David Chilosi-Giovanni Federico

The effects of market integration during the first globalization: a multi-market approach

This paper measures the effects of international market integration on world trade and welfare during the first globalization (1815-1913). The analysis is carried uses a multi-market partial equilibrium model, which takes into account the interactions between route-specific changes in trade costs. We consider world trade in the two principal traded commodities, cotton and wheat. The collapse in trade costs accounted for 60% of the increase in trade in cotton and 40% of the increase in trade of wheat. Overall welfare gains were fairly small for large countries, but substantial for small open economies. They were mainly determined by trade policies, with larger gains for those polities that liberalized trade.

1) Introduction

Economists and economic historians firmly believe that globalization during the 'long' 19th century, from Waterloo to World War One, has handsomely contributed to economic growth and many scholars have tried to measure this contribution. They have explained the growth of trade with gravity models (Estevadeordal et al. 2003, Jacks and Pendakur 2010, Jacks et al. 2011, Fouquin and Hugot 2016, Pascali 2017) and have used a variety of statistical techniques to measure the contribution of openness or tariffs to economic growth (O'Rourke 2000, Clemens and Williamson 2004, Jacks 2006b, Schularick and Solomou 2011, Lampe and Sharp 2013, Pascali 2017). Yet the results are far from conclusive. The works on the effects of trade on economic growth share the problem of too many variables explaining a single outcome which bedevils the growth regression approach, while gravity models measure trade costs very imperfectly. They measure barriers to trade with aggregate nominal duties, possibly adding variables for specific extra costs (floating exchange rate, borders or ethnic diversity and so on) and sometimes they omit them altogether. Almost all the papers proxy transportation costs with bird fly distance and only few add interactions with time.

In theory, the literature on market integration could offer precious additional evidence because its focus on specific products makes it much easier to estimate trade costs. In fact, if the market is efficient, arbitrage keeps price gaps between two trading markets equal or very close to trade costs (Federico 2012). Yet, as our review in Section Two shows, this opportunity has been largely missed. This paper is a first step to address this gap. We estimate the effect of integration on trade and welfare with a multi-market partial equilibrium

approach. These models have been developed by agricultural economists and are used by World Bank economists to study the effects of trade liberalization and other poverty-alleviation policies (Minot and Goletti 1998, Arulpragasam and Conway 2003, Robinson et al. 2015), but have never been used in economic history. They can be seen as an intermediate approach between bilateral partial equilibrium estimates (Federico and Sharp 2013, Chilosi and Federico 2016), which are simple to implement but neglect interactions with third markets (Anderson and van Wincoop 2003), and world-level general equilibrium models, which are extremely data-intensive and so far have only been applied to the historical analysis of international integration of a single core country (Alexander and Keay 2018). Our model measures the effects of integration of the world market for a given commodity on exporters and importers by comparing actual trade and welfare in a base-year with counterfactual, no market integration, ones. It is thus possible to compute the contribution of price convergence to the growth of world trade and compare the benefits of integration (albeit for specific commodities) with static estimates of macroeconomic gains from trade à la Arkolakis et al (2012).

Our empirical contribution is twofold. First and foremost, we explore the effects of the development of a world market for wheat and cotton, the two most important traded commodities in the long 19th century, (Yates 1959 tab 17). We pick 1913 as base-year for our computation, on grounds of data availability and we estimate separately the effects of price convergence since 1815, 1830 or 1870. These benchmarks capture the market conditions in three different periods – the start of the 'long 19th century', when trade costs were still very high for the consequences of the Napoleonic Wars and of the restrictions to trade with Asia, the beginning of the 'early globalization' (O'Rourke and Williamson 2002, Chilosi and Federico 2015, Federico and Tena-Junguito 2017) and the start of the 'first globalization' according to the conventional wisdom (Jacks et al 2010, Klasing and Milionis 2015). The model, as any other in this literature, needs a set of supply and demand elasticities. We get some of them from other historical or contemporary works, but, as our second empirical contribution, we estimate the parameters of British demand for (different qualities of) wheat and cotton, with an AIDS model (Deaton and Mullbauer 1980).

After a short survey of the literature (Section Two), we present the main trends in trade and price convergence in Section Three. We describe our model in Section Four. Section Five presents our estimate of British demand elasticities and the other elasticities used in the model (with more information on the sources in the Appendix). The next two Sections discuss the effects of integration on bilateral and total trade (Section Six) and on welfare (Section Seven). Section Eight concludes.

2) On the effects of market integration: a survey of the literature

The historical literature on market integration is extensive, but the overwhelming majority of articles deal with the measurement of integration and the rest looks at its causes (Federico 2012 and 2019). The effects of integration have been almost entirely neglected. There is a dearth of works on the effects of market integration during the first globalization on trade, economic growth and welfare. Ejrnæs and Persson (2010) and Steinwender (2018) deal with the beneficial effect of the lay-out of the of telegraph cables between England and the United States in July 1866, arguably the biggest positive shock in market efficiency during the first globalization. It slashed the time of transmission of information from about ten days to few minutes and the consequent reduction in uncertainty increased American exports. Ejrnæs and Persson (2010) and Steinwender (2018) estimate the corresponding benefits with different specifications and data (respectively monthly prices for wheat and daily prices for cotton), but the results are fairly similar: the telegraph increased exports of cotton by 8% and export of wheat by 2% relative to their pre- telegraph level.

Federico and Sharp (2013) estimate the long run effects of changes in trade costs with a variant of the standard partial equilibrium analysis of the benefits from trade liberalization (Hufbauer et al. 2002). They hypothesize, more realistically, that trade costs for a given product decline rather than disappear with the abolition of duties. In this case, the gains from lower (but still positive) costs are captured by an additional term, which is proportional to the (absolute) difference between shares of the product on consumption and output of the country. Thus, the benefits from integration are greater the more relevant the product is in the country economy and the higher share of exports on its total output. Federico and Sharp (2013) use

this simple framework to estimate the losses from the regulation of American rail fares, which prevented a full transfer of productivity gains to consumers and, above all, the adjustment to collapsing prices for agricultural products during the Great Depression. Chilosi and Federico (2016) deal with the integration of the market between Europe and Asian (British India and Dutch East Indies) and American suppliers for a large number of commodities. They find that consumers gained more than producers. For instance, in the UK, where the commodities account for 20% of the imports, the long-run gains were equivalent to 2% of its GDP.

