THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

Economic History Working Papers No: 183/2013

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DEPARTMENT OF ECONOMIC HISTORY
WORKING PAPERS
NO. 183 - NOVEMBER 2013

Asian Globalisations: Market Integration, trade and economic growth, 1800-1938

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Abstract

This paper contributes to the debate on globalization and the great divergence with a comprehensive analysis of trends, causes and effects of the integration of Asia in the world market from 1800 to the eve of World War Two, based on a newly compiled data-set. The analysis finds that: most price convergence occurred before 1870, with only little disintegration in the inter-war years; market integration was determined to a large extent by the fall of Western trading monopolies; it implied significant static welfare gains and emerges as a major cause of substantial improvements in the terms of trade.

JEL Codes: F1, F6, N7, O4.

Keywords: globalization; market integration; international trade;economic growth; Asia; nineteenth century

1) Introduction

Asia and Europe had been trading at least since the times of the Roman Empire (Findlay and O'Rourke, 2007), but the Early Modern era featured a massive leap forward. Between the 1510s and the 1780s, spice exports to Europe grew at 1.1 per cent yearly –, i.e. 25 times over the whole period (De Vries, 2010). Yet, as O'Rourke and Williamson (2002) argue, price dynamics implied few benefits to European consumers and Asian producers. Most gains accrued to the shareholders of Western trading companies, such as the *Vereenigde Oost-Indische Compagnie* (VOC) for the Dutch East Indies (nowadays Indonesia) and the East India Company (EIC) for India, which ruled the Asian countries and monopolized trade. The situation changed dramatically in the early 19th century. The monopolies were slowly dismantled and China and later Japan were opened up to Western traders. Costs of sea transportation declined and the transfer of information was greatly accelerated by the introduction of the telegraph. Exports from Asian countries boomed throughout the 19th and early 20th centuries, and the share of European imports increased. However, the economic performance of the main Asian countries was far from impressive. From 1850 to 1913, GDP per capita fell by 8 per cent in China and grew only by 13 per cent in India. Admittedly, it increased by 80 per cent in the Dutch East Indies and doubled in Japan, but this was not sufficient to catch up with the two world leaders, the United Kingdom (increase by 111 per cent in the same period) and the United States (increase by 187 per cent). On the eve of World War One, the GDP per capita of Japan was 28.1 per cent of the British one, that of Indonesia 17.7 per cent, that of India 13.7 per cent, and that of China 11.2 per cent (Maddison Project, 2013). Was the growth of trade beneficial but insufficient for growth or was it harmful?

This question was at the center of political discourse about colonial rule in the 19th century and early 20th century and it shaped the early debate in economic history of British India. In the first comprehensive economic history of India under British rule, Romesh Dutt (1969, vol. 1: 302) wrote that "the manufacturing power of the [Indian] people was stamped out by protection against her industries and then free trade was forced on her so as to prevent a revival". This "left-nationalist" paradigm prevailed until the 1980s, but it was later questioned. Tomlinson (1993: 51-66) has singled out exports of agricultural products as the main stimulus to growth in an otherwise stagnant economy from the 1860s to the onset of World War One. Subsequent revisionist studies have questioned that there was de-industrialization, highlighting differences within traditional industries from the early 19th

century (Roy, 2000; Ray, 2011). The case of Dutch East Indies is less controversial. On the one hand, there is no doubt that in the 1830s and 1840s, the Dutch government ruthlessly exploited Javanese peasants, forcing them to produce cash crops for exports at prices well below world market. On the other hand, in the second half of the 19th century the production of cash crops for export, by large estates but also by small-holding farmers, was by far the most dynamic sector of the economy (van der Eng, 1996; Booth, 1988: 238-247). Foreign trade played a marginal role in China, for the effect of restrictions by the imperial government, political turmoil of the mid-19th century, but above all for the sheer size of the Chinese economy (Feuerwerker, 1980, 1983). The contact with the West stimulated modernization and brought some useful import of technology (Brandt et al., 2013), but the macro-economic effect of export was sizeable only in the fairly limited areas of production of exportables, such as Chekiang and Guangdong for silk (Federico, 1997) or Manchuria for soya beans. Only in Japan exports are deemed the key source of growth. They grew faster than domestic demand and Japan successfully changed its specialization from silk to textile manufactures (Minami, 1993).

Most of the works quoted in this very short survey date to the 1980s and 1990s. Indeed, the issues of trade and trade policy have been sidelined in the recent debate among specialist in Asian economic history (Ma, 2004; Roy, 2004). Ironically, this happened just when Asia was becoming arguably the hottest topic in world economic history, following the publication of *The Great Divergence* by Ken Pomeranz (2000). There, he claimed that as late as 1800 some areas in China, such as the region around Shanghai, were as advanced as England. Some years later Parthasarathi (2011) made a similar claim for India. Yet, neither India nor China underwent an industrial revolution and in the 19th century stagnated or declined. The two authors explain this divergence with different mechanisms, which are both related to foreign trade. Pomeranz (2000) argues that China was damaged by the lack of opportunities to trade. Unlike the United Kingdom it had no access to overseas colonies and thus it had to allocate all its resources to feed its population. Parthasarathi (2011) resurrects the "left-nationalist" paradigm, blaming British protectionism at home, and free trade and the lack of investment in education in India. The most adventurous statements about the development of Asian countries have not been confirmed: all estimates show that the GDP gap with the United Kingdom (or Netherlands) was already wide at the beginning of the 19th century (Allen, 2007; van Zanden, 2003; Broadberry and Gupta, 2006; Allen et al., 2011).

Still, this fact does not necessarily impinge on the interpretation of the role of foreign trade in the economic growth (or lack of it) in Asia. Thus, in a series of papers and a book, Williamson (2008, 2011, 2012) has argued that in the first half of the 19th century the periphery of the world suffered a serious case of curse of primary products (cf. Sachs and Warner, 2001). The spectacular improvement in the terms of trade of most peripheral countries, including Indonesia and (to a lesser extent) India (but not China), induced them to specialize in exporting primary products, abandoning production of manufactures. In theory, this change in the allocation of resources should have been beneficial, but, Williamson argues, the specialization in primary products damaged the long run prospects for growth in the periphery, for three reasons. It increased the volatility of terms of trade, a serious hindrance to growth (Blattman et al., 2007), it reduced the economies of agglomeration from industry, and, last but not least, it affected negatively the investments in human capital by shifting the distribution of income towards landlords (cf. Engerman and Sokoloff, 1997; Galor and Montfourt, 2008). In a slightly different twist of this argument, Allen (2011) has argued that the former great empires of Asia failed to develop because, unlike the United States and the European countries, they did not pursue a coherent industrialization policy. The key role of changes in terms of trade in this narrative raises an obvious question: why did they improve? To some extent, this movement reflects the growth of productivity in European manufacturing during the industrial revolution. However, as pointed out by Williamson himself (Hadass and Williamson, 2001; Williamson, 2011), terms of trade of both trading partners may improve (worsen) even without any change in relative productivity if prices gaps between them decrease (widen). How important was this effect? Did prices between Asia and Europe converge and by how much? If so, what determined this convergence? Last but not least, to what extent did it increase the welfare of Asian producers and European consumers?

The literature on the integration of Asia in the world economy is growing fast, but significant gaps remain. Before 1800, during the mercantilist era, price gaps between Asia and Europe fluctuated widely, while results about long-run trends depend on the choice of periods and products (O'Rourke and Williamson, 2002; Rönnbäck, 2009; De Vries, 2010). Any gain was anyway lost during the Napoleonic wars (O'Rourke, 2006). From 1870 and 1890 to World War One, price differentials between India and the United Kingdom reduced somewhat and they remained stable overall also after the war (O'Rourke and Williamson, 2002; Hynes et al., 2012). No work, as yet, has dealt with the key period from 1815 to the late 19th century. For those years in particular, the conventional wisdom is

heavily shaped by our knowledge of trends in the Atlantic economy. As O'Rourke and Williamson (1999: 1-2) put it in the introduction to their authoritative book *Globalization and History*: "the really big leap to more globally integrated commodity and factor markets took place in the second half of the [19th] century", adding that "the world economy had lost all of its globalization achievements in three decades, between 1914 and 1945". In fact, later research has suggested that the integration of the transatlantic wheat market may have started in the 18th century, to gather momentum in the first half of the 19th century (Jacks, 2005; Uebele, 2011; Sharp and Weisdorf, 2013).[1] Yet, recent estimates of world-wide trading costs confirm that there was a marked decline from 1870 to1913, while barriers rose during the Great Depression (Jacks and Pendakur, 2010; Jacks et al., 2010, 2011).[2] In short, the conventional wisdom points to a division of the long 19th century in four phases, which can be conventionally named as "twilight of mercantilism", "early globalization", "heyday of globalization" and "war and interwar". This periodization, however, may or may not hold for the integration across the Indian and Pacific Oceans: barriers to trade are by definition product and market-specific and thus timing and causes of convergence may differ a lot among markets even with common trends in transportation costs. At the same time, to date, there is no quantitative estimate of the effects of transoceanic price convergence on welfare and terms of trade.[3]

This paper contributes to filling in these gaps in our historical knowledge with a comprehensive analysis of trends, causes and effects of the integration of Asia in the world market from 1800 to the eve of World War Two. We focus on the four main Asian countries, British India, the Dutch East Indies, China and Japan and we add, for purpose of comparison, the integration of markets for cotton and wheat across the Atlantic Ocean. Section two outlines the growth in exports and extends Williamson's (2008, 2011) analysis of trends in terms of trade up to 1938. After a short presentation of the data (section three), section four documents patterns of convergence of prices, which we interpret in the next two sections. We introduce the analysis with a short overview of changes in

[1] An important limitation of studies positing Atlantic integration in the early nineteenth century is that they mostly rely on European markets, with only a few cases of trans-Atlantic ones.
[2] The conventional wisdom is, however, only partly supported for the inter-war: in the 1920s, barriers fell. Unfortunately, these studies report separately series for the period before and after World War One, and thus it is impossible to assess to what extent the decline in the 1920s was a return to normalcy after the war-time shock.
[3] Federico (2008) investigates gains and losses resulting from dynamics of European integration from the second half of the eighteenth century, Federico and Sharp (2013) deal with losses from disintegration of the American domestic market in the interwar years, while Ejrnæs and Persson (2010) focus on gains from increasing market efficiency speed of transmission. Haddas and Williamson (2001) rely on comparative analysis rather than statistical testing to speculate that market integration was the main drive behind the terms of trade boom in the nineteenth-century world periphery.

