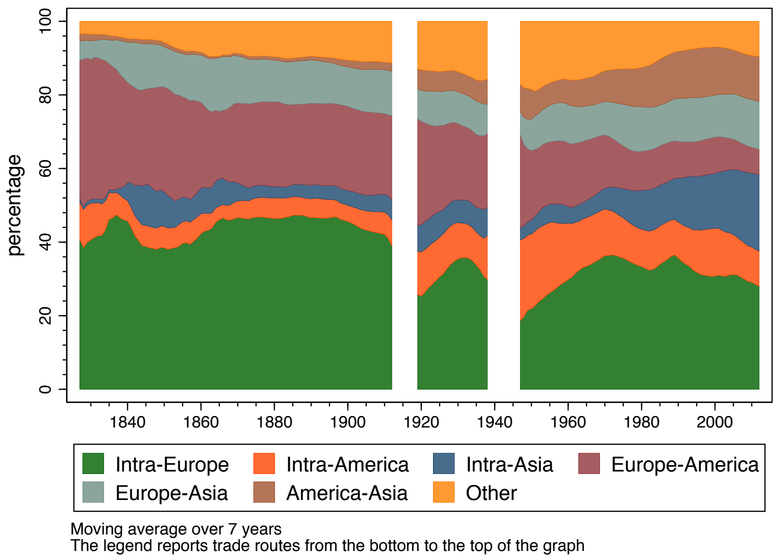

Figure 47: Cumulative share of trade in the data set, by trade route

Colonial ties

I provide two dummy variables to identify the colonial status of country pairs. *Curcol* is set to unity if the pair is in a colonial relationship. *Evercol* is set to unity if the pair ever was in a colonial relationship. Those variables are expanded versions of the data from Head et al. (2010). Figure 25 (appendix B), combines the *Curcol* variable with the bilateral trade data, to identify the share of colonial trade in the data set. Figure 25 emphasizes the overwhelming role of the U.K. in colonial trade.

Variable	Dimension	Description
$iso\_o(d)$	country	Origin (destination) country iso3 code
$year$	year	Year
$FLOWgbr$	country-pair-year	Bilateral trade flow in current British pounds
$SOURCE\_TF$	country-pair-year	Source for the bilateral trade flow
$GDPgbr\_o(d)$	country-year	GDP of the origin (destination) country in current British pounds
$SOURCE\_GDP\_o(d)$	country-year	Source for GDP
$SH\_PRIM\_o(d)$	country-year	Share of the primary sector in the origin (destination) country's GDP, in percentage
$SOURCE\_SH\_PRIM\_o(d)$	country-year	Source for the share of the primary sector
$SH\_SECD\_o(d)$	country-year	Share of the secondary sector in the origin (destination) country's GDP, in percentage
$SOURCE\_SH\_SECD\_o(d)$	country-year	Source for the share of the secondary sector
$IPTOTgbr\_o(d)$	country-year	Total imports in current British pounds
$SOURCE\_IPTOT\_o(d)$	country-year	Source for total imports
$XPTOTgbr\_o(d)$	country-year	Total exports in current British pounds
$SOURCE\_XPTOT\_o(d)$	country-year	Source for total exports
$BITARIFF$	country-pair-year	Bilateral tariff imposed by country d on imports from country o (i.e. ratio of bilateral customs duties to imports, in percentage)
$TARIFF_o$	country-year	Average tariff imposed by country o (d) (i.e. ratio of total customs duties to imports, in percentage)
$SOURCE\_TARIFF\_o(d)$	country-year	Source for aggregate tariffs
$Dist$	country-pair	Population-weighted-great-circle distance, in kilometers (see: variable *distw*, p.11 in Mayer and Zignago (2011))
$Dist\_o(d)$	country	Internal distance of the origin (destination) country computed as: $.67\sqrt{area/\pi}$, in kilometers (see: p.21 in Head and Mayer (2002))
$SeaDist$	country-pair-year	Bilateral shortest maritime distance, in kilometers
$Dist\_nocanal$	country-pair	Bilateral shortest maritime distance without the Suez and the Panama canals, in kilometers
$Dist\_suezonly$	country-pair	Bilateral shortest maritime distance with the Suez canal and without the Panama canal, in kilometers
$Dist\_twocanals$	country-pair	Bilateral shortest maritime distance with both the Suez and the Panama canals, in kilometers
$Dist\_panaonly$	country-pair	Bilateral shortest maritime distance with the Panama canal and without the Suez canal, in kilometers
$Evercol$	country-pair	Dummy set to 1 if the origin and the destination country ever were in a colonial relationship
$Curcol$	country-pair-year	Dummy set to 1 if the origin and the destination country are in a colonial relationship
$POP\_o(d)$	country-year	Population of the origin (destination) country (1000s of people)
$XCH\_RATE\_o(d)$	country-year	Exchange rate vis-à-vis the British pound (x British pounds = 1 local currency unit)
$SOURCE\_XCH\_o(d)$	country-year	Source for the exchange rate
$BITARIFF$	country-pair-year	Customs duties to imports ratio, in percentage
$CONTI\_o(d)$	country	Continent of the origin (destination) country
$REGIO\_o(d)$	country	Sub-continental region of the origin (destination) country