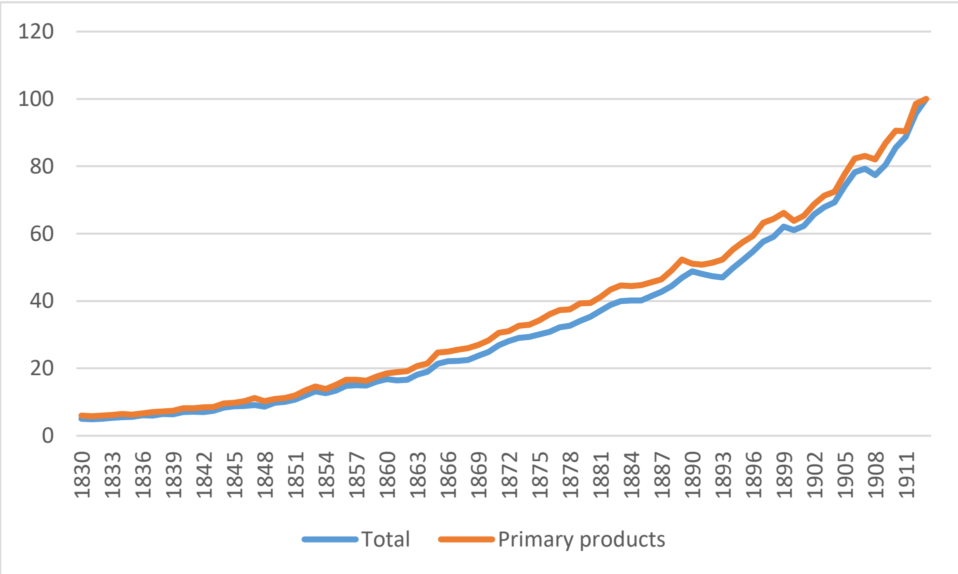
Bilateral partial equilibrium models implicitly assume that the decline in trade costs is similar across pairs of countries and ignores all the (static) general equilibrium effects of market integration. Donaldson has put forward two different strategies to estimate these latter, both broadly inspired by new trade theory. Costinot and Donaldson (2016) estimate separately the contributions of technical progress (measured by the differences between maximum potential and actual yields) and market integration (measured by gaps between local and New York prices) to the growth of American agricultural output since 1887. They compare actual output of all counties in a number of benchmark years with a counterfactual one, computed with linear programming by multiplying the actual prices of the benchmark year by the yields of the optimal output in the following benchmark. In another paper, Donaldson (2018) uses a three step regression-based approach to estimate the effects of railways on agricultural output of Indian districts, quite a good proxy for GDP in the case at hand. First, he estimates the costs of transportation with different means by comparing price of a specific type of salt (extracted in a single location) all over India. Then, he shows that transportation costs determined trade flows and he estimate the effect of the existence of a railways connection on output and the contribution of railways to increasing trade, as opposed to replacing other means. Unfortunately, these sophisticated general-equilibrium methods need a lot of detailed data which are simply not available for international analysis.

3) Trade and price convergence

The long 19th century featured a fast growth of world trade and an almost parallel growth of trade in primary products: from 1830 to 1913, the trade in primary products grew by 17.2 times (Figure 1).

Figure 1

The growth of world trade, 1815-1913



Source: Federico and Tena-Junguito (2019)

There are no comparable series of trade in cotton and wheat, but the long-term growth can be gleaned from the available evidence on their shares on total trade.[1] The share of cotton fluctuated widely around 5% from the 1830 onwards, with a hump around the American Civil war – and thus in the long run cotton trade increased roughly as much as total trade. In contrast, the share of wheat has been declining steadily, from 3.7% in the mid-1850s to 2.9% in the mid-1880s to 2.3% on the eve of World War One, corresponding to an increase of 'only' 4.3 times.

In principle, the multi-market approach should include separately all producing and consuming countries, but as the number of parameters increases, their estimates become less precise. Thus, for cotton we consider the three main producers, United States, India and Egypt, and the two main importers, Europe (here considered as a single area, as costs were similar) and Japan, which opened up to world trade in 1853

[1] The shares for cotton (5.0% in 1830, 6.5% in 1850, 7.3% in 1870, 5.0% in 1890, 3.8% in 1900 and 4.7% in 1913) are computed by dividing the value of cotton trade from Federico and Tena-Junguito 2017b by the world total exports in current dollars from Federico and Tena (FT website). The total value of trade in wheat is computed by multiplying the average quantities in 1854-58 and 1884-1884 from Stern (1960 tab 1) and in 1909-13 from Bacon and Schloemer (1940 p. 62-63) by the 'world' prices from FT website.

and started to import massively cotton in the 1890s (Panza 2013; Otsuka et al 1988: 25-26). For wheat we distinguish the United Kingdom from the rest of Western Europe, for their different trade policies (see commentary to Table 2, below), and we consider two main producing areas, North America (United States and Canada) and Eastern Europe (mostly Russia).

Table 1
The growth of cotton and wheat trade
a) wheat (000 tons)

	1815		1830		1870		1913	
Exporters	Quantity	Share	Quantity	Share	Quantity	Share	Quantity	Share
North America	1.5	0.8	2.5	0.7	872.1	29.9	3656.8	33.3
Eastern Europe	198.2	99.2	364.7	99.3	2046.4	70.1	7328.5	66.7
Total	199.7		367.2		2918.5		10985.3	
Importers								
UK	11.1	5.5	22.8	6.2	1403.2	48.1	2719.1	24.8
Western Europe	188.7	94.5	344.4	93.8	1515.3	51.9	8266.2	75.2
Total	199.8		367.2		2918.5		10985.3	41.6

b) cotton (000 tons)

	1816		1830		1870		1913	
Exporters	Quantity	Share	Quantity	Share	Quantity	Share	Quantity	Share
US	37	71.8	127.0	68.4	544.1	63.2	2177.1	75.4
India	14.6	28.2	49.8	26.8	248.9	28.9	429	14.9
Egypt	0	0	8.9	4.8	67.6	7.9	281.2	9.7
Total	51.6		185.7		860.6		2887.3	
Importers								
Europe	51.6	100	185.7	100.0	860.6	100	2586.5	89.6
Japan	0	0	0	0	0	0	300.8	10.4
Total	51.6		185.7		860.6		2887.3	

Sources: See Appendix
Notes: North America is Canada and US, Eastern Europe is Austria-Hungary, Bulgaria, Romania, Russia and Serbia, Western Europe is Belgium, Finland, France, Germany, Greece, Italy, Netherlands, Norway, Portugal, Spain and Sweden, and Europe is Austria-Hungary, Belgium, France, Germany, Italy, Netherlands, Russia, Spain, Switzerland, and UK.

Our country coverage is almost complete on the demand side for both products and on the supply side for cotton. The three producers of cotton accounted for 80% of the value of trade in 1820 (with 11% to Brazil), 91% in 1870 and 94% in 1913 (Federico and Tena-Junguito 2017b).[2] Europe and Japan accounted for 97% of world imports of cotton in 1909-13. The United Kingdom and Western Europe accounted

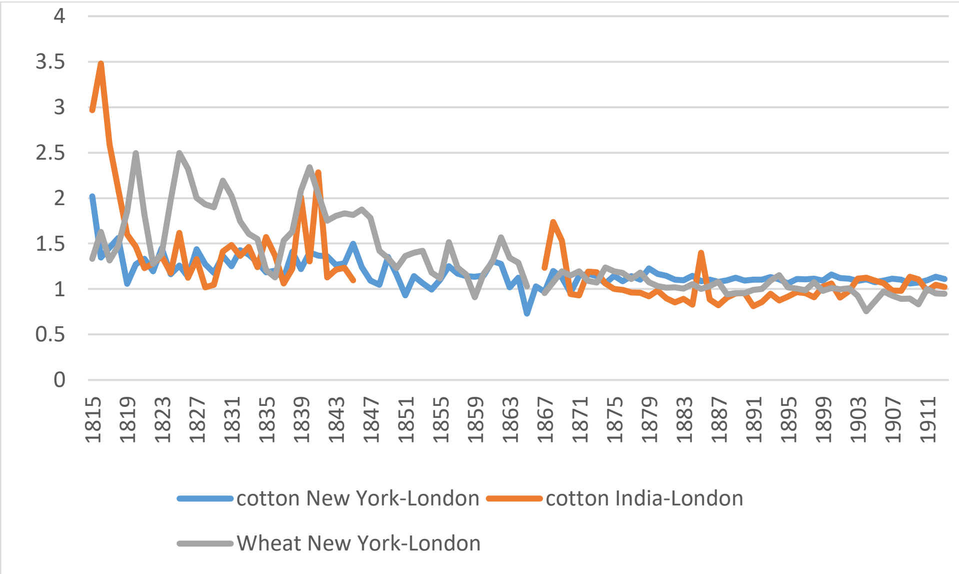
[2] Egypt did not export any cotton before the discovery of the long-staple Jumel (or Mako) variety in 1820.

respectively for 34.1% and 47.9% of world import of wheat on the eve of World War One (Bacon and Schloemer 1940:62-63 and 417). The country coverage is less complete for the wheat supply. Other producers accounted for 46.9% of exports in 1854-1858, for 19.1% in 1884-1888 (Stern 1960 tab 1 A) and for 34.7% in 1909-13 (Bacon and Schloemer 1940:62-63).[3]

By definition, trade can grow either because of shifts in demand and/or supply or for declines in trade costs. If the market is reasonably efficient, trade costs can be estimated with price gaps between producing and consuming countries. Indeed, the 'long 19th century' was characterized by a wide-ranging process of convergence in prices, both within Europe and between Europe and overseas producers. The process of price convergence involved also wheat and cotton (Figure 2).