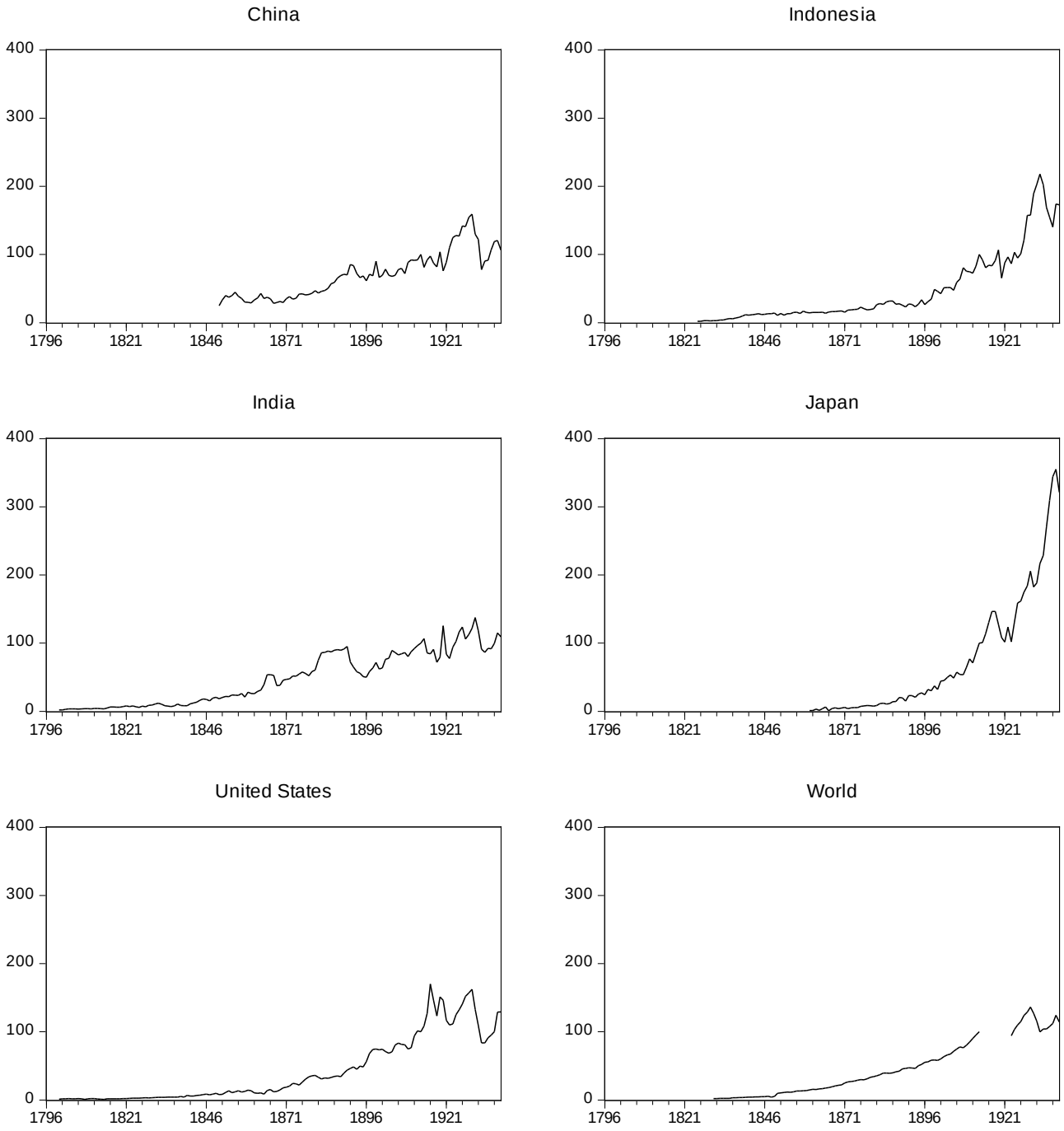
transport costs and in barriers to Asian trade (section five) and then run a panel regression in order to estimate the contribution of increasing efficiency, falling transport costs and changes to institutional barriers to trade to overall convergence (section six). Section seven estimates the (static) welfare effects of price convergence for European consumers and Asian producers and the contribution of price convergence to improved terms of trade in India and Indonesia. The concluding section summarizes and discusses the implications of our findings for the two bodies of literature we want to speak to, that on market integration and that on the growth of Asian countries.

2) The growth of Asian trade: a quantitative overview

As shown by Fig. 1, there is no doubt that Asian countries did join the great growth of world trade from the early 19th century. Despite a marked slow-down in India and China between the late nineteenth and the early twentieth centuries, exports increased more or less continuously until the Great Depression across the four countries.[4] Exports from Japan rose hundredfold from the early 1860s until the end of the 1920s, and continued to grow even during the Great Depression: the rate of growth from 1927-1929 to 1937-1938 is 6.5 per cent per year – i.e. only marginally lower than in the previous fifty-five years (7.1 per cent from 1862-1864 to 1927-1928). No country, not even the United States, came close to match this stellar growth.

[4] All data on foreign trade have been collected in an on-going research project on the growth of world trade from 1800 to 1938 (cf. Federico and Tena, 2013 for details on sources). Figure 1 reports series at constant (1913) prices, while the shares of Table 1 are computed on three-year moving averages with data on current prices. Trends of shares at 1913 prices are similar, but the decline of India is decidedly steeper: its exports accounted for almost 10 per cent of world trade in 1832, 8 per cent in 1890 and 4.5 per cent on the eve of World War Two.

Figure 1
The growth of exports (1913=1)



Source: Federico and Tena (2013)

Table 1
Shares on world exports

	China	India	Indonesia	Japan	USA	World (mil $)
1831	5.0	5.6	0.6		7.0	939
1850	3.0	5.6	1.6		9.4	1871
1870	2.3	5.4	0.9	0.3	8.0	4839
1890	1.7	6.0	1.0	0.7	11.5	8704
1900	1.5	4.0	1.1	1.2	14.5	11138
1912	1.6	4.5	1.4	1.7	13.0	17476
1928	2.1	3.9	2.0	3.6	15.4	23357
1937	1.0	3.4	1.8	5.2	13.2	20680

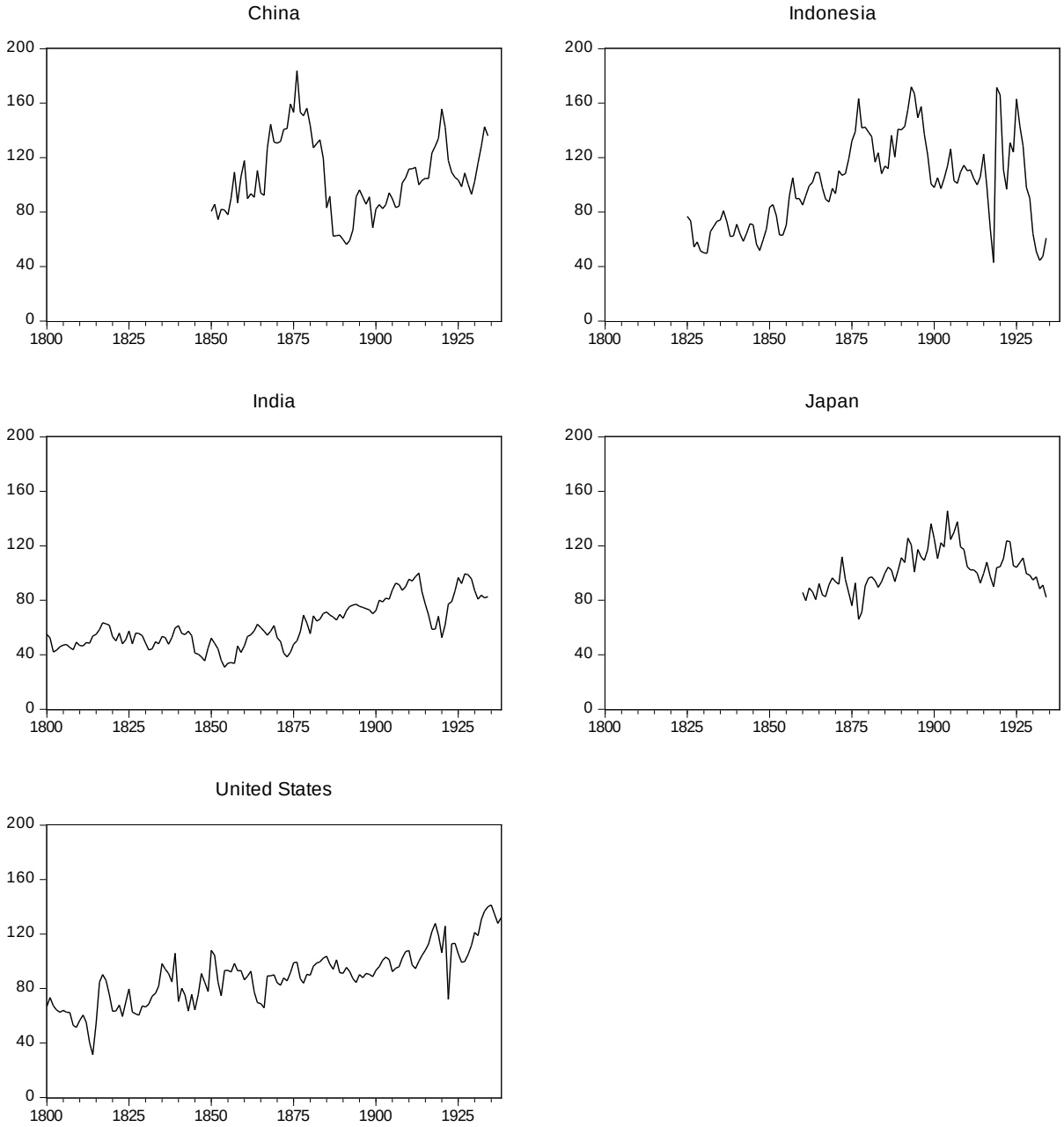
Source: Federico and Tena (2013)

The United States and Japan, as well as the Dutch East Indies, managed to increase their share of the fast-growing world trade (cf. Table 1).[5] In contrast, both India and above all China lost in the long run the position of major exporters which they had held in the early 19th century. Yet, the pattern differed substantially between the two countries. The Chinese share fell rather sharply in the 1830s and it was further clobbered by the political turmoil of the 1850s and 1860s. In contrast India managed to keep and even increase its share until the mid-1880s, while in the 1890s it was hit hard by the collapse of exports of wheat and the stagnation of those of jute and cotton cloths (Chaudhuri 1982).

What about terms of trade? According to Williamson (2008, 2011), not all Asian countries shared the boom of the periphery. Our new estimates yield a somewhat more optimistic view (Fig. 2). From the start of the series (which differs across countries) to 1913, the terms of trade improved in all countries, with yearly rates ranging from 0.4 per cent to 0.6 per cent. The increase was however far from steady, with the notable exception of the United States, which however were changing their specialization. All Asian countries experienced wide fluctuations, but China stands out. Prices of silk, its main export product boomed in the 1860s and 1870s, when the European silk production was hit by a very serious disease of silkworms, and they returned to their long-run levels when it recovered. After the war, terms of trade fluctuated widely, and on the eve of World War Two they were lower than before World War One in the Dutch East Indies (by a third), Japan (by a quarter), India (by a tenth), but higher in China.

[5] In the figures and tables “Indonesia” is used for brevity.

Figure 2
Terms of trade of Asian countries and the United States (1913=100)



Source: Federico and Tena (2013)

Thus, trends in terms of trade are broadly consistent with the conventional wisdom about patterns of market integration as sketched out in the introduction. We shall return to the relationship between market integration and terms and trade in section 7. We now present our data-base of prices.