Table 9: Description of the variables in the dataset

E Data sources

Multiple-country sources

Accominotti, Olivier, Jung-Hyun Ahn, Béatrice Dédinger, and Marc Flandreau, "World Trade According to RICardo: A User's Guide," Technical Report unpublished, 2010.

Barbieri, Katherine and Omar Keshk, "Correlates of War Project Trade Data set," 2012, *version 3.0.* Available online: `http://correlatesofwar.org`.

Clemens, Michael A. and Jeffrey G. Williamson, "Why Did the Tariff-Growth Correlation Reverse after 1950?," *Journal of Economic Growth*, Mar. 2004, *9* (1), 5–46.

Denzel, Markus A., *Handbook of World Exchange Rates, 1590-1914*, Farnham, United Kingdom: Ashgate publishing, 2010.

Edvinsson, Rodney, Tor Jacobson, and Daniel Waldenstrm, "Introduction to Historical Monetary and Financial Statistics for Sweden: Exchange Rates, Prices and Wages, 1277-2008," *Sveriges Riksbank*, 2008. Available online: `http://www.riksbank.se/en/Research/Historical-Monetary-Statistics-/Exchange-rates/`.

Estevadeordal, Antoni, Brian Frantz, and Alan M. Taylor, "The Rise and Fall of World Trade, 1870-1939," *The Quarterly Journal of Economics*, May 2003, *118* (2), 359–407.

European Central Bank, "Exchange rates," 2014. Available online: `http://stats.oecd.org`.

Head, Keith and Thierry Mayer, "Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade," working paper 01, CEPII Jan. 2002.

Head, Keith, Thierry Mayer, and John Ries, "The Erosion of Colonial Trade Linkages after Independence," *Journal of International Economics*, May 2010, *81* (1), 1–14.

International Monetary Fund, "Direction of Trade Statistics (historical and regular)," 2002 and 2013. Available on CD-ROM.

International Monetary Fund, "International Finance Statistics," 2012. Available on CD-ROM.

Jacks, David S., Christopher M. Meissner, and Dennis Novy, "Trade Costs: 1870-2000," *American Economic Review papers and proceedings*, 2008, *98* (2), 529–34.

Kitson, Michael and Solomos Solomou, *Interwar Trade Dataset, 1913-1938*, Colchester, Essex, United Kingdom: History Data Service - UK data archive, Apr. 1990.

Maddison, Angus, *The World Economy: A Millenial Perspective*, Paris, France: Development Centre Studies - OECD, 2001. Available online: `http://theunbrokenwindow.com/Development/MADDISON%20The%20World%20Economy--A%20Millennial.pdf`.

Mayer, Thierry and Soledad Zignago, "Notes on CEPII's Distances Measures: The GeoDist Database," working paper 25, CEPII Dec. 2011.

Mitchell, Brian R., *International Historical Statistics: Africa, Asia & Oceania: 1750-2005*, 5 ed., Basingstoke, United Kingdom: Palgrave Macmillan, 2007.

Mitchell, Brian R., *International Historical Statistics: Europe: 1750-2005*, 5 ed., Basingstoke, United Kingdom: Palgrave Macmillan, 2007.

Mitchell, Brian R., *International Historical Statistics: the Americas: 1750-2005*, 5 ed., Basingstoke, United Kingdom: Palgrave Macmillan, 2007.

OECD, "Tax Revenue in National Currency, series No. 5123," 2014. Available online: `http://stats.oecd.org`.

Officer, Lawrence H., "Exchange Rates between the United States Dollar and Forty-One Currencies," *Measuring worth*, 2014. Available online: `http://www.measuringworth.com/exchangeglobal/`.

Schneider, Jürgen, Oskar Schwarzer, and Friedrich Zellfelder, *Wahrunger der Welt: Europaïsche und Nordamerikanische Devisenkurse: 1777-1914*, Stuttgart, Germany: Franz Steiner verlag, 1991.