Figure 2

Price ratios producer/consumer market



Source: Chilosi and Federico (2015)

The size of price gaps varied a lot between routes and commodities, depending on the specific barriers to trade. De Zwart (2016) shows how gaps between East Indies and Amsterdam differed across products according to the power of the VOC (the Dutch East India Company) on the source of supply. The gaps in wheat prices between the United Kingdom and East coast of North America were low as long as the latter

[3] Stern (1960) does not specify which countries are included in his 'other countries' aggregate in the first period, but one would presume Prussia accounted for a large share of it. The major exporters outside North America and Eastern Europe were India (10.7% in 1884-1888 and 7.1% in 1909-13), Argentina (1.4% and 13.2%) and Australia (2.4% and 6.9%).

was a British colony, widened in the 1780s, exploded during the Napoleonic Wars and remained high after 1815 because of the adoption of almost prohibitive duties in the United Kingdom (Sharp and Weisdorf 2013: Fig 1). The price gap between India and the United Kingdom were kept artificially high by the monopoly of the East India Company. Chilosi and Federico (2015) estimate, with a panel regression for a representative sample of commodities, that the abolition of monopoly of the East India Company in 1813 accounted for two thirds of convergence of Indian prices (and telegraph for a quarter) in the 'long 19th century'. In contrast, the convergence in wheat and cotton prices between the United States and Britain was determined mostly by the decline in freights, with a sizeable contribution of the liberalization of imports in 1846.

In principle, one could use price gaps as a measure of trade costs, but, as shown by Figure 2, the ratios are rather volatile in the short run. Thus, whenever possible, we use the values fitted by panel regressions to estimate route- and product-specific real trade costs. We first combine the coefficients from the regression with the values of explicative variables to predict the price ratios between the US and the United Kingdom (for cotton and wheat) and between India and Europe (for cotton) in each benchmark year.[4] Then we convert the ratios in current pounds per ton. Finally, we deflate them with the British GDP deflator, following Hummels (2007), to obtain specific trade costs in constant 1913 pounds, which we need for the multi-market model (Section Four).

We estimate the costs on other routes with two different procedures (see for details Appendix). As a second best, we proxy trade costs with price ratios, after smoothing them with a Hodrick-Prescott filter. We use this method for cotton exports from Egypt and cotton imports into Japan, from both India and the United States, in 1913. As before, we convert the fitted price gaps in current pounds per ton and deflate them with the British GDP deflator. Our price data for Egypt start in 1822, and thus we extrapolate the series to 1816 with the US-Europe costs. We assume trade costs for export to Japan to have been

[4] The results for British import of wheat in 1815 may not be fully representative, because the Corn Laws were approved only in April and large quantities of wheat were imported in the first months of the year in prevision of the change in trade policy. Thus, as a robustness check, we produce an alternative estimate of the trade costs as the sum of freights and the implicit duty, which we define as the difference between the domestic ('Gazette') price and the threshold (80 shillling/quarter) to let import free. The results hardly differ.

prohibitively high in 1816 and also in 1870, as the shipping market was highly regulated before 1875 (Kemble 1940: 345, Yasuba 1978).

Lastly, we use an indirect approach to estimate costs of exporting wheat from Eastern Europe to the United Kingdom and Western Europe because the available price series refer to different qualities and thus their difference do not measure trade costs precisely enough for our purposes. We use the US-UK trade costs as a baseline and we add up differences in transport costs or duties, with different assumptions for exports to Great Britain and to Western Europe. For imports into Great Britain, we assume that duties and other transaction costs were the same from North America and from Eastern Europe and any difference in trade costs reflected transportation costs. Consequently, our estimate is the sum of the trade costs from North America to the United Kingdom and of the difference in freight rates between the two routes, using a suitably extrapolated series of freights from Odessa to London (Harley 1988 and 1989). In contrast, in the case of export to Western Europe, we assume that transport and other transactions costs were the same as to the United Kingdom and we obtain total trade costs as the costs into the UK plus the difference in duties. We estimate the British unit duty in 1815 and 1830 as a three years moving average of revenues from tariff divided by the total weight of the wheat imported, while we compute duties for countries in Western Europe as the weighted average of specific duties in the benchmark years (O'Rourke 1997, Federico 2012), using as weights the shares of imports from the US (North America) and Russia (Eastern Europe) in 1913.

For the sake of comparability in time and space, in Table 2 we report our estimates as the ratio of trade costs to the price at the origin.

Table 2

Trade costs as percentage of price at origin

a) Wheat

Origin	Destination	1815	1830	1870	1913
North America	UK	93.9	90.7	20.7	0.58
North America	Western Europe	65.3	59.7	21.7	38.4
Eastern Europe	UK	152.2	85.1	33.3	4.1
Eastern Europe	Western Europe	111.8	58.3	34.7	46.5

b) Cotton

Origin	Destination				
US	Europe	58.3*	22.9	6.1	8.7
US	Japan				25.2
India	Europe	230.9*	23.0	17.9	0.0
India	Japan				9.9
Egypt	Europe	199.6*	35.8	11.1	5.9

Sources: see the text and the Appendix.
Notes: * is 1816.

Our estimates confirm the conventional wisdom (Section Two). All costs were proportionally very high at the end of the Napoleonic wars, but then trends differed across products and routes. Costs for exporting cotton collapsed quickly. They were fairly low already in 1830, as outside Japan, barriers to trade were very limited. The export of Egyptian cotton was stifled by the state monopoly on cotton, which channeled cotton towards domestic industries (Panza and Williamson 2015). Great Britain imposed a modest fiscal duty on imports (about 5%). The duty was reduced in 1838 and abolished in 1846, while the Egyptian monopoly had been abolished three years earlier. Since 1846, cotton imports were free all over Europe and thus any subsequent decline in trade costs was caused by improvement in transport technology. In contrast, duties accounted for most of the trade costs for wheat. The 1815 British Corn Laws were more restrictive than any trade barrier on the continent (Sharp 2010, Barnes 1930, Federico 2012). Prussia was a net exporter of wheat and France and other Continental European countries waited the early 1820s before imposing very high duties. Protection remained fairly high both in Britain and on the continent until the 1840s. The repeal of the Corn Laws in 1846 is the most famous of a spate of measures which liberalized wheat trade all over Europe, leaving only minimal fiscal duties in few countries, including the United Kingdom. This last duty was abolished in 1869. Imports into the United Kingdom remained free until War World One and thus the United Kingdom benefitted from the reduction in transportation costs. The major continental European countries reacted to the "grain invasion" of the 1880s (O'Rourke 1997) by increasing duties, which more than compensated the technical progress in transportation. Trade costs into Western Europe increased from 1870 to 1913. Duties were equal for all provenances, and thus the somewhat higher costs of importing from Eastern Europe than from North America depended on transportation costs.