3) The data-base

As Federico (2012) argues, in order to minimize the risk of spurious results, the data-base should meet three conditions:

i) Any bilateral comparison of prices should refer to pairs of markets which were actually trading. Otherwise, price differentials can be lower than costs and move (quasi-) randomly within the band of commodity points. If markets trade and are efficient à la Fama (1970), in equilibrium price gaps must be equal to transaction costs, inclusive of monopoly mark-ups.

ii) Each prices series should refer to a specific quality (e.g. the "Ngatsain" rice quoted in Rangoon) rather than to the market average and each pair of series should refer to the same quality. Otherwise, price gaps might reflect quality differentials, and any change in quality in a market might introduce spurious trends.

iii) The commodities should be broadly representative of the actual trade flows. Extending inferences from one product only (e.g. cereals), is tantamount to assume that that movements in transport costs, barriers to trade and market efficiency are similar across all traded goods.

These conditions imply a trade-off between representativeness of the sample (number of series and coverage of trade flows) and the quality of the data (homogeneity of prices and trade). How does our data-base fare? Table 2 lists the series used in the analysis.[6]

[6] For a more detailed discussion of our sources see the Appendix B.

Table 2
The data-base

	Period	Market		Homogeneous quality?		
				Within markets		Across
		Origin	Destination	Origin	Destination	markets
Atlantic						
Cotton	1801-1938	New York	Liverpool	Yes	Yes	Yes
Wheat	1800-1937	New York	London	No	No	No
Far East						
Silk	1834-1877	Canton	London	Yes	Yes	Yes
Silk	1874-1913	China	London	Yes	Yes	Yes
Silk	1874-1914	China	Lyon	Yes	Yes	Yes
Silk	1894-1914	Yokohama	Lyon	No	No	No
Silk	1894-1938	Yokohama	New York	No	No	No
Tea	1811-1831	Canton	England	No	No	Yes[a]
Tea	1820-1877	Canton	London	Yes	Yes	Yes
India						
Cotton	1796-1845	Calcutta	London	Yes	Yes	Yes
Cotton	1867-1938	Bombay	London	Yes	Yes	Yes
Indigo	1822-1931	Calcutta	London	Yes	Yes	Yes
Jute	1844-1938	Calcutta	London	Yes	Yes	Yes
Linseed	1846-1938	Calcutta	London	Yes	Yes	Yes
Rapeseed	1871-1921	Calcutta	London	Yes	Yes	Yes
Rice	1870-1938	Rangoon	London	Yes	Yes	Yes
Saltpetre	1796-1853	Calcutta	London	Yes	Yes	Yes
Silk	1796-1856	Calcutta	London	Yes	Yes	Yes
Silk	1857-1877	Calcutta	Lyon	Yes	Yes	Yes
Sugar	1796-1856	Calcutta	London	Yes	Yes	Yes
Tea	1893-1931	Calcutta	London	Yes	Yes	Yes
Wheat	1861-1931	Calcutta	London	Yes	No	No
Indonesia						
Coffee	1833-1913	Batavia	Rotterdam	No	Yes	Yes
Pepper	1828-1938	Batavia	Amsterdam	No	No	No
Rice	1848-1913	Batavia	Amsterdam	Yes	Yes	Yes
Rubber	1913-1938	Batavia	London	Yes	Yes	Yes
Sugar	1822-1938	Batavia	London	No	No	No
Tea	1893-1938	Batavia	Amsterdam	Yes	Yes	Yes
Tin	1863-1913	Batavia	Amsterdam	Yes	No	No

Notes: [a] since all these figures refer to tea imported and sold at auctions by the East India Company, we expect the quality mix to be similar in the same year, but not necessarily across years

Sources: see the Appendix B

i) The first condition is surely met in the overwhelming number of pairs. All covered cities were major trading centers in their own countries, and we collected trade statistics reporting trade between the two countries for about 93 per cent of the observations. Missing data are mostly scattered, which

suggests failure to record rather than absence of trade. There is a slight suspicion that absence of trade could be an issue in only c. 2 per cent of the cases (exports of cotton from the United States to the United Kingdom in 1801-1805 and 1809-1814, exports of sugar from Java to the UK in 1822-1824, 1826-1832, and 1864-1866, and exports of wheat from India to the UK in 1861-1867).[7]

ii) We can rule out a significant bias in level or trends of price gaps in the majority of cases. In fact, 22 out of 29 ratios it is reasonable to assume the same quality across markets (Yes in the column "across markets"). In two of the other cases, one series can be considered as qualitatively homogeneous (Yes in the column "within market"), but the quality surely differs between series (No the column "across markets"), while in the remaining ones the quality differs between markets and changes in time in each market (No in all three columns). In short, in less than one fourth of cases, the corresponding trends might be spurious, although there is no evidence to prove this suspicion.[8]

iii) The range of primary products is undoubtedly wide, while we have been unable to find suitable series for manufactures. As Table 3 shows, they accounted for half or more of exports from India and the Dutch Indies, from China in the 19th century and from the United States before the Civil War. In these two latter countries, the share declined quite fast in the 20th century, while it was always comparatively low for Japan.

[7] There is another exception to this rule: the Chinese exports of silk to Great Britain after World War One. By then the British silk industry was in terminal decline and the London prices refers officially to "tsatlee", a traditional native silk, which had almost disappeared from Chinese exports (Federico, 1997). We have thus decided to drop prices of silk in London and China after 1914 from our data-base.

[8] One can be more specific about American wheat on the London market. According to Ejrnæs et al. (2008), from 1850 to 1900, its quality rose steadily relative to the domestic product, as measured by the Gazette series, which is an un-weighted average of prices in markets all over England. The ratio increased at 0.35 per cent per year, corresponding to a massive 19 per cent quality improvement over the whole period (the figure is obtained cumulating the rate of change obtained from a basic regression of a log ratio on time trend). In the same period, the ratio of (unadjusted) prices in New York and London declined by 26 per cent (yearly rate 0.60 per cent). Thus, if prices for New York referred to export-quality wheat, the improvement could have accounted for about three quarters of the convergence (19 per cent/26 per cent). Anyway, this paper does not use the Gazette price, but a series of London prices.

Table 3
Shares of covered products on total exports (in percentage)

	China	India	Indonesia	Japan	United States
1810		26.4	84.0[a]		34.8
1830		45.0[b]	67.1		50.8
1850		40.5	76.3		46.5
1870	95.4	55.5	73.3	28.8	64.9
1890	58.7	57.1	59.4	24.0	33.5
1900	33.3	46.5	56.4	20.6	22.2
1913	29.0	53.3	43.4	26.3	26.7
1929	20.3	46.0	57.2	29.4	17.1
1938	9.5	42.2	43.1	9.0	10.0

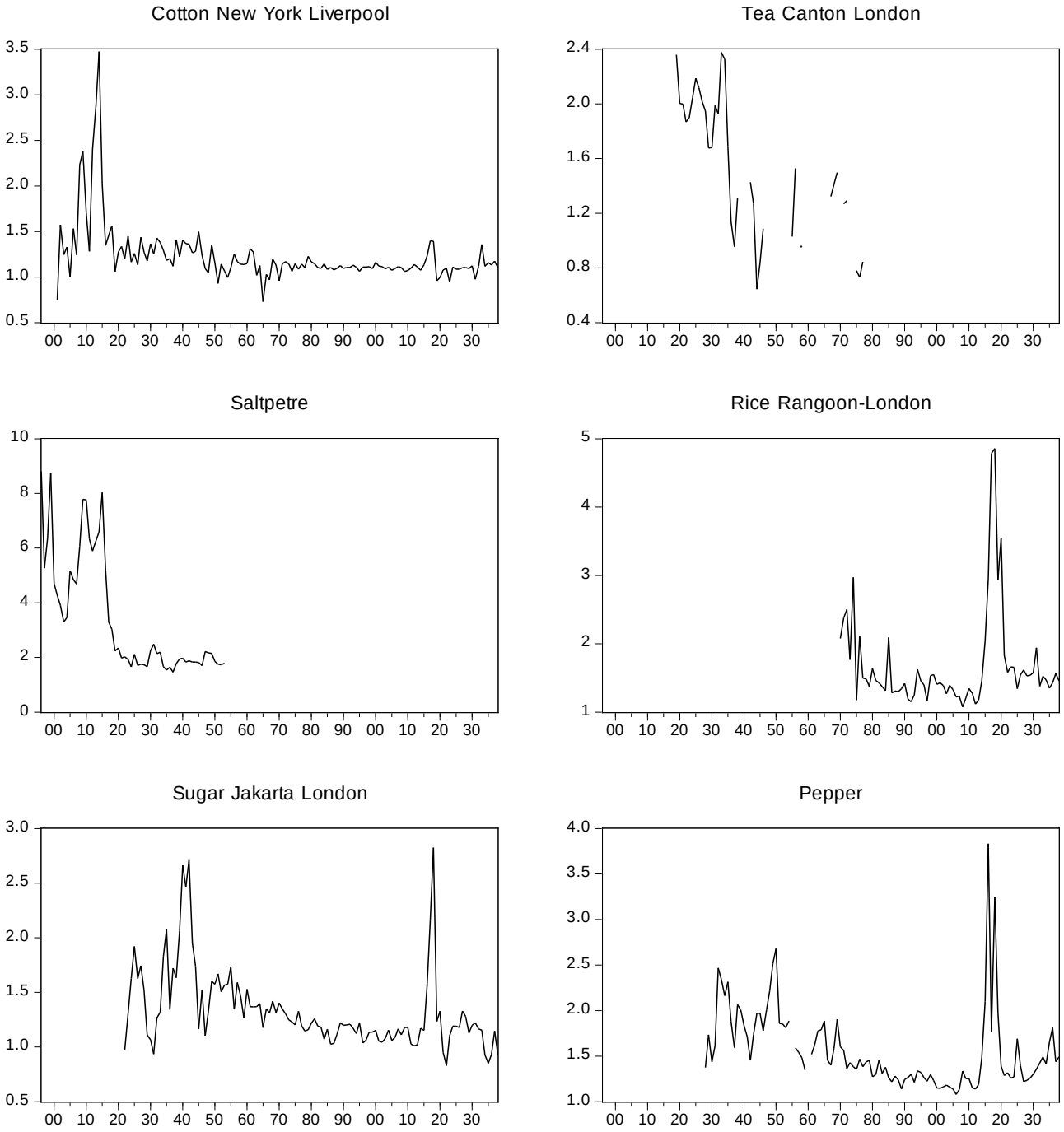
Notes: [a] 1823, [b] 1828
Sources: see the Appendix B and Federico and Tena (2013)

Summing up, the data-base, though falling short of being perfect, can be considered as fit for our purposes. We can now turn to the results.

4) The process of integration: a statistical analysis

Fig. 3 reproduces our series price differentials for a subset of commodities, which highlights some key features of the process of convergence. On the one hand, as expected, the price ratios were fairly high at the beginning of the 19th century and declined in the long run, with a spike during World War One. On the other hand, differentials differed hugely among commodities at the same time, and they often collapsed rather than steadily declining. Such changes are too big and sudden to be explained only by technological progress in shipping.