Smits, J. P., P. J. Woltjer, and D. Ma, "A Dataset on Comparative Historical National Accounts, ca. 1870-1950: A Time-Series Perspective," Research memorandum GD-107, University of Groningen, Groningen Growth and Development Centre, Groningen, The Netherlands 2014. Available online: `http://www.rug.nl/research/ggdc/data/historical-national-accounts`.

Vesseltracker.com, "Routing," 2014. Available online: `https://www.vesseltracker.com/en/Routing.html`.

World Bank, "World Development Indicators," 2012. Available online: `http://data.worldbank.org/data-catalog/world-development-indicators`.

Argentina

Della Paolera, Gerardo and Alan Taylor, *A New Economic History of Argentina*, Cambridge, United Kingdom: Cambridge University Press, 2003.

Tena Junguito, Antonio and Henry Willebald, "On the Accuracy of Export Growth in Argentina, 1870-1913," working paper 13-03, Universidad Carlos III de Madrid May 2013.

Australia

Bureau of census and statistics, *Trade and Customs and Excise Revenue of the Commonwealth of Australia*, Melbourne, Australia: Commonwealth bureau of census and statistics, 1906-1907.

Austria

Handelsministerium, *Statistik des Auswärtigen Handels des Österreisch-Ungarischen Zoolgebiets*, Wien, Austria: Statistischen departement, 1891-1917.

Staatsamtes für handel etc., *Statistische Überfichten über den Auswärtigen Handel Österreichs*, Wien, Austria: Staatsamtes für handel und gewerbe, industrie und bauten, 1919-1930.

Belgium

Ministère de l'intérieur, *Annuaire Statistique de la Belgique et du Congo Belge*, Brussels, Belgium: Office central de statistique, 1934-1939.

Ministère des affaires économiques, *Annuaire Statistique de la Belgique et du Congo Belge*, Brussels, Belgium: Office central de statistique, 1942-1944.

Ministère des affaires économiques, *Annuaire Statistique de la Belgique et du Congo Belge*, Brussels, Belgium: Institut national de statistique, 1945-1949.

Ministère des finances, *Tableau Général du Commerce avec les Pays Étrangers*, Brussels, Belgium: Ministère des finances, 1881-1913.

Ministère des finances, *Tableau Annuel du Commerce de la Belgique avec les Pays Étrangers*, Brussels, Belgium: Ministère des finances, 1920-1921.

Ministère des finances, *Tableau du Commerce Extérieur de la Belgique et du Grand-Duché de Luxembourg*, Brussels, Belgium: Ministère des finances, 1922.

Ministère des finances, *Tableau Annuel du Commerce avec les Pays Étrangers*, Brussels, Belgium: Ministère des finances, 1923-1931.

Belgian Congo

Ministère des colonies, *Statistiques du Commerce Extérieur du Congo Belge*, Brussels, Belgium: Ministère des colonies, Office colonial, 1918-1930.

British colonies

Board of Trade, *Statistical Abstract for the British Empire*, London, United Kingdom: H.M. Stationery office, 1920-1932. Some opuses available online: `http://www.parliament.uk/business/publications/parliamentary-archives/archives-electronic/parliamentary-papers/`.

Bulgaria

Ivanov, Martin, "Bulgarian National Income between 1892 and 1924," Discussion papers 54, Bulgarian national bank Jun. 2006.

Chile

Díaz, José and Gert Wagner, "Política Comercial: Instrumentos y Antecedentes. Chile en lost Siglos XIX y XX," Documento de Trabajo 223, Pontificia Universidad Católica de Chile, Instituto de Economia, Santiago, Chile Apr. 2004.

Lüders, Rolph J., "The Comparative Economic Performances of Chile: 1810-1995," *Estudios de Economía*, Dec. 1998, *25* (2), 217–249.

Oficina central de estadistica, *Estadística Comercial de la República de Chile*, Valparaiso, Chile: Oficina central de estadistica, 1888-1911. Some opuses available online: `http://repositorio.uc.cl/xmlui/handle/123456789/1562`.

China

Chinese Maritime customs, *Statistical Secretary's Report on the Foreign Trade of China*, Shanghai, China: Chinese Maritime customs, 1934.

Imperial maritime customs, *Returns of Trade at the Ports in China Open by Treaty to Foreign Trade*, Shanghai, China: Imperial maritime customs, 1867.

Imperial maritime customs, *Returns of Trade and Trade Reports*, Shanghai, China: Statistical department of the inspectorate general of customs, 1871-1909.