4) The model

Our model deals with the effects of an exogenous change in trade costs (*t*) on demand and supply of a given commodity in *N* exporting and *M* importing markets. Following the standard Armington (1969) assumption, the quality of the good produced in each place differs. Exporters only consume the local variety. Importers can consume the local variety and those produced by any of the exporters. Under the *ceteris paribus* assumption of constant factor endowment and technology in the rest of the economy, we can model demand and supply of the good produced in place *i* consumed in place *j* as functions of prices and real income per capita only. Following Steinwender (2018) we assume linear functions:[5]

$D_{ij}=a_{ij}+\Sigma_k \beta_{ijk} P_{kj}+\delta_{ij} Y_j$ 1a)

$S_i=b_i+\gamma_i P_{ii}$ 1b)

Where $j=1$ to $N+M$, for the exporters $i=j$ and $k=1$, for the importers $i, k=1$ to $N+1$, a_{ij} and b_i are stochastic intercepts, $\beta_{ijk}<0$ if $j=k$ or for complements and >0 for substitutes, $\delta_{ij}>0$ and $\gamma_i \geq 0$ for all *i* and *j*. We assume 'specific' rather than 'iceberg' trade costs because we deem the assumption of strict proportionality of trade costs to prices highly unrealistic. It surely does not hold true for specific duties as the British Corn Laws nor, to some extent, for freights which depended on the volume per unit of weight (Thomas 1930: 230). Each pair of exporting and importing markets are related by arbitrage by representative traders, who choose the profit-maximizing level of exports E_{ij} between markets *i* and *j*:

$\pi_{ij} =(P_{ij}-P_{ii}-t_{ij})E_{ij}$ 2)

Neither $(P_{ij}-P_{ii})<t_{ij}$ nor $(P_{ij}-P_{ii})>t_{ij}$ can be equilibrium solutions, as traders would lose money in the former and would want to export an infinite amount in the latter. Hence, the only equilibrium with positive trade is:

$(P_{ij}-P_{ii})=t_{ij}$. 3)

In this case, traders are indifferent with respect to the quantity exported, which is thus determined by the markets' clearing conditions (Steinwender 2018). The market clearing conditions are:

[5] We cannot reproduce her approach to market efficiency because it needs high-frequency data which are not available.

$\Sigma_j D_{ij}=S_i$ 4a)

For all *i* and *j*. Moreover, when $i\neq j$:

$E_{ij}=D_{ij}$ 4b)

It is straightforward to compute the parameters of the demand and supply functions with prices and quantities in the baseline year and elasticity estimates, by substituting in the formulae of the elasticities (eg. $\beta_{ijj}=\eta_{ijj}D_{ij}/P_{ij}$ where η_{ijj} is the own-price elasticity of the demand of the good produced in *i* and consumed in *j*). We make the standard assumption that the change in trade costs implies a change in income per capita equal to the change in the producer's surplus and that this surplus is equally redistributed to domestic consumers:

$dY_i=(dP_iS_i+0.5*dP_idS_i)/L_i$ 4c)

Where *d* is the difference operator and L_i is the population of market *i*. As usual in multi-market partial equilibrium analysis (cf. e.g. Minot and Goletti 1998, Robinson et al. 2015), new equilibrium prices and quantities produced, consumed and traded with changed trade costs are computed by solving the system of equations 1a), 1b), 3), 4a) and 4c) with the Mixed Complementarity Programme solver, implemented with the software GAMS.

Following a standard approach in multi-market welfare analysis (Boadway and Bruce 1984: ch. 7), we estimate the welfare effect of a change in trade costs with the compensating variation of the resulting change in prices and quantities.[6] In other words, as in the standard partial equilibrium analysis of protectionism (e.g. Feenstra 1995), we measure the value of transfers which are needed to sustain the 1913 levels of welfare for each consumer with pre- globalization trade costs, given 1913 endowments and technology. However, the change in the set-up from bilateral to multi-lateral trade implies that the computation becomes more complex than with the classical Harberger's triangles. Taking the second order approximation of the change in the expenditure function (i.e. neglecting all terms higher than the first order in the Taylor series expansion of the expenditure function) and using the Slutsky equation for

[6] Following Guerra and Sancho (2018) we use as numeraire the world price of the commodity (wheat or cotton), estimated as the average of the local sample prices weighted by share of consumption.

consumer demand to determine the substitution effects, the per capita compensating variation in market j is:

$$CV_j=-\Sigma_i(D_{ij}/L_i)dP_{ij}-0.5\Sigma_i\Sigma_k(\beta_{ijk}+D_{kj}\delta_{ij}/L_j)dP_{ij}dP_{kj}+dY_j \qquad 5)$$

Where the notation is as before. Summing up, we can estimate the effect on trade and welfare of changes in trade costs between each year and the baseline one, given demand and supply in the baseline year and the relevant parameters (own-price elasticities of supply and own-price, cross-price and income elasticities of demand). The next Section deals with these parameters.

5) The estimate of British demand elasticities

We estimate the parameters of British demand with a linear approximation of the AIDS (LA/AIDS) model developed by Deaton and Muellbauer (1980). We prefer the linear approximation to the original version because it outperforms the true AIDS model, especially when the prices are highly correlated, as is the case here (Alston et al 1994). In particular, we estimate the following two equations, for wheat:

$$w_{it}=\alpha_i+\Sigma_j\gamma_{ij}lnp_{jt}+\beta_i\,ln(x_t/P_t)+\delta_{1i}\,t+u_{it} \qquad (6a)$$

and cotton:

$$w_{it}=\alpha_i+\Sigma_j\gamma_{ij}lnp_{jt}+\beta_i\,ln(x_t/P_t)+D_i\,CW_t+\delta_{1i}\,t+\delta_{2i}\,t^2+u_{it} \qquad (6b)$$

Where w_{it} is the market share of the good of quality i at time t, p_{jt} is the price of the good of quality j at time t, with $i, j=1$ to 3 for both wheat and cotton, x_t is the total expenditure on the good (wheat or cotton), and $ln(P_t)$ is the weighted average of the natural logarithm of the prices of the various qualities of the good, where the weights are determined by the quantities consumed, as usual in the LA/AIDS model. The time trends capture the changes in market shares determined by the evolution of comparative advantage and technology. For cotton, we add a quadratic term, since trends are clearly non-linear (see the Appendix) and a dummy (CW_t) to control for the shock of the American Civil War (1861-1865), which temporarily dried up supplies from the US, by far the largest producer. With the coefficients from equations 6a and 6b, it is

straightforward to compute the demand elasticities (Green and Alston 1990).[7]

We estimate equation 6a for wheat, following the standard approach, with a seemingly unrelated regressions specification. We prefer to estimate equation 6b for cotton with a fractional multi-logit model because the market shares are often close to the boundaries (0 or 1). This specification takes into account that the dependent variables are fractions summing up to one (Buis 2017). We consider three different qualities of cotton, American, Indian and Egyptian (to which we assimilate the equally high-quality Brazilian variety), and as many for wheat, domestic, and high and low quality imports. We define imports of high (low) quality if the average value in 1913 was higher (lower) than the median one.[8] Eastern European grain was decidedly inferior, while American wheat improved steadily and in 1913 was comparable to the domestic one (Federico and Persson 2007, Ejrnæs et al. 2008). The Wald and likelihood ratio tests accept the hypotheses of homogeneity and symmetry for wheat, but not for cotton.[9] These rejections are common in the study of cotton demand elasticities and the imposition of restrictions causes bias when they are rejected (Chang and Nguyen 2002: 106-107). We therefore use an unrestricted model for cotton. We convert the estimates of expenditure elasticities by quality from the model into income elasticities by multiplying them by the aggregated income elasticity of cotton or wheat since, by definition, the expenditure is unit elastic with respect to the quantity demanded.[10]

Table 3 reports the results, as well as the other parameters we use for the estimation of our model. We extract supply elasticities from an extensive review of the literature (Appendix). We use the British demand elasticities estimated with equations 6a) and 6b) for other consumer countries as well. As as a sensitivity test, in all the following sections we report in brackets also results with elasticities one third higher or one third lower than our baseline parameters.