Figure 3
Price ratios: selected commodities



We test formally the extent and speed of convergence by running the following regression (Razzaque et al., 2007):

$$\Delta Ln\ RP^{i} = \alpha + \beta\ TIME + \psi\ ln\ RP^{i}_{t-1} + \varphi\ ln\ \Delta Ln\ RP^{i}_{t-1} + u \qquad 1)$$

Where RP^{i} is the relative price of the *i-th* good between two markets and *TIME* is a linear trend. The long-run rate of change can be computed as $t = -(\beta/\psi)$. Prices converge if the coefficient *t* is negative

and significant. The error correction model coefficient ψ (ranging between -1 and 0) tests whether and estimates how rapidly price ratios return to this trend after a shock, while the lagged change in relative prices is added to address possible serial correlation. We first run Equation 1) in a fixed effects panel version, for the whole sample and separately by country, considering jointly the (comparatively few) observations for China and Japan.

Table 4
Long-run convergence: panel estimation

	N. obs	Initial ratio	Half-life (months)	Rate (in percentage)	Cumulated (in percentage)
All	1725	1.940	24	-0.443***	-46.72
Atlantic	257	1.618	20	-0.401***	-42.46
Far East	191	2.024	18	-0.520***	-52.22
India	805	2.085	26	-0.501***	-50.89
Indonesia	472	1.746	18	-0.402***	-37.25

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and the Appendix B

The statistical analysis confirms the conventional wisdom about price convergence: at the beginning of the series (which differed by product and route), on average European prices doubled the Asian ones and by the end this difference had been cut by a half, so that export and import prices had become almost identical. All rates are statistically significant and very similar across routes. The half-lives of shocks, the standard measure of speed of reaction to shocks, are quite high (Federico, 2012). One might sum up that the market was becoming increasingly integrated, but overall it had still a long way before becoming really efficient.

However, clearly, such a conclusion would be a tad hasty, for three reasons. First, it overlooks the differences among products in the extent and rate of convergence, which depend on the initial level of differentials and on the product and market-specific barriers.[9] Second, any long run analysis by definition assumes convergence to have been linear, in clear contrast with the conventional wisdom. Finally, the half-lives, being computed over the whole period, by definition average out any increase in market efficiency. A simple way to address the two latter issues is to re-run the panel regressions according to the traditional periodization, as stated in the introduction (Table 5).

[9] To demonstrate the point, we have run regressions according to equation 1 consider the five series with at least two thirds of the observations – i.e. 93 out of 138 (cotton and wheat from the United States, cotton, indigo and jute from India and pepper and sugar from the Dutch East indies). Their rates of convergence (Statistical Appendix Tab A1) varied widely, ranging from a maximum of -1.08 for jute to a minimum of -0.26 for cotton from the United States (in percentage, both significant at 1 per cent). The rate is not significant for indigo.

Table 5
Trends by period: panel regression

	N. obs	Initial ratio	Half-life (months)	Rate (in percentage)	Cumulated (in percentage)
Twilight of mercantilism (1796-1815)					
All	102	2.274	10	0.968	20.20
Atlantic	27	1.215	9	3.249	62.81
India	72	3.099	9	0.285	17.00
Early globalization (1815-1870)					
All	565	1.973	16	-0.896***	-38.92
Atlantic	109	1.632	10	-0.678***	-31.12
Far East	48	2.245	12	-1.501**	-55.55
India	263	2.125	17	-1.243***	-49.51
Indonesia	145	1.892	12	-0.504**	-21.48
Heyday of globalization (1870-1913)					
All	765	1.291	8	-0.418***	-16.44
Atlantic	88	1.129	12	-0.288***	-11.65
Far East	114	1.266	12	-0.334**	-13.37
India	330	1.326	7	-0.517***	-19.95
Indonesia	233	1.311	8	-0.347***	-13.85
War and interwar (1914-1938)					
All	313	1.441	10	-1.128***	-23.71
Atlantic	37	1.084	7	-0.160	-3.78
Far East	27	1.157	0	-0.250*	-5.82
India	150	1.559	10	-1.478**	-28.86
Indonesia	99	1.483	9	-1.181**	-24.69

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and the Appendix B

As posited by the conventional wisdom, the results show no integration before 1815, although the number of observations is comparatively small and thus the results are potentially not representative. The data for the two subsequent periods are undoubtedly representative and they yield a clear conclusion: convergence was twice faster in the "early globalization" than in its (alleged) "heyday". The difference between the two periods is particularly wide for the Far East, while convergence between the Dutch East Indies and Europe was only 45 per cent faster in 1815-1870 than in 1870-1913. That prices converged after 1914 reflects a return to normal levels, after the sharp increase in price differentials during the war: indeed, dropping the first five years, the rates become positive (except for the Far East). Yet these diverging trends are not significant;[10] the inter-war disintegration

[10] The overall rate of change (in percentage) is 0.50 (not significant), while rates by area are: -0.39 for the Far East (significant at 10 per cent), 0.63 for India, 0.53 for Dutch East Indies and 0.51 for the United States (none significant).

of the world trading network seems to have affected only inconsistently exports from Asia, at least for primary commodities; for the trade of these products, it certainly did not entail a return to the barriers of the pre-globalization era.

There is also evidence of improvement in market efficiency between the second and the third periods, but the fall in half-lives is not shared by all routes. Furthermore, the speed of reaction remained quite high. One may surmise that in modern markets, most shocks were arbitraged away within the year and that, consequently, our yearly series capture only very large shocks, which needed more time to be absorbed. This conjecture should be tested with higher frequency data. Indeed, Brunt and Cannon (2013) show that half-lives of shocks tend to be higher if estimated with yearly data than if estimated with monthly or weekly data.

One might point to two additional shortcomings of our analysis: the choice ex-ante of the periodization and the assumption of linear trends within each period. In theory, breaks in series can be in any year, not just in or around 1815 or 1870. Thus, we have looked systematically at breaks in the series of price ratios with Bai-Perron tests (Bai and Perron, 1998, 2003). Most series, twenty-three out of twenty-nine, do show at least one such break and six of them more than one break – for a total of 31. About a third of these breaks can be classified as major ones, as they entailed a change exceeding 30 per cent of the differential before the break. We report full results of the test in Table A1 of the Appendix A and we sum them up in Table 6. Column 1 reminds the number of series by period and country (from Table 1). Columns 2 to 4 reports the number of trends, distinguishing between converging (negative and significant coefficient of the time variable), divergence (positive and significant trend) and trendless (not significant). The number of trends (sum of columns 2 to 4) would exceed the number of pair of markets (col 1) whenever there is more than one trend within a given period. Then we count the number of breaks which entail also an upward (column 5) or downward (column 6) jump exceeding 10 per cent of the last year of the previous trend. We estimate the total change in each period/country (Column 7) and the contribution by shocks (Column 8), both as averages of product specific figures. Last but not least, we average the product-specific yearly rates of change (column 9), so that results are comparable to estimates of linear trends from Table 5.

Table 6

The four phases of globalization

	Number of trends			Number of breaks		Total change in the period	Contribution of shocks	Implicit rate of change
	Pairs of markets	Convergence	Divergence	Trendless	Upward shock	Downward shock	(in percentage)	(in percentage)	(in percentage)
Twilight of mercantilism (1796-1815)									
Atlantic	2			2			-1.10	0.00	-0.10
India	4			4			-3.50	0.00	-0.31
All	6			6			-2.70	0.00	-0.24
Early globalization (1815-1870)									
Atlantic	2	1		2		2	-27.60	45.50	-0.45
Far East	3	1	1	2		1	-28.50	25.80	-0.79
India	8	4		5	1	5	-46.10	41.80	-1.90
Indonesia	5	3	1	3		2	-10.60	16.20	-0.47
All	18	9	2	12	1	10	-32.50	33.39	-1.20
Heyday globalization (1870-1913)									
Atlantic	2			2			-8.40	21.40	-0.21
Far East	4	3	1	1		1	-2.80	5.70	-0.06
India	8	6	1	2	1	2	-19.30	22.70	-0.54
Indonesia	6	3		3		2	-14.30	41.30	-0.40
All	20	12	2	8	1	5	-13.40	24.76	-0.37
War and interwar (1914-1938)									
Atlantic	2			2			-1.80	0.00	-0.08
Far East	1	1					-2.90	0.00	-0.12
India	8	4	2	2	3		1.80	17.50	0.28
Indonesia	4	1	1	2	2	1	4.90	43.50	0.16
All	15	6	3	6	5	1	1.84	20.91	0.17

Sources: see the text and the Appendix B

As a whole, this approach corroborates the two main insights from the panel regression results: convergence was consistently and significantly faster during the "early globalization" than during the "heyday of globalization", although the difference for the Dutch East Indies is very small; and, in no case do we find a break after the end of World War One, confirming little or no inter-war disintegration for our series. The analysis adds two important results. First, related to the last point, the timing of the breaks only weakly supports the traditional periodization: slightly less than half of the detected breaks (14 out of 31) fall within an interval of six years around the pre-selected end-dates of the periods (1815, 1870 and 1913) and almost as many (10) are farther than ten years. Second, shocks mattered a lot, particularly in the "early globalization" phase. In that period, on average, they accounted for one third of changes, as compared to a quarter during the "heyday" and a fifth during the last period. It is also noteworthy that almost all the major shifts, 10 out of 12, clustered around 1815 or 1913 –, i.e. the end of Napoleonic Wars in Europe and of the EIC monopoly in Indian trade (1813) or the outbreak of World War One. The two other major shifts are likewise related to political and institutional events. Prices of Benares sugar in London boomed in 1840 as a consequence of the boycott of Caribbean sugar, as part of the anti-slavery campaign. The price differential for Congou tea between Canton and London suddenly fell in 1835 (Figure 4), two years after the demise of the EIC's monopoly in Canton.