Ma, Ye, Herman de Jong, and Tianshu Chu, "Living Standards in China between 1840 and 1912: A New Estimation of Gross Domestic Product per capita," GGDC research memorandum 147, Groningen Growth and Development Centre Jul. 2014.

Maritime customs, *Foreign Trade of China*, Shanghai, China: Statistical department of the inspectorate general of customs, 1913-1924.

France

Lévy-Leboyer, Maurice and François Bourguignon, *L'économie Française au XIXème Siècle. Analyse Macroéconomique*, Paris, France: Economica, 1985.

Ministère des finances, *Tableau Général du Commerce de la France avec ses Colonies et les Puissances Étrangères*, Paris, France: Direction Générale des Douanes et des Droits Indirects, 1827-1948.

Toutain, J.-C., *Le Produit Intérieur Brut de la France de 1789 à 1982*, Grenoble, France: Presses Universitaires de Grenoble, 1987.

Villa, Pierre, "Une Analyse Macroéconomique de la France au XXe Siècle," 1993. Available online: `http://www.cepii.fr/francgraph/bdd/villa/mode.htm`.

French colonies

Gouvernement géneral de l'Algérie, *Documents Statistiques sur le Commerce de l'Algérie*, Algiers, Algeria: Direction des douanes, 1902-1930.

Ministère des colonies, *Renseignements Généraux sur le Commerce des Colonies Françaises et la Navigation*, Paris, France: Ministère des colonies, 1910-1928.

Présidence du conseil, *Statistique Générale de la France - Annuaire Statistique*, Paris, France: Sous-secrétariat de l'économie nationale, 1932.

Service du commerce et de l'industrie, *Statistiques du Mouvement Commercial et Maritime du Maroc*, Tangier, Morocco: Division du commerce et de la marine marchande, Comité des douanes, 1913-1930.

Greece

Bitzis, G. and G. Kostelenos, "Factors Affecting Long Run Growth in pre-WWII Greece (1850-1938)," working paper, Center of planning and economic research, Athens, Greece Nov. 2008.

India

Government of India, *Annual Statement of the Trade and Navigation of British India with Foreign Countries and the Coasting Trade between the Several Presidencies and Provinces, Together with the Miscellaneous Statistics Relating to the Foreign Trade of British India*, Calcutta, India: Financial Department of the government of India, Office of superintendent of government printing, 1872-1898.

Government of India, *Annual Statement of the Sea-borne Trade and Navigation of British India with the British Empire and Foreign Countries*, Calcutta, India: Director-general of commercial intelligence, Office of the superintendent of government printing, 1904-1949.

Houses of Parliament, *Statistical Abstract relating to British India*, London, United Kingdom: Her Majesty's Stationary Office, 1867-1905.

Mexico

Instituto nacional de estadistica, *Estadísticas Históricas de México*, Mexico city, Mexico: Instituto nacional de estadistica geographia e informatica, 1985. Available online: `http://biblioteca.itam.mx/recursos/ehm.html`.

Netherlands

Centraal-bureau voor de statistiek, *Statistiek van den in-, uit- en Doorvoer*, The Hague, The Netherlands: Centraal-bureau voor de statistiek, 1920-1944.

Centraal-bureau voor de statistiek, *Jaarcijfers voor Nederland van den in-, uit- en Doorvoer*, Utrecht, The Netherlands: Centraal-bureau voor de statistiek, 1951.

Departement van financien, *Statistiek van den Handel en de Scheepvaart van het Konigrijk der Nederlanden*, The Hague, The Netherlands: Departement van financien, 1847-1876.

Departement van financien, *Statistiek van den in-, uit- en Doorvoer*, The Hague, The Netherlands: Departement van financien, 1877-1916.

Smits, Jan-Pieter, Edwin Horlings, and Jan Luiten van Zanden, *Dutch GDP and its Components, 1800-1913* monograph series no.5, Groningen, The Netherlands: Groningen growth and development centre, 2000. Available online: `http://nationalaccounts.niwi.knaw.nl/tables.htm`.

Norway

Grytten, Ola H., "The Gross Domestic Product for Norway 1830-2003," in Øyvind Eitrheim, Jan T. Klovland, and Jan F. Qvigstad, eds., *Historical Monetary Statistics for Norway 1819-2003*, number 35. In 'Norges bank occasional papers.', Oslo, Norway: Norges bank, 2004, chapter 6. Available online: `http://www.norges-bank.no/Upload/HMS/PDF/HMSI_chapter6.pdf`.