[7] Since for cotton we rely on the fractional multi-logit model, we use the average marginal effects of the natural logs of prices and real expenditure on market shares.
[8] We obtain average values with a panel regression on origin and year dummies.
[9] Carried out on a simple SUR specification.
[10] Formally, $dln(D_i)/dln(Y)=[dln(D_i)/dln(x)][dln(x)/dln(D)][dln(D)/dln(Y)]= [dln(D_i)/dln(x)][dln(D)/dln(Y)]$ since $dln(x)/dln(D)=dln(pD)/dln(D)=[d(PD)/dD][D/PD]=P/P=1$, where, as before, *D* is the demand (of quality of *i* when subscripted and total of th(croe good otherwise), *Y* is the income per capita, *P* is the price of the good and *x* is the expenditure on the good.

Table 3: Elasticity parameters

a) Wheat

Origin	Destination	Demand Own-price	Cross-price by origin UK	W. Europe	N. America	E. Europe	Income	Supply Own-price
N. America	N. America	-0.5					0.70	0.75
E. Europe	E. Europe	-0.5					0.50	0.75
UK	UK	-0.5			0.28	-0.23	0.96	0.75
N. America	UK	-2.36	0.94			1.36	0.04	
E. Europe	UK	-3.07	-0.82		1.96		1.35	
W. Europe	W. Europe	-1.41			0.28	-0.23	0.96	0.75
N. America	W. Europe	-2.36		0.94		1.36	0.04	
E. Europe	W. Europe	-3.07		-0.82	1.96		1.35	

b) Cotton

Origin	Destination	Demand Own-price	Cross-price by origin India	US	Egypt	Income	Supply Own-price
India	India	-0.8				0.50	0.50
US	US	-0.65				0.50	1.00
Egypt	Egypt	-0.8				0.50	0.50
India	Europe	-0.44		1.02	-0.5	0.46	
US	Europe	-1.85	-0.03		0.18	0.64	
Egypt	Europe	-1.34	-0.13	2.05		0.12	
India	Japan	-0.44		1.02		0.46	
US	Japan	-1.85	-0.03			0.64	

Sources: see the text and the Appendix

The results for cotton are very close to the estimates by Irwin (2003) for the early part of the 19th century (1831-1860): the coefficient of correlation between the two set of estimates is as high as 0.95.[11] Indian cotton was a shorter staple than the American variety, and thus not wholly suitable for all spinning technologies, most notably ring spinning (Panza 2013: 863). Consequently, its demand was inelastic with respect to its own price and it was a poor substitute of US cotton, as shown by the negative and very low cross-elasticities of demand for American and Egyptian cotton to changes in prices of Indian cotton (-0.03 and -0.13 respectively). Vice-versa, the demand for Indian cotton was responsive to changes in the price of US cotton (cross elasticity 1.02). As it is well-known, the United Kingdom turned to India to substitute American cotton at the time of

[11] The absolute values are substantially lower than the comparable parameters for silk, which was a luxury good (Federico 1996)

the US civil war. Indian cotton was a complement rather than a substitute for the (top-quality) Egyptian cotton, while the (fairly good) American cotton was a substitute.

Our estimates of elasticities of demand for wheat are consistent with the results of studies with an approach similar to ours.[12] The wheat cross-price elasticities (like those of cotton) suggest a lower level of substitutability between qualities than the elasticities of substitution usually assumed in the literature (e.g. Jacks et al 2011: 189). In fact, the demand for high quality British wheat turns out to be inelastic with respect to the price of imports. The low-quality Eastern European wheat shows up as a complement for British wheat, with negatively signed cross-price elasticities across the two varieties. The British land-owners may have overstated the threat posed by foreign competition in the wake of the repeal of the Corn Laws in 1846. The market share of imported wheat increased only slowly: in the 1850s over 80 per cent of the wheat consumed in the UK was still locally produced; it is only in the 1880s that the market share of imported wheat became larger than that of local wheat (Appendix).

6) The results: trade

The multi-market model produces separate estimates of the effect of price convergence on each bilateral flow (e.g. from North America to Western Europe). We sum them up to get aggregate estimates by producing area (North America to World), by consuming area (World to Western Europe) or for the whole trade (World to World). We report the results as ratios to actual flows in Table 4.

Table 4
The effect of market integration: predicted over actual change in trade (%)
a) wheat

From	to	1815-1913	1830-1913	1870-1913
North America	UK	70.61	59.82	34.11
		(47, 100)	(40, 90)	(22, 52)
North America	Western Europe	6.7	0.80	-14.45
		(5, 10)	(0, 1)	(-10, -21)
North America	World	39.43	30.99	4.08

[12] Our averages (-2.28 own-price elasticity and 0.58 cross-price elasticity) compare well with the same averages by Wilson and Gallagher (1990) and Mohanty and Peterson (1999) - respectively -1.58 and 0.48 and -1.78 and 0.47. Mohanty and Peterson (1999) also find a complementary relationship between high and low qualities of wheat in the European Union, as millers blend them to obtain desired characteristics.

		(26, 56)	(20, 47)	(2, 6)
Eastern Europe	UK	101.32	97.34	119.69
		(87, 101)	(65, 146)	(79, 180)
Eastern Europe	Western Europe	37.12	13.83	-4.32
		(24, 57)	(9, 21)	(-3, -6)
Eastern Europe	World	44.65	23.75	1.63
		(31, 62)	(16, 36)	(1, 3)
World	UK	80.09	71.33	50.58
		(60, 100)	(47, 107)	(33, 76)
World	Western Europe	30.41	10.89	-6.91
		(20, 47)	(7, 16)	(-5, -10)
World	World	42.88	26.24	2.47
		(30, 60)	(17, 40)	(1, 4)

b) cotton

From	to	1816-1913	1830-1913	1870-1913
India	Europe	30.29	-5.76	-9.96
		(17, 50)	(-6, -2)	(17, -50)
India	Japan	100	100	100
		(100, 100)	(100, 100)	(100, 100)
India	World	65.33	52.33	117.24
		(59, 75)	(47, 48)	(113, 123)
US	Europe	64.54	3.43	-3.41
		(42, 99)	(1, 7)	(-4, -3)
US	Japan	100.00	100.00	100.00
		(100, 100)	(100, 100)	(100, 100)
US	World	66.08	7.80	2.44
		(44, 99)	(5, 11)	(2, 3)
Egypt	Europe	31.07	5.28	7.20
		(21, 47)	(4, 8)	(5, 11)
Egypt	World	31.07	5.28	7.20
		(21, 47)	(4, 8)	(5, 11)
World	Europe	58.04	2.98	-1.99
		(38, 89)	(1, 6)	(-3, 0)
World	Japan	100.00	100.00	100.00
		(100, 100)	(100, 100)	(100, 100)
World	World	62.49	13.77	13.14
		(44, 90)	(12, 17)	(12, 15)

Sources: see the text and Appendix

Notes: The figures in parentheses use two thirds and three halves of the elasticities in the baseline specification.

For instance, for our baseline estimate, the collapse in costs of exporting wheat from North America to the United Kingdom from 7.59 pounds per ton in 1815 to 0.05 in 1913 increased exports by about 1.32 million tons. They increased by 1.87 million tons, and thus price convergence explains more than two thirds of the growth over the whole period. The rest of the increase in imports was determined by the increase in

population of the Kingdom, from 18 to 45 million people, and changes in comparative advantage, as the UK specialized in the exports of industrial products and coal.