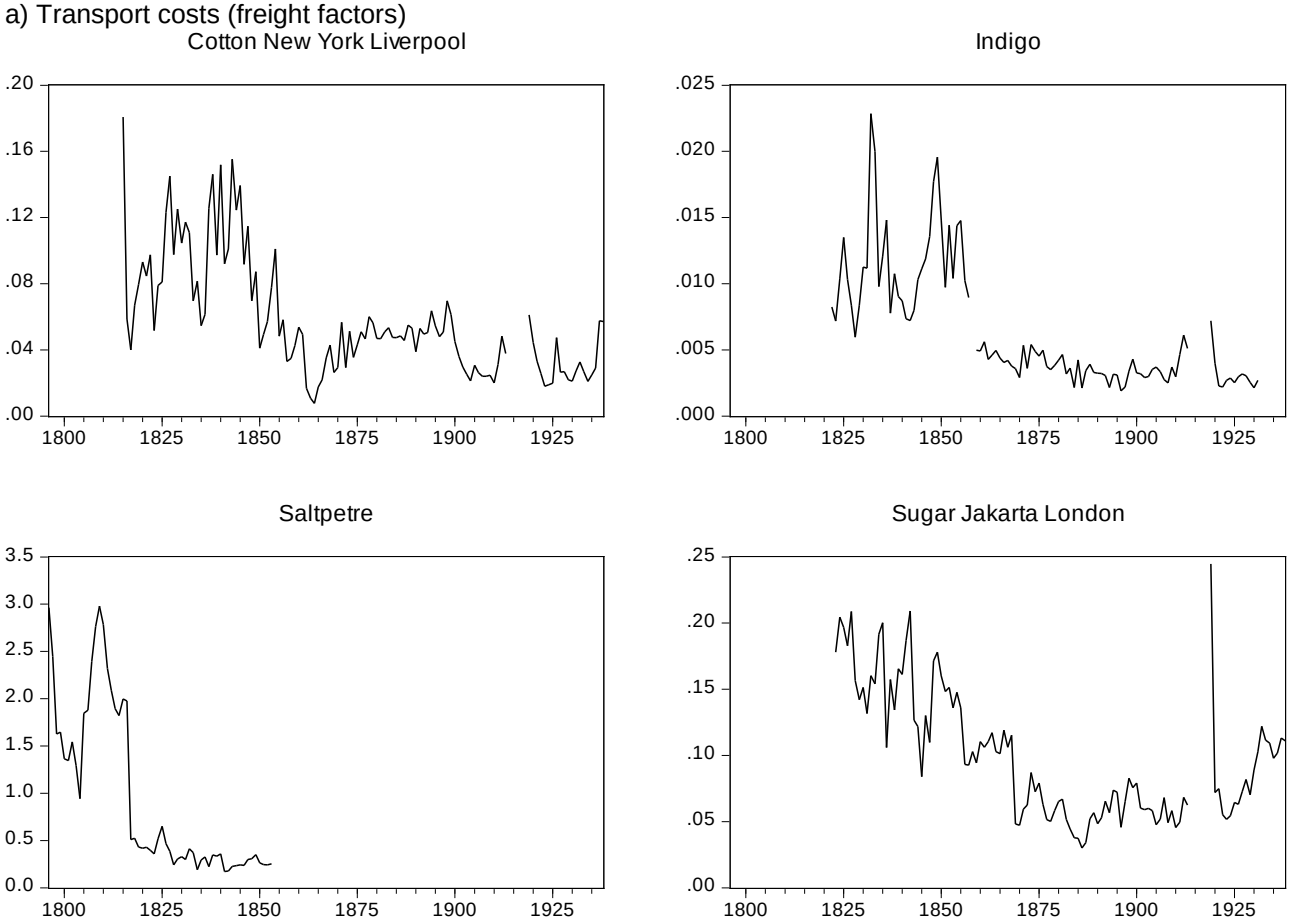
5) The causes of convergence: transport costs and barriers to trade

The perceived wisdom attributes the integration of world market before World War One to the combined effects of a fall in transport costs and the liberalization of trade, and the disintegration after the war to the protectionist backlash. Figure 4 illustrates these trends for some representative commodities: the upper part measures transport costs with freights, and the lower part proxies barriers to trade with total duties (sum of import duties in consuming countries and export taxes from India and the Dutch Indies) .[11] In both cases, we normalize costs with prices in the export country.

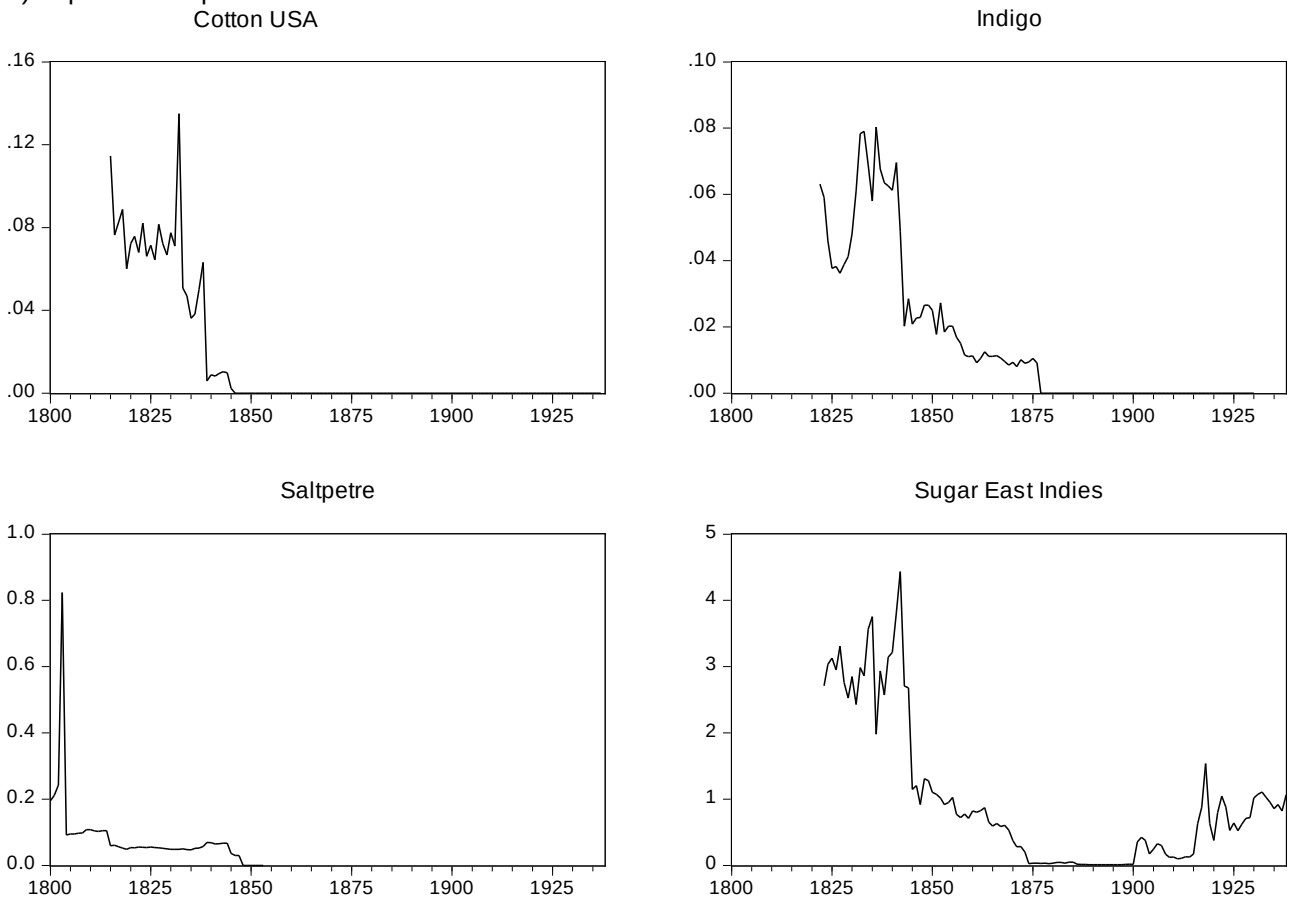
[11] We assume other transport costs (e.g. insurance) to have been proportional to freights. In this section, we use data collected for the statistical analysis and thus we focus on the Atlantic, India and the Dutch East Indies only.

Figure 4
Barriers to trade for selected commodities

a) Transport costs (freight factors)



b) Import and export duties



Sources: see the Appendix B

Levels in are not directly comparable because the scales on the vertical axis differ, but trends are by and large similar across countries and products.[12] They confirm the conventional wisdom only partially. Both duties and freights did fall in the first part of the 19th century,. but the rise in protection in the interwar years is very limited. During the Great Depression (1930-1938) total duties were on average equivalent to 26.8 per cent of the price in the exporting country, exceeding 50 per cent in 22 observations out of 95 (most of them on sugar). Thus, over the whole period 1796-1938, the impact of protection was fairly small: total duties exceeded 5 per cent of prices in slightly more than a quarter of cases and 50 per cent only in about a eight. On the same line, one should note that most of the fall in freights was over by 1875 and that the change was often quite sudden. The 75 per cent collapse in the freight factor for saltpetre in 1816-1817 is an extreme case, but there are several other instances of major jumps, including a 70 per cent fall in freights for tea from China to England in 1835, just after of the end of the EIC monopoly. Such sudden changes cannot be accounted for by innovations in

[12] We are not using the same scale because levels for saltpetre are so much higher than for the other goods that changes in time would have disappeared. For the same reason, we omit war years from Fig. 4 a).

shipping organization or technology, the two competing explanations for the fall in costs of sea transport (North, 1968; Harley, 1988; Shah and Williamson, 2004). Jointly with the evidence about duties, they suggest that the traditional narrative is not sufficient to explain integration over the whole period. It must be supplemented by an analysis of the process of dismantling of institutional barriers, which hampered the long-range trade with Asia at the beginning of the 19th century.

In Japan and China, exports were limited by national governments. Since the mid-17th century, Japanese were not allowed to trade with Western merchants, but for a small Dutch post in Nagasaki. The self-isolation ended in 1853 and the next years Japan was forced to sign trade treaties with the main Western powers, which enshrined the principle of free trade, forbidding it to raise protective duties until 1905. The case of China was broadly similar although the initial restrictions were less extreme (Dermigny, 1964; Wakeman, 1978; Fairbank, 1978). Western merchants were allowed to trade only in Canton, and only through Chinese intermediaries (hongs). Most restrictions to the activity of Western traders were lifted after the first opium war (1842), and all the remaining ones were effectively ended after the second opium war (1858).

The Indian subcontinent had been throughout the 18th century a battleground among European trading companies, but eventually the British EIC succeeded to gain control of most of it. The company enjoyed a monopoly of the trade between its Indian possessions and the United Kingdom, although it never entirely succeeded in repressing smuggling. It used specialized, very large and heavily manned and armed ships, the so-called Indiamen, which it rented from owners. These latter were often also shareholders of the Company and this relationship is often invoked to explain the "excessive" freight the Company charged, even after they had been capped in the renewal of its charter in 1793 (Webster, 2009: 32-40; Mui and Mui, 1984; Wakeman, 1978; Bowen, 2006: 252-256).[13] In a very recent paper, Solar (2012) argues that Indiamen were much more expensive to build and to run than smaller ships, but they were needed to fight the military threat of other Western trading companies. In the 1810s, the combined effect of technical progress (mostly copper sheathing) and of the reduced need for protection at sea, thanks to the successes of the Royal Navy, made it possible to use smaller ships, cutting drastically the cost of transportation. The monopoly on trade

[13] This arrangement reflects the official constraints in its charter. It stipulated that the price of company wares in London "should not exceed the prime cost, the freight and charges of importation, the lawful interest of capital from the time of arrival of such tea in Britain, and the common premium in insurance" (Mui and Mui, 1984: ix). Indeed, the official profits of the Company were quite low (Wakeman, 1978: 167).

with India was abolished with the renewal of the charter in 1813, and competition from private shipping caused freight rates with India to collapse (Webster, 2009: 72). However, the company continued to play a key role in the trade with China, as it still enjoyed a monopoly on the production of Indian opium and on the export of Chinese tea to Britain. All its mercantile activities were discontinued after the renewal of the charter in 1833: since then, Indian trade was entirely in private hands and in all likelihood the market was competitive.