Klovland, Jan Tore, "Historical Exchange Rate Data 1819-2003," in Øyvind Eitrheim, Jan T. Klovland, and Jan F. Qvigstad, eds., *Historical Monetary Statistics for Norway 1819-2003*, number 35. In 'Norges bank occasional papers.', Oslo, Norway: Norges bank, 2004, chapter 7. Available online: `http://www.norges-bank.no/Upload/HMS/PDF/HMSI_chapter7.pdf`.

Portugal

Nuno, Valério, *Portuguese Historical Statistics*, Lisbon, Portugal: Instituto Nacional de Estatśtica, 2001. Available online: `http://pedrolains.typepad.com/pedrolains/estatsticas-data.html`.

Russia

Harrison, Mark and Andrei Markevich, "Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928," working paper WP-2, The Maddison project, Groningen, Netherlands Mar. 2011.

Spain

Álvarez-Nogal, Carlos and Leandro Prados de la Escosura, "The Rise and Fall of Spain (1270-1850)," *The economic history review*, Dec. 2013, *66* (1), 1–37.

Junta general de estadistica, *Anuario Estadistico de Espanã*, Madrid, Spain: Junta general de estadistica, 1858-1943. Some opuses available online: `http://biblioteca.ua.es/es/servicios/obras-de-consulta/estadisticas.html`.

Ministerio de hacienda, *Estadistica del Comercio Exterior de Espanã*, Madrid, Spain: Direccíon general de aduanas, 1944-1948.

Tena Junguito, Antonio, "EHE Sector Exterior," Technical Report unpublished, 2012.

Sweden

Edvinsson, Rodney, "Growth, Accumulation, Crisis: With New Macroeconomic Data for Sweden 1800-2000." PhD dissertation, Stockholm University, Faculty of Social Sciences, Department of Economic History, Stockholm, Sweden 2005. Available online: `http://www.historicalstatistics.org`.

Statistika centralbryån, *Historisk Statistik för Sverige: 1732-1970*, Stockholm, Sweden: Statistika centralbryån, 1972.

Switzerland

Stohr, Christian, "Let's Get this Right: Swiss GDP and Value Added by Industry from 1851 to 2008," Working paper WPS-14-09-1, Université de Genève - Geneva School of Economics and Management Sep. 2014.

Tunisia

Régence de Tunis, *Documents Statistiques sur le Commerce de la Tunisie*, Tunis, Tunisia: Régence de Tunis, Protectorat Français, Direction générale des finances, Direction des douanes, 1914-1930.

United Kingdom

Broadberry, Stephen N., Bruce M. S. Campbell, Alexander Klein, Mark Overton, and Bas van Leeuwen, "British Economic Growth, 1270-1870: An Output-based Approach," School of economics discussion paper KDPE 1203, University of Kent Dec. 2011.

Houses of Parliament, *Annual Statement of the Trade and Navigation of the United Kingdom with Foreign Countries and British Possessions*, London, United Kingdom: H.M. Stationery office, 1855-1949.

Houses of Parliament, *Statistical Abstract of the United Kingdom*, London, United Kingdom: H.M. Stationery office, 1870-1913.

Mitchell, Brian R., *British Historical Statistics*, Cambridge, United Kingdom: Cambridge University press, 1988.

United States

Carter, Susan B., Scott Sigmund Gartner, Michael R. Haines, Alan L. Olmstead, Richard Sutch, and Gavin Wright, *Historical Statistics of the United States, Earliest Times to the Present, Millennial Edition*, Vol. 5, New York, N.Y., USA: Cambridge University Press, 2006.

Department of commerce, *The Foreign Commerce and Navigation of the United States*, Washington, D.C., USA: Bureau of foreign and domestic commerce, 1913-1915.

Department of commerce and labor, *The Foreign Commerce and Navigation of the United States*, Washington, D.C., USA: Bureau of statistics, 1906-1908.

Haskel, Daniel, *A Complete Descriptive and Statistical Gazeteer of the United States of America*, New York, N.Y., USA: Sherman and Smith, 1844.

Treasury department, *Annual Report of the Foreign Commerce of the United States*, Washington, D.C., USA: Bureau of statistics, 1884.

Treasury department, *Monthly Summary of Commerce and Finance of the United States*, Washington, D.C., USA: Treasury department, Bureau of statistics, 1896-1901.

United States Senate, *Rates of Duty on Imports into the United States*, Vol. 24 of *Senate report, 51st Congress, 2d Session*, Washington, D.C., USA: GPO, 1891.

Williamson, Samuel H., "What Was the U.S. GDP Then?," *Measuring worth*, 2014. Available online: `http://www.measuringworth.com/usgdp/`.