The table highlights three main points. First and foremost, in the long 19th century, price convergence did matter a lot for the growth of world trade, accounting for almost two thirds of the increase for cotton and over a third for wheat. Second, most of this effect showed in the early post-Waterloo years for cotton, with the notable exception of Japan, and in the mid-19th century for wheat. This is hardly surprising, given the time pattern of convergence (Figure 2) and of the effect of policies on trade costs (Section Three), but it calls for separate analysis for wheat and cotton. Third, changing elasticities within a plausible range (figures in brackets), does not affect qualitatively the results. The sign of the effect changes only for Indian exports to Europe since 1870: the higher elasticity yields a decline, as in reality, rather than a rise, but the absolute difference is really minimal (the predicted change being a decline by ca 18000 tons vs. an increase by 4000 in the baseline case).

The interpretation of changes in American cotton exports is straightforward. The United States dominated the world market for cotton and trade costs from the United States to Europe fell by four fifths in second half of the 1810s, from 54 £/ton to 10-15 £/ton. According to our model, this massive decline explains about a half of the total increase of cotton exports in long run from our three countries. Since the early 1820s, trade costs from the United States to Great Britain declined little, and the contribution to increase in trade was correspondingly modest. One has to infer that most of the growth in exports was driven by the shift in demand, which, in the case of Great Britain, included a large foreign component. The case of Egypt was broadly similar, while India was different. First, unlike in other cases, trade costs were higher in 1870 than in 1830, possibly because the market had not yet returned to normal after the bonanza of the years of the American Civil War. Second, Indian exports were affected more than those of the other exporters by the opening of Japan, which by 1913 accounted for a tenth of the world trade of raw cotton (Table 1). Under our assumption of prohibitive trade costs in 1816 and 1870, by construction, market integration accounts for all the increase in trade from all exporters. However, India was better located than the United

States to supply the Japanese market and its low quality but cheap cotton was suited to Japanese coarse production more than to the European one. The attraction of the Japanese market was so great as to cause Indian exports to Europe to decrease by about a tenth, while, given the substantial decline in costs, the model predicts a small increase in trade (hence the negative sign in Table 4).

Our estimate shows the powerful impact of different trade policies on exports of wheat. As said, the abolition of Corn Laws had a powerful effect on American exports to the United Kingdom. The effect of liberalization was even greater for imports of Eastern European wheat, which had to compete on price to overcome the inferior quality. In fact, all their increase was determined by the fall in trade costs. In contrast, the contribution of market integration to the growth of imports into Western Europe was much smaller since 1815 (ca 30% considering both North American and Eastern European corn) and negative since 1870 (-7%). This is clearly the outcome of the return to protection in the 1880s. In 1913, importing wheat from North America and from Eastern Europe cost 41% and 31% more than in 1870, and only 41% or 47% less than in 1815. The combination of rising trade costs into Western Europe and falling into the United Kingdom shifted exports towards the latter. The model predicts a decrease of imports into Western Europe by about half a million tons from 1870 to 1913, while they increased by almost 7 million tons.

7) The results: welfare

As expected, market integration benefitted both producers and consumers (Table 5).

Table 5
The effect of market integration: welfare (% GDP)
a) wheat

	1815-1913	1830-1913	1870-1913
Eastern Europe	0.100	0.066	0.011
	(0.1, 0.088)	(0.072, 0.06)	(0.014, 0.008)
North America	0.018	0.015	0.004
	(0.020, 0.015)	(0.017, 0.013)	(0.005, 0.003)
UK	0.500	0.400	0.200

	(0.6, 0.3)	(0.5, 0.3)	(0.2, 0.2)
Western Europe	0.200	0.076	-0.100
	(0.2, 0.2)	(0.076, 0.075)	(-0.1, -0.1)

b) cotton

	1816-1913	1830-1913	1870-1913
Egypt	5.000	0.900	1.000
	(5.3, 4.6)	(1, 0.9)	(1, 1)
India	0.400	0.300	0.300
	(0.5, 0.3)	(0.4, 0.2)	(0.5, 0.2)
US	0.400	0.091	0.042
	(0.5, 0.3)	(0.1, 0.079)	(0.057, 0.0314)
Europe	0.500	0.037	-0.009
	(0.5, 0.4)	(0.017, 0.049)	(-0.029, 0.004)
Japan	4.200	4.200	4.200
	(6.2, 2.8)	(6.2, 2.8)	(6.2, 2.8)

Sources: see the text and Appendix.
Notes: The figures in parentheses use two thirds and three halves of the elasticities in the baseline specification.

The results are robust to changes in elasticities, even more than those for trade (Table 4). In one case only, cotton in Europe in 1870-1913, the sign of the effect depends on the parameter, but the absolute range is anyway very narrow. Unsurprisingly, given the changes in trade costs (Table 2), gains were much larger in the 'long 19th century' than during the 'first globalization' since 1870. The gains for Japan are equal in all periods by construction, as we assume it opened the market only after 1870.

There are only two exceptions to the generalization that countries gained from market integration, both for consumers since 1870. The losses for European cotton importers are minimal (as the change in trade costs) and, as said, not robust to changes in elasticities. The losses for wheat importers in Western Europe are rather more substantive and a self-inflicted wound from the protectionist trade policy.

Table 6
Shares of wheat and cotton on GDP and trade in 1913

	Products	Openness	% Trade	% GDP	% Consumption
USA	Wheat and Cotton	11.6	15.5	3.1	1.9
UK	Wheat	50.4	3.7	0.3	2.2
India	Cotton	20.0	9.0	2.8	1.0
Japan	Cotton	28.5	15.3	0.0	4.4
Russia	Wheat	14.3	7.1	8.0	7.4
Egypt	Cotton	53.7	47.6	24.3	2.5
W. Europe	Wheat	37.6	3.5	1.9	3.8

Europe	Cotton	35.7	4.7	0.0	1.7

Source: GDP and total trade Federico- Tena (2017a); trade cotton and wheat Table 1; production of cotton and wheat in India and the United States from Chilosi and Federico (2016), in Egypt from Owen (1969) in Japan from Otsuka et al (1988); gross output of wheat in Russia from Falkus (1968); gross output of wheat in other European countries estimated as total production Mitchell (1998) times prices in capital cities or representative cities from Federico-Schulze-Volckart (2018); Value Added in wheat production is estimated as gross output times the country ratio VA/output ratios from Federico (2004).

The size of gains differs widely across areas, depending on the openness of the country and the share of wheat and cotton in production and consumption (Table 6). The United States gained little (at most half a percentage point in the long run) because the country traded little and wheat and cotton accounted for a small proportion of its GDP, even if they still accounted for a relatively high share of trade in 1913. Russia was barely more open than the United States, but it was still an agricultural country and wheat loomed large in its GDP and exports. Of course, small, open producers gained more. Thus Egypt, who exported almost only cotton and consumed only a small share of its cotton production, gained handsomely. European countries were quite open, but by 1913 wheat and (raw) cotton accounted for a small share of their trade and consumption.

By definition, our analysis can capture only a part of total gains from integration. It does not include the gains from increasing market efficiency, the general equilibrium effects of price convergence and, above all, it does not cover the gains from integration of markets for other products. In 1913 other products accounted for a minimum of a half of trade for Egypt to over 95% for European consuming countries. As sais before, the most important improvement to market functioning in the 19th century was the telegraph. Steinwender (2018 Tab. 13) and Ejrnæs and Persson (2010 tab 3) have estimated the effects on American and British GDP of the lay-out of the first transatlantic cable between the United States and Great Britain in 1866. The gains (respectively 0.0073% of US GDP for cotton and 0.0015% of US GDP for wheat) are an order of magnitude smaller than our estimates and thus add very little to the overall benefits.[13]

[13] Both estimate a range of gains at current prices, respectively 1.7 to 5.4 million $ in 1866 (with a baseline value of 3.5) for cotton and from 0.6 to 2.1 million in 1883-1889 for wheat. We compute the corresponding shares on GDP at 1913 prices by deducting 10% to convert in VA (Federico 2004) and by deflating with UK deflator share on GDP 1913. We quote in the text the lower-bound estimate by Ejrnæs and Persson (2004) because they are obtained with the parameters (demand elasticity -0.5 and supply elasticity 0.5) quite close to ours. The upper bound gains are 0.0056% of American GDP.