Unlike the British EIC, the Dutch VOC had enjoyed a monopoly of trade with the Dutch East Indies since the early 17th century. It collapsed in the 1790s, and from then to 1824, the islands enjoyed a short period of freedom, during the British occupation (1811 to 1816) and the early years of the restored Dutch rule. In 1825, the monopoly of trade between the Netherlands and its Asian colony was granted to a new trading company, the Nederlandsche Handel-Maatschappij, or NHM (Furnivall, 1976; Horlings, 1995: 142). Similarly to the EIC, the company rented ships from Dutch owners, at "exceptionally high" rates (Horlings, 1995: 145; Korthals Altes, 1994: 161). In the first years of activity, exports were reduced by a rebellion of natives, the so called Java War. At its end, the Dutch government, desperate for revenues, established a system of compulsory delivery of coffee, sugar and indigo for exports, known as Cultivation System (de Klerck, 1938; Dobbin, 1983; Fasseur, 1992; Houben, 2002; van Zanden and Marks, 2012).[14] Peasants were paid much less than the world market price –, about a half of the Batavia price for coffee (Fasseur, 1992: 37).[15] The goods were transported by the NHM to Amsterdam, and there sold at auction: the profits, net of a fee for the NHM, accrued to the Dutch government. The amount was very substantial: at its peak, in the 1850s, it accounted for over half the state revenues and for about 3.8 per cent of Dutch GDP (van Zanden and van Riel, 2004; Smits et al., 2000). Including the hidden subsidies to the Dutch economy from shipping and production of manufactures for the colonial market, the total rises to 4.3 per cent of GDP. In spite of its benefits for the Dutch economy, the Cultivation System was increasingly unpopular and was slowly phased out. From the point of view of this paper, the key provision was the monopoly on shipping. It was relaxed in 1850, by widening the access to bidding contracts for renting ships and was abolished altogether in 1868 (NHM, 1924: 23; Furnivall, 1976: 168; Korthals Altes,

[14] Forced production and deliveries of products under the Cultivation System involved coffee, sugar and indigo, but monopoly trade affected also other goods, including pepper and tin (which was produced by state-owned mines).

[15] Interestingly, a monopsonist (as the Dutch government was in Java) would pay half the market price even without coercion if supply elasticity were unitary. In fact, the ratio between prices under monopsony (P_M) and perfect competition (P_{PC}) is $P_M/P_{PC}=(\varepsilon/1+\varepsilon)$, where ε is the elasticity of supply.

1994). From then to 1918, the Dutch trade with the colonies remained free. In that year, the sugar producers set up a private association (VJSP) to allocate the scarce available shipping. The organization continued to manage sugar exports after the end of the war and in 1932, it was substituted by a governmental organization (NIVAS) to manage sugar production quotas under the international agreement (van der Eng, 1996: 224-226). The Great Depression featured also the first intervention in American agriculture: the Agricultural Adjustment Act (AAA), part of the New Deal policies, established a loan facility for cotton farmers, which in practice set a minimum price of cotton since 1934 (Federico and Sharp, 2013).[16]

Summing up, this very brief sketch confirms the conventional wisdom about the liberalization of trade in the first half of the 19th century. The process was however much more far-reaching in Asia than in the Atlantic economy as it involved also the dismantling of institutional constraints. In contrast, the backlash against globalization affected only marginally the Asian trade. Even during the Great Depression, duties on primary products remained low and the institutional regulation of trade much less invasive than one century earlier. In the next section, we try to measure more precisely the contribution of these causes to overall convergence

6) The causes of integration: an econometric analysis

We can sum up the implicit causation model in a regression

$$Log\ RP_{it}=F(\boldsymbol{B}, \boldsymbol{E_m}, \boldsymbol{T_c}) \qquad 2)$$

Where the ratio of prices for the *i-th* good between two markets is explained by sets of variables measuring the policy-induced barriers to trade (***B***), the efficiency of markets ($\boldsymbol{E_m}$) and the transaction costs ($\boldsymbol{T_c}$).

The set ***B*** includes the total duties (*LOG_DUTY*) and dummies for monopolies - a dummy for the *EIC* (1796 to 1816) and separate dummies for the *NHM* under the full monopoly regime (*NHM1*), from 1824 to 1850, and for the partially liberalized one (*NHM2*) from 1851 to 1868.[17] All these variables

[16] In subsequent years, this facility was extended also to other commodities, including wheat (since 1939).

[17] The variable *LOG_DUTY* is computed as *log(1+t)*, where *t* is the ratio of (usually specific) duties to the price in the producing country. It is thus zero if *t=0*. The dummy *EIC* is equal to 1 until 1816, instead of 1813 since it evidently took a few years for the demise of the monopoly to become effective: recorded freight rates between India and the UK detect a sudden downward level shift from 1817. Neglecting the effect of the end of the Napoleonic Wars is mainly methodologically dictated (the dummy would be collinear with the *EIC* dummy), and may potentially introduce a positive bias in the size of the estimated coefficient of *EIC*. It

are expected to be positive, as they increase transaction costs. We also add specific dummies for the AAA support to American cotton prices (since 1933) and for the two marketing boards for Javanese sugar, the private VJSP (1918 to 1931) and the public NIVAS (after 1932). The sign of these variables is not defined a priori, as the effect of the intervention of these agencies on the commodity market varied according to the specific procedure they adopted.

We use two separate sets of variables to capture market efficiency. The first deals with long-run changes, and features a dummy for the existence of a telegraph connection (*TELEGRAPH*) and country-specific linear trends (*TREND*). The telegraph connections were opened in 1866 between the United Kingdom and the United States and around 1875 between Europe and Asia (Headrick, 1988: 101; Lew and Cater, 2006: 148). They greatly increased the efficiency of the market by cutting the time to transmit information from weeks to minutes and thus the dummy is expected to be negative. The linear trends capture all other organization changes. The second set consists of dummies for major political events - the Java War in 1825-1827 (*JAVA WAR*), the Indian Mutiny in 1857-1859 (*MUTINY*), the American Civil War (*CIVIL WAR*), the anti-slavery campaign, which boycotted Caribbean sugar, in 1840-1845 (*SLAVE*) and World War I (*WWI*). We expect these events to have disrupted the orderly working of markets and thus to widen price gaps, *ceteris paribus*.

As said, we measure transport costs with the freight factor (*LOG_FREIGHT*). The series for the East Indies and India include the rents paid to privileged Dutch or British ship-owners under the NHM and EIC monopoly system. We estimate these rents as a time-invariant proportion of actual freights, with coefficients from a fixed-effect panel regression, which explains freights with dummies for the NHM and the EIC.[18] We use the coefficients of dummies to scale down the series of freights and thus we obtain a series (*LOG_ADJFREIGHT*) net of the estimated extra-costs of monopolies (Fig. 5).

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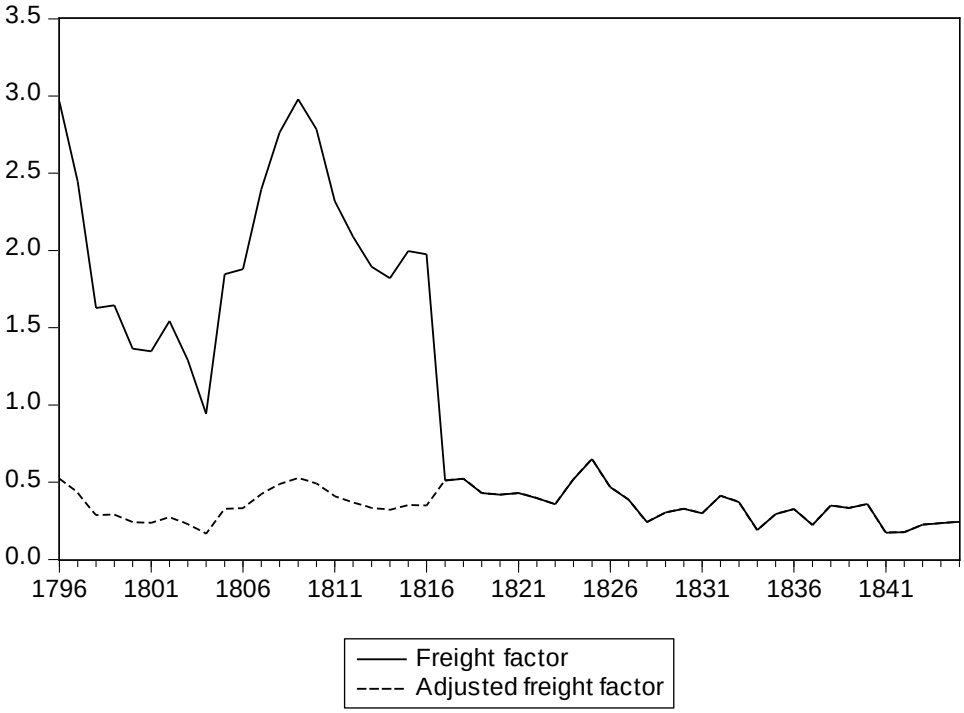
is nevertheless relatively safe to neglect such bias. After Trafalgar (1805) the French were no longer a serious threat for British long-distance trade. As shown by O'Rourke (2006), price gaps with Asia in Britain were much less affected than in continental Europe by the Napoleonic Wars. That the key factor behind sudden falls in freight rates and price gaps between Calcutta and London in around 1815 was the demise of the EIC is confirmed by our own data. Thus for the Canton-London trade of Congou tea, as mentioned earlier, we detects an analogous level shifts in freight factors and price gaps shortly after the EIC monopoly there was dismantled in 1833. Conversely, on the transatlantic trade, we fail to identify breaks at the end of the Napoleonic Wars.

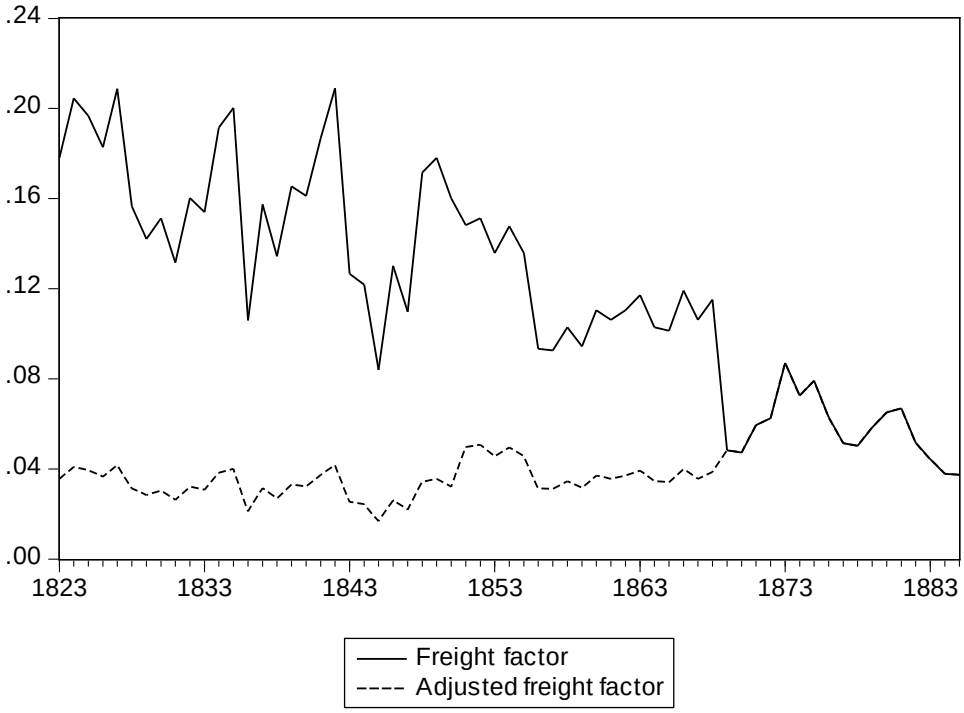
[18] Specifically, the regression is $LOG\_FREIGHT_{it}=c+\alpha_i+\beta_1 EIC_{it}+\beta_2 NHM1_{it}+\beta_3 NHM2_{it}+\varepsilon_{it}$ and we compute the adjusted freights as follows: $LOG\_ADJFREIGHT_{it}=LOG\_FREIGHT_{it}-(\beta_1 EIC_{it}+\beta_2 NHM1_{it}+\beta_3 NHM2_{it})$. Using alternative specifications, like including a time trend, yielded qualitatively identical results and only small quantitative differences.

Figure 5
Freight factors and adjusted freight factors: selected commodities

i) Saltpetre India



ii) Sugar Dutch East Indies



Sources: see the text and the Appendix B

The yearly changes of the two series are equal by construction, except in the final year of the *EIC* and *NHM* dummies. Therefore, the substitution of *LOG_ ADJFREIGHT* for *LOG_FREIGHT* does not

affect their coefficients under the least squares specification and only marginally under the instrumental variables ones. At the same time, it changes the size and the interpretation of the *EIC* and *NHM* coefficients. In the baseline specification *LOG_FREIGHT* includes the costs of monopoly of shipping and thus the dummies measure only the additional effect of the trading monopoly on commerce. In the alternative specification, the variables *EIC* and *NHM* capture the entire effect of monopolies, including the additional mark-ups on transport costs. Lastly, we add the lagged value of the dependent variable to reduce auto-correlation and to take into account the possible delay in adjustment to shocks, but its omission does not affect qualitatively the results. The coefficients are thus short term elasticities; long run elasticities can be computed as $\beta_k/(1-\gamma)$ where β_k is the coefficient of the *k-th* variable and γ is the coefficient of the lagged dependent variable.

We report the descriptive statistics for all variables and the pairwise coefficient of correlation between them in the Appendix A (Table A3 and Table A4). As a whole, they do not add much new information. However, it is worth noting that the average freight factors and the average duties are almost identical – respectively 18.1 per cent and 18.2 per cent (17 per cent on imports and 1.2 per cent on exports) of prices in exporting countries- and that the coefficient of correlation between the two variables is only 0.18. The correlation between explicative variables is in general very low and thus there is not a risk of multi-collinearity. Yet, most variables are clearly non-stationary (cf. the Appendix A, Table A2 for a formal testing) and thus results might be spurious. We thus test ex-post the stationarity of the residuals with a Levin et al. (2002) test for panel regressions.

We omit from the regression the Far Eastern markets, as the series are very short and their quality is particularly poor (three series out of seven are not qualitatively homogenous even in the same market). This leaves a total of twenty-two cross-sections and 1534 observation. We have also run separate regressions for the United States, India and Dutch East Indies (cf. the results in the Appendix A, table A6), which yield qualitatively identical results. All regressions use fixed-effects specification with panel corrected standard errors to address cross-section heteroskedasticity (reflecting different levels of transaction costs) and contemporaneous correlation (which may arise as a result of common shocks). In the short run, Jacks and Pendakur (2010) stress, the supply of transport is inelastic; in consequence, freights are co-determined by the demand, which depends on price gaps. As the flows covered here account for an only small proportion of world transportation by

Table 7

The causes of integration: econometric analysis

	(1) PCSE	(2) PCSE/IV	(3) PCSE/IV	(4) PCSE/IV	(5) PCSE/IV	(6) PCSE/IV
C	0.524	0.404	0.402	-0.079	0.371	0.416
	(17.27)***	(12.19)***	(12.10)***	(-0.12)	(11.59)***	(11.69)***
LOG_DUTY	0.073	0.076	0.076	0.079	0.066	
	(3.34)***	(3.45)***	(3.45)***	(3.51)***	(2.96)***	
LOG_DUTY*ATLANTIC						0.094
						(2.51)**
LOG_DUTY*INDIA						0.028
						(0.45)
LOG_DUTY*INDONESIA						0.072
						(2.27)**
EIC	0.164	0.210	0.360	0.200	0.258	0.166
	(4.79)***	(5.99)***	(10.60)***	(5.57)***	(7.23)***	(4.09)***
NHM1	-0.097	-0.058	0.081	0.007	0.009	0.017
	(-4.10)***	(-2.41)**	(3.44)***	(0.20)	(0.38)	(0.56)
NHM2	-0.060	-0.043	0.051	-0.005	-0.015	0.010
	(-2.90)***	(-2.13)**	(2.39)**	(-0.19)	(-0.76)	(0.42)
AAA	0.030	0.027	0.027	0.006	0.013	0.022
	(0.64)	(0.58)	(0.58)	(0.13)	(0.30)	(0.49)
VJSP	-0.087	-0.057	-0.057	-0.097	-0.035	-0.030
	(-2.29)**	(-1.49)	(-1.48)	(-2.34)**	(-0.92)	(-0.78)
NIVAS	-0.210	-0.165	-0.164	-0.220	-0.145	-0.135
	(-4.06)***	(-3.18)***	(-3.17)***	(-3.92)***	(-2.76)***	(-2.54)**
LOG_FREIGHT	0.130	0.087		0.088		
	(13.89)***	(8.28)***		(8.04)***		
LOG_ ADJFREIGHT			0.086			
			(8.19)***			
LOG_FREIGHT*LIGHT					0.054	
					(5.10)***	
LOG_FREIGHT*BULKY					0.135	
					(9.82)***	
LOG_FREIGHT*ATLANTIC						0.085
						(5.71)***
LOG_FREIGHT*INDIA						0.122
						(6.85)***
LOG_FREIGHT*INDONESIA						0.053
						(4.77)***
TELEGRAPH	-0.023	-0.052	-0.053	-0.056	-0.047	-0.041
	(-1.34)	(-3.01)***	(-3.04)***	(-2.51)**	(-2.76)***	(-2.28)**
YEAR*ATLANTIC				0.000		
				(0.96)		

Table 7-continued

	(1) PCSE	(2) PCSE/IV	(3) PCSE/IV	(4) PCSE/IV	(5) PCSE/IV	(6) PCSE/IV
YEAR*INDIA				0.000		
				(-0.75)		
YEAR*INDONESIA				0.001		
				(2.62)***		
JAVA_WAR	0.073	0.053	0.053	0.067	0.058	0.050
	(0.95)	(0.69)	(0.69)	(0.85)	(0.74)	(0.62)
MUTINY	-0.060	-0.054	-0.053	-0.068	-0.071	-0.069
	(-0.68)	(-0.60)	(-0.60)	(-0.77)	(-0.82)	(-0.79)
SLAVE	0.246	0.204	0.204	0.204	0.199	0.208
	(5.78)***	(4.73)***	(4.71)***	(4.72)***	(4.53)***	(4.72)***
CIVIL_WAR	0.005	-0.027	-0.028	-0.025	-0.054	-0.019
	(0.14)	(-0.76)	(-0.78)	(-0.70)	(-1.49)	(-0.52)
WWI*ATLANTIC	-0.084	-0.023	-0.022	-0.038	0.010	-0.025
	(-1.55)	(-0.43)	(-0.41)	(-0.72)	(0.20)	(-0.47)
WWI*INDIA	0.071	0.124	0.125	0.132	0.110	0.081
	(1.67)*	(2.86)***	(2.88)***	(2.91)***	(2.56)**	(1.72)*
WWI*INDONESIA	0.163	0.197	0.197	0.189	0.226	0.227
	(5.38)***	(6.47)***	(6.48)***	(6.20)***	(7.24)***	(7.26)***
LOG_RATIO1	0.444	0.482	0.482	0.476	0.443	0.468
	(17.76)***	(18.58)***	(18.60)***	(18.40)***	(16.65)***	(18.04)***
N	1534	1534	1534	1534	1534	1534
Adjusted R-squared	0.79	0.79	0.79	0.79	0.80	0.79
F	155.62***	135.52***	135.32***	126.25***	136.58***	123.99***
LLC t-stat	-33.38***	-38.53***	-38.57***	-38.37***	-38.49***	-39.31***
Wooldridge exogeneity test chi-squared stat		58.92***	61.61***	52.65***	59.29***	52.52***
Wooldridge exogeneity test F stat		58.84***	61.48***	55.07***	29.72***	17.86***
Adjusted R-squared first stage		0.98	0.97	0.98		
Partial R-squared first stage		0.77	0.77	0.73		
Shea's partial R-squared first stage first inst					0.81	0.86
Shea's partial R-squared first stage second inst					0.80	0.74
Shea's partial R-squared first stage third inst						0.85
Adjusted partial R-squared first stage first inst					0.80	0.85
Adjusted partial R-squared first stage second inst					0.79	0.73
Adjusted partial R-squared first stage third inst						0.85
F first stage first inst		3769.16***	3749.19***	2422.04***	1957.87***	738.55***
F first stage second inst					2624.01***	1121.71***
F first stage third inst						562.546***

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and Appendix B

sea, it is still reasonable to assume exogeneity of freights. Nonetheless, we prefer to minimize this risk and thus we run also an instrumental variable (IV) version of the baseline regression, using as instrument the values of the trend component of *LOG_FREIGHT*, obtained with a Hodrick-Prescott filter. The series captures the (surely exogenous) effects of the decline of institutional barriers and technical progress, by discounting short term fluctuations, which can be driven by oscillations in the demand. The Wooldrige's (1995) statistics test the null hypothesis of endogenity, with a heteroskedasticity-robust covariance matrix (like all the IV's diagnostic tests). The first stage statistics test the quality of the instruments with measures of the strength of their association with the instrumented variables. Table 7 reports both versions of our baseline specification and the IV version of the additional specifications (the least squares versions are in table A6 of the Appendix B).