There is one only estimate of aggregate welfare gains from liberalization of trade for a single product, the Computable General Equilibrium model on the impact of the British Corn Laws by Williamson (1990). Protection reduced the UK's GDP of the 1840s by 1.5%, which corresponds to a 0.35% of the (4.3 times bigger) 1913 GDP. The two estimates are thus very close, especially if one take into account the additional gains from the decline in transportation costs (about a third in the same period). This suggests that in this case general equilibrium effects were not that large.

In theory, one might estimate total gains by rescaling our product estimates according to the (inverse of the) share of the covered products on total trade. For instance, using wheat as a yardstick total British gains would be around a tenth of GDP (0.5/0.037), corresponding to about a sixth of the UK's economic growth in the 'long 19th century'. However, this computation would ignore differences across products in levels and changes in trade costs, as well as in demand and supply parameters. For instance, the price of British coal, a very bulky product, was 57% higher in Genoa than in London in 1870 and 40% higher in 1913 (compare with Figure 2).[14] It is however possible to compare our estimates with other estimates of aggregate gains from trade. Bernhofen and Brown (2005) compute Japanese consumers' welfare gains from opening to world trade in the 1850s to be 8-9% of GDP, which corresponds to 3% of 1913 GDP. The gains were so low because they are obtained comparing the prices in the 1850s and in the 1870s, when transaction costs were still very high. Federico and Tena (2017a) estimate gains from moving to autarchy to free trade with the sufficient statistics by Arkolakis et al's (2012), assuming the 'standard' value of 3.78 for the elasticity of trade to trade costs. One would expect total gains to be larger than our estimates for each single product and, a fortiori, for total trade. This is indeed the case for the results for 1913: 1.41% of GDP in the United States, 7.53% in Canada, 2.31% in India, 9.08% in the United Kingdom, 7.73% in Egypt and 4.40% in Japan. These figures are however sensitive to the choice of the elasticity (the higher elasticity, the lower gains) and the baseline statistics by Arkolakis et al (2012) underestimates total gains (Costinot and Rodriguez-Clare 2016).

[14] The figures are obtained from a Hodrick-Prescott filtered series of the ratio between prices in Genoa (Felloni 1958 and Cianci 1933) and British export prices (Mitchell 1988: 748-749).

The gains from international market integration for large countries such as the United States or India are smaller than gains from domestic integration. The partial-equilibrium estimate by Federico and Sharp (2013) suggests that the combination of constant nominal railroad rates and falling prices inflicted substantial losses to the American economy during the Great Depression, ranging, according to hypotheses on specialization of output and to assumption about elasticities, from 0.55% to 3.1%. Donaldson and Hornbeck (2016) estimate that the static welfare gains from the building of railroads in the US amounted to 3.4% of its GDP if the alternative was, à la Fogel, the construction of canals and 5.3% if the alternative was no transportation. In another paper, Donaldson and Costinot (2016) compare the contribution of market integration and of technical progress to the growth of agricultural output in the US from 1887 to 1997. Market integration increased output by 62% from 1887 to 1920 and by 55% from 1954 to 1997 (vs. respectively 30% and 70% for technical progress). Market integration accounted for about a tenth of total growth in American GDP before 1920.[15] Last but not least, Donaldson (2018) shows that in India the establishment of a railway connection increased agricultural income by 16% on average in the period 1870-1930 (equivalent about 8% of GDP) and that about half of this increase is explained by the additional trade caused by the railway. In the absence of estimates on the gains from domestic integration we cannot make the same comparison for small open economies. However, our estimates suggest that during the first globalization for small open economies the gains from international integration were comparable to domestic gains for large economies, like the US.

8) Conclusions

Our multi-market analysis exercise highlights two main points. First, the effects on trade were, predictably, large and concentrated in the period(s) of falling trade costs in the early part of the 19th century. Market integration accounted for as much as 60% of the growth of cotton trade and nearly a third of the growth of wheat trade over the long nineteenth century. The effects on welfare were timed similarly,

[15] Agriculture produced about 27% of GDP in 1890 and the additional gross output corresponded to about 18% of GDP (assuming a GDP/output ratio around 0.90).

and were fairly small for large countries but substantial for small and open economies. Furthermore, it can be argued that static welfare analyses are insufficient to capture all gains from integration.

Second, the effects of market integration depended mostly on political decisions rather than on technical progress. As recently stressed by de Bromehead et al (2019) trade policy mattered. In the cotton market, by far the biggest gains were made in the aftermath of 1815 partly as a result of the resumption of political stability after Waterloo, but above all for the end of trading monopolies and the liberalization of Egyptian cotton exports. Henceforth – with the only exception of Japan, which was forcibly opened to trade in 1853 – the effects of market integration were rather modest. The return of protectionism in Western Europe in the later nineteenth century cost its consumers dearly. Over the very long-run, their gains much lower than those enjoyed by British consumers. In the classical age of the first globalization (1870-1913) protectionism hindered the growth of wheat trade and led to welfare losses for Western European consumers, more than offsetting the effects of the growth of the telegraph and the steamship.

References

Alexander, P.D. and Keay, I., 2018. A general equilibrium analysis of Canada's national policy. *Explorations in Economic History*, 68:1-15.

Alston, J.M., Foster, K.A. and Green, R.D. 1994. Estimating elasticities with the linear approximate almost ideal demand system: some Monte Carlo results. *The Review of Economics and Statistics*, 76(2): 351-356.

Arulpragasam, J. and Conway, P., 2003. Partial equilibrium multimarket analysis. In Bourguignon, F. and Pereira da Silva, L. A. (eds.) *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*. New York and Washington: World Bank and Oxford University Press, pp. 261-77.

Bacon L.B. and Schloemer F.C, 1940. *World trade in agricultural products*, Rome:FAO

Boadway, R.W. and Bruce, N., 1984. *Welfare Economics*. New York: B. Blackwell.

Buis, M. 2017. FMLOGIT: Stata module fitting a fractional multinomial logit model by quasi maximum likelihood. Available at: https://econpapers.repec.org/software/bocbocode/s456976.htm (consulted in July 2018).

Bernhofen, D.M. and Brown, J.C., 2005. An empirical assessment of the comparative advantage gains from trade: evidence from Japan. *American Economic Review*, *95*(1), pp.208-225.

Chang, H.S. and Nguyen, C., 2002. Elasticity of demand for Australian cotton in Japan. *Australian Journal of Agricultural and Resource Economics*, 46: 99-113.

Chilosi, D. and Federico, G., 2015. Early globalizations: the integration of Asia in the world economy, 1800-

1938' *Explorations in economic history* 57: 1-18

Chilosi, D. and Federico G., 2016. The effects of market integration: trade and welfare during the first globalization, 1815-1913 LSE Economic History WP 238/2016

Costinot, A. and Donaldson, D., 2016. **'**How large are the gains from economic integration? Theory and evidence from US agriculture, 1880-1997' NBER WP 22496.

Costinot A. and Rodriguez-Clare, A. 2014**.** Trade theory with numbers: quantifying the consequences of globalization in Gopinath, G.. Helpman E. and Rogoff, K. (eds) *Handbook of international economics* vol 4 Amsterdam and New York:Elsevier North Holland pp. 197-261

De Bromhead, A., Fernihough, A., Lampe, M. and O'Rourke, K.H., 2019. When Britain Turned Inward: The Impact of Interwar British Protection. *American Economic Review*, *109*(2), pp.325-52.

De Zwart, P., 2016. Globalization in the Early Modern Era: New Evidence from the Dutch-Asiatic Trade, c. 1600–1800. *The Journal of Economic History*, *76*(2), pp.520-558.

Deaton, A. and Muellbauer, J., 1980. An almost ideal demand system. *The American Economic Review*, 70: 312-326.

Donaldson, D., 2018. 'Railroads of the Raj: estimating the impact of transportation infrastructure' *American Economic Review* 108:899-934.

Donaldson D. and Hornbeck R., 2016. 'Railroads and American economic growth: a 'market access' approach' *Quarterly Journal of Economics 131:* 799-858

Ejrnæs, M. and Persson, K.G., 2010. 'The gains from improved market efficiency: trade before and after the transatlantic telegraph'. *European Review of Economic history* 14: 361-381.

Falkus, M. E. 1968. "Russia's National Income, 1913: a Revaluation." *Economica* 35: 52-73

Federico, G., 1996. 'An econometric model of world silk production 1870-1914' *Explorations in economic history*, 33:250-274

Federico G. 2004 The growth of world agricultural production, 1800-1938, *Research in economic history*, 22: 125-181

Federico, G., 2012. 'How much do we know about market integration in Europe?' *Economic history review,* 65: 470-497

Federico, G. forthcoming 'Market integration' in Claude Diebolt and Mike Haupert (eds.) *Handbook of cliometrics* 2nd editions, Berlin-Heidelberg:Springer

Federico, G. and Sharp, P., 2013. 'The Cost of Railroad Regulation: The Disintegration of American Agricultural Markets in the Interwar Period' *Economic history review,* 66:1017-1038.

Federico, G. and Tena-Junguito, A., 2017a. 'A tale of two globalizations: gains from trade and openness 1800-2010'. *Review of World Economics:* 601-626

Federico, G. and Tena-Junguito A. 2017b. Lewis revisited: tropical polities competing on the world market 1830-1938', *Economic history review* 70:1244-1267

Federico, G. and Tena-Junguito, A., 2019 World trade, 1800-1938: a new synthesis' *Revista de Historia Economica/Journal of Iberian and Latin Economic history,* 37:1-33.

Federico, G. Schulze, M.S. and Volckart, O.J. 2018. European Goods Market Integration in the Very Long Run: From the Black Death to the First World War LSE Economic History WP 277/2018

Feenstra, R. C., 1995, Estimating the effects of trade policy. Gene Grossman, and Kenneth S. Rogoff (eds) *Handbook of International Economics*, vol. 3, Amsterdam-New York: Elsevier North-Holland pp-1553-95.

Felloni G. 1957 'I prezzi delle merci nel portofranco e nella borsa merci di Genova dal 1828 al 1890', *Archivio Economico dell'Unificazione Italiana*, Serie I, vol 6 fasc 1

Fouquin, M. and Hugot, J., 2014. Trade globalization 1827-2012. When did trade costs start to fall? CEPII Document de travail 2014

Green, R. and Alston, J.M., 1990. Elasticities in AIDS models. *American Journal of Agricultural Economics*, 72: 442-445.

Harley, C.K., 1988. Ocean freight rates and productivity, 1740–1913: the primacy of mechanical invention reaffirmed. *The Journal of Economic History*, 48:851-876.

Harley, C.K. 1989 Coal exports and British Shipping, 1850-1913. *Explorations in economic history* 26:311-338.

Hoag C., 2006. 'The Atlantic cable and capital market information flows. *Journal of Economic History* 66: 342-353

Hufbauer, G., Wada, E. and Warren, T., 2002. *The benefits of price convergence: speculative computations* Washington: Institute for international economics.

Hummels, D., 2007. Transportation costs and international trade in the second era of globalization. *Journal of Economic Perspectives*, *21:*131-154.

Irwin, D., 2003. The Optimal Tax on Antebellum Cotton Exports. *Journal of International Economics* 60: 275-291.

Jacks, D.S., Meissner, C.M. and Novy, D., 2010. Trade costs in the first wave of globalization. *Explorations in Economic History*, *47*(2), pp.127-141.

Jacks, D.S., Meissner, C.M. and Novy, D., 2011. Trade booms, trade busts, and trade costs. *Journal of International Economics*, 83:185-201.

Kemble, J.H., 1940. The Big Four at Sea: The History of the Occidental and Oriental Steamship Company. *The Huntington Library Quarterly*, 3: 339-357.

Klasing, M.J. and Milionis, P., 2014. Quantifying the evolution of world trade, 1870–1949. *Journal of International Economics*, *92*(1), pp.185-197.

Harrison, M. and Markevich, A. 2011. Great War, civil war and recovery: Russia's national income, 1913 to 1928. *Journal of Economic History* 71:672-703.

Mitchell B (1998) European historical statistics….

Minot, N. and Goletti, F., 1998. Export liberalization and household welfare: the case of rice in Vietnam. *American Journal of Agricultural Economics*, 80:738-749.

Mohanty, S. and Peterson, E.W.F., 1999. Estimation of demand for wheat by classes for the United States and the European Union. *Agricultural and Resource Economics Review*, 28:158-168.

O'Rourke, K.H., 1997. The European grain invasion, 1870–1913. *The Journal of Economic History*, *57*(4), pp.775-801.

O'Rourke, K. and Williamson, J.G., 1994. Late nineteenth-century anglo-american factor price convergence: were Heckscher and Ohlin right?. *Journal of economic history,* 54: 892-916.

O'Rourke, K.H. and Williamson, J.G., 2002. When did globalisation begin?. *European Review of Economic History*, *6*(1), pp.23-50.

Otsuka, K. Ranis, G., Saxonhouse, G. 1988. *Comparative Technology Choice in Development: the Indian and Japanese Cotton Textile Industries*. Basingstoke and London: Macmillan.

Panza, Laura 2013 'Globalization and the Near East: A study of cotton market integration in Egypt and Western Anatolia' *Journal of Economic History* 73, pp. 847-872

Panza Laura and Jeffrey G. Williamson, 2015. **'**Did Muhammad Ali foster industrialization in early nineteenth century Egypt?' *Economic History Review* 68, pp.79-100

Richards Alan 1982 *Egypt's agricultural development, 1800-1980.Technical and social change*, Westview Press, Boulder.

Robinson, Sherman; Mason d'Croz, Daniel; Islam, Shahnila; Sulser, Timothy B.; Robertson, Richard D.; Zhu, Tingju; Gueneau, Arthur; Pitois, Gauthier; and Rosegrant, Mark W. 2015. The International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model description for version 3. IFPRI Discussion Paper 1483.

Steinwender, C. 2018. Real effects of information frictions: when the States and the Kingdom became United' *American Economic Review* 108: 657-96

Stern R., 1960. A century of food exports *Kyklos* 13, pp.45-61

Thomas R.E.1930. *Stowage* Glasgow: Brown-Ferguson

Williamson, J. G., 1990. The impact of the corn laws just prior to repeal. *Explorations in Economic History* 27, 123-156.

Wilson, W.W. and Gallagher, P., 1990. Quality differences and price responsiveness of wheat class demands. *Western Journal of Agricultural Economics*, 15(2), pp.254-264.

Yasuba, Y., 1978. Freight rates and productivity in Ocean transportation for Japan, 1875-1943. *Explorations in Economic History*, *15*(1), pp.11-39.

Yates Lamartine Forty years of foreign trade 1959 tab. A 17