The overall performance of the model is good. The residuals are stationary, the combined variables are highly significant (F-test) and explain about four fifths of the total variance. Almost all the signs agree with expectations. The Wooldridge's (1995) tests find strong evidence of endogeneity in all cases: not so surprisingly, the change in the estimated coefficients across the least squares and IV specifications is sufficiently large to recommend the use of the latter. Predictably, all first stage tests find that the instruments are very highly correlated with the variables, so that the expected small-sample bias is low. Turning to the results:

i) Transport costs mattered as expected. The coefficients for freights are positive and highly significant, and remarkably stable across specifications. In the IV versions, a 10 per cent increase in freights augmented price gaps by about 0.8 per cent in the short run and by about 1.7 per cent in the long run. As column 4 shows, the coefficients differed according to the physical characteristics of each good: the impact of changes in transportation was average 2.5 times greater for bulky than for light products (column 5).[19] To some extent, this is purely a numerical effect: *ceteris paribus*, a given absolute change in transportation costs is bound to reduce less the price differential for high-value goods, as these costs account for a lower share of the price at origin. But the unit value of

[19] We distinguish "light" from "bulky" goods with the coefficient of product dummies in an OLS regression with *LOG_FREIGHT* as dependent variable, explained by a linear trend and by route and product dummies. The coefficients yield a ranking of commodities the lightest to the heaviest (silk, indigo, tin, cotton, tea, coffee, pepper, rubber, sugar, wheat, jute, saltpetre, linseed, rapeseed, and rice). Our distinction between the first nine products ("light") and the others ("bulky") closely mirrors the conventional one between "grain and seeds" and "lighter goods".

commodities affected also the choice of shipping technology, and thus ultimately the rate of change in costs: sailing ships have been employed for the long-distance transport of high value goods, such as tea, until the end of the 19th century. This product-specific effect can partly explain differences between countries (column 6). In fact, bulky goods accounted for half the observations for India (427 out of 839) and only a sixth for the East Indies (66 out of 427). However, the coefficient for the United States is a third lower than the Indian one, in spite of a similar share of bulky goods. Naturally, the numerical impact of freight factors on price gaps tends to decline with distance, too, but the result may also reflect differences in the demand for shipping services - most notably for return cargoes- and possibly differences in levels of transportation costs other than freights (e.g. port handling and fees).

ii) The variable *LOG_DUTY* is positive and significant, and coefficients in the IV versions are similar to those for freight factors – as one would expect given the similar percentage on the price of goods. The difference among country-specific coefficients (Column 6) is greater than for freights because duties differed by product much more than freight factors. The high coefficient for Atlantic trade reflects the impact of British Corn Laws, which were repealed in 1846; conversely, for products from India, a low coefficient is associated with particularly low duties, on average. The effects of monopolies are quite complex and somewhat unexpected. According to the baseline specification, with *LOG_FREIGHT* (column 1 and 2), the EIC widened the price differentials with India by at least 15 per cent, while apparently the NHM reduced them, without much difference before and after 1850. An official history of the Company claims that it sold at a loss to help Dutch middlemen to be competitive on the European market (NHM, 1924). It is also possible that the NHM increased the efficiency of the market, by improving the transmission of information and by reducing the risks. On the other hand, the result is not robust to small changes in specification (columns 4-6). Substituting our monopoly-adjusted series of freights (column 3) causes the coefficients for monopoly dummies to change as expected. The EIC increased price gaps, *ceteris paribus* by more than a third in the short run and by almost 70 per cent in the long run. The NHM dummies become positive as expected, but its coefficient(s) are about a quarter of the *EIC* one. This difference, however, does not imply that the Dutch monopoly system was less harmful than the EIC. In fact, the estimate deals exclusively with the effects on trade, neglecting the effects of Cultivation System. A comparison between columns 3 and the others suggests that the NHM affected negatively integration only because it charged high

freights, while the EIC also for its trading practices. The American AAA did not affect integration, while the NIVAS (in all specifications) and the VJSP (in some specifications) reduced price differentials.

iii) The market efficiency variables yield mixed results.[20] The variable *TELEGRAPH* is negative as expected and significant in all specifications but the panel baseline (Column 1). We have tried to interact it with a time trend, to capture the effect of technical progress and increases in transmission (or changes in policy to set rates), but the results are poor. Our results confirm the earlier work by Lew and Cater (2006), who stress the positive effect of telegraph on world trade. The high coefficient of the *SLAVE* variable highlights the market disrupting effect of the start of the campaign against slave-produced sugar in the United Kingdom, which caused an upward jump in the series (Table A1, Appendix A). In contrast, political shocks in producing countries seem not to have affected price differentials, although of course they may have had important consequences in producing areas. The dummies for *WWI* are positive and significant, as expected, for India and Dutch East Indies but not for the Atlantic. We interpret them as the effect of disruption in the market on top of war-related increase in transport costs, which should already be captured by the variable *LOG_FREIGHT*. For instance, the VJSP was set-up in 1917-1918 specifically to manage a shortage of transport (van der Eng, 1996: 215-216; Knight, 2010). The trends are significant only in the Dutch East Indies, where the variable is unexpectedly positive – i.e. *ceteris paribus* markets have been disintegrating. A decrease in efficiency is conceivable, but not so plausible. As an alternative, we speculate that this increase might reflect the increasing exposure to price shocks originating in other markets.

So far we have discussed the effect of each variable in isolation, but the key question is about their contribution to long-run convergence. We compute this latter as the percentage change in the *n-th* variable times the corresponding long-run elasticity and we compute its share on percentage change in price differentials over the covered period. In table 8, we report results for the long-run convergence from Waterloo to World War One as well as for its two phases, the “early globalization” (1815-1870)

[20] We have tested two additional measures of efficiency, total traded quantity and a dummy for fixed exchange rates between countries. Both are expected to be negative: more trade should increase the flow of information and fixed exchange rates should reduce the risks of trading. The dummy for fixed exchange rates is wrongly signed and not significant. The quantity variable is negative, but it worsens the overall results of the regression (available upon request). The former result suggests that more refined measures of exchange rate volatility than afforded by the available data are needed to adequately capture the effect of exchange rate regimes; the latter result can be expected given that quantities are endogenous to price gaps.

and the "heyday of globalization" (1870-1913), with coefficients from Table 7.[21] We also analyse the long-run change separately for the three routes (coefficients from Table A6, Appendix A).

Table 8
The causes of integration: decomposition analysis (in percentage)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	All	All	All	All	Atlantic	India	Indonesia
Years	1816-1913	1816-1870	1871-1913	1816-1913	1816-1913	1815-1913	1849-1913
EIC	33.58	43.60		57.73		70.06	
NHM1							42.33
LOG_DUTY	7.66	9.48	1.64	7.67	15.07	2.61	5.48
LOG_FREIGHT	43.53	54.34	66.32		52.75		
LOG_ ADJFREIGHTS				19.22		9.48	21.23
TELEGRAPH	12.54	2.51	44.64	12.69	11.01	9.26	15.05
Total	97.31	109.93	112.60	97.32	78.84	91.41	84.10

Sources: see the text and the Appendix B

The last row of Table 8 sums up the contributions of all variables: the model performs very well in the long run (columns 1 and 4) and fairly well in all other cases. In the long run, the contribution of trade liberalization (*LOG_DUTY*) and *TELEGRAPH* is rather modest. Most of the change is explained by changes in transportation costs and by the abolition of the EIC, which looms large in the long run analysis as the majority of observations in 1815 refer to India. According to the baseline specification (column 1), the fall in freights mattered more, but this conclusion is decidedly reversed if we use the coefficient from *LOG_ADJFREIGHTS* (column 4). The NHM does not appear among the variables in the aggregate analysis, because the series for the Dutch East Indies start later, but column (7) shows it played a similarly important role in the convergence of prices between the colony and Europe. By definition, institutional change did not contribute to convergence in the second period (column 3). This latter reflected mostly the fall in freights, with a very substantial contribution of the telegraph.

Summing up, our results strongly highlight the difference between the two periods. The "early globalization" was mostly determined by political decisions, while further convergence during the "heyday of globalization" was achieved thanks to the lay-out of the telegraph lines and to technical

[21] The exact starting date differs somewhat across products, in order to maximise the number of covered goods. We omit explicative variables which did not affect the dependent variables at the beginning and/or at the end of the period (such as the World War dummies). The cumulated change in the dependent variable is obtained as the average of the differences between the values fitted by the panel at time *0* and that of time *T* divided by the former.

progress in sea transportation. On the whole, political decisions mattered more in the long run because, as shown in section four, most of total convergence pre-dated 1870.

7) Who gained from market integration?

We estimate the welfare gains from price convergence with a modified version of the standard static partial equilibrium analysis of gains from trade liberalization – the Haberger triangles (Vousden, 1990). Following Hufbauer et al. (2002), we assume that price gaps remain non-zero (Federico, 2008). We obtain total gains from convergence (or losses from divergence) by summing up the estimates by product

$$\Delta\ DWL/GNP_i = \Delta P_i |\ \alpha - \beta\ | + 0.5 * \Delta P_i^{\ 2} * [\ \eta * \alpha_j + \varepsilon * \beta_j] \quad 3)$$

Where the subscript *i* refers to the product, η is the (absolute value of the) price elasticity of demand, ε is the price elasticity of supply, α and β are its shares of production and consumption, and ΔP_i is the percentage change in price. Our estimate, however, refer to changes in price differentials (Table 6). Their movement may reflect a fall in prices in consuming countries or an increase in producing countries, or both. The allocation of total change determined the distribution of gains from integration to Western consumers or Asian producers, but unfortunately we do not have information to apportion the change. Therefore, in Table 9 we adopt the simplest solution – i.e. to present the upper and lower bound of gains to producers as well as the compromise estimate of an equitable distribution. We assume $\eta=1.5$ and $\varepsilon=1$, but results are not very sensitive to changes in elasticity for a reasonable range of parameters. The shares α and β must be obtained from national accounts, which are detailed enough only since 1900 in India and, with some approximation, since 1880 in Dutch East Indies. We thus can compute only the cumulative gains from convergence on the eve of World War One. We consider separately the gains since 1816 – i.e. in the whole process of globalization-, or since 1870 (only during the "heyday"). We report full results by product in the Appendix A (Table A7) and we sum them up by country in Table 9.

Table 9
The welfare effect of price convergence (in percentage)

	(1) Equitable division	(2) 100 per cent producers	(3) 100 per cent consumers
1870-1913			
India	1.77	5.75	
Indonesia	0.43	0.89	
United States	0.03	0.08	
United Kindgom	0.51		1.10
1816-1913			
India	2.86	8.36	
Indonesia	0.60	1.28	
United States	0.25	0.68	
United Kindgom	1.35		3.05

Sources: see the text and Appendix B

The estimated gains are far from negligible, for a partial-equilibrium estimate. Note that gains are significantly greater in the long-run than during the "heyday of globalization" and that, in the equitable division, India gained substantially more than the United Kingdom. This was mainly thanks to wheat and especially rice; it therefore looks as if agricultural exports did contribute substantially to the growth of the Indian economy. It is worth stressing that we implicitly assume no changes in price differentials in periods not covered by our series – e.g. from 1816 or 1870 to 1891 for the series of tea from the East Indies, which starts in 1892. As these commodities were subject to the same forces which caused prices of other products to converge this assumption implies a negative bias. Moreover, our estimate refers only to a subset of exported goods, omitting other exports and all imports. In 1913, they accounted for about 50 per cent of total exports in India and for about 40 per cent in the Dutch East Indies (Table 3). Assuming that all flows benefitted from the same cut in prices from integration and all other parameters (elasticities and shares on consumption and production) were the same is clearly unrealistic: for instance, shares of consumption of imported goods were surely quite low. Anyway, this computation shows that aggregate gains from integration may have been quite substantial: a very crude estimate would place the static contribution of the first globalization to GDP to c. 3 per cent in the Dutch East Indies and to c. 11 per cent in British India.[22]

This raises an obvious question: who gained? Were gains evenly distributed among regions within each country and among agents? The consumption of wheat, tropical goods and textile manufactures

[22] By way of comparison, Hersh and Voth (2009) estimate that English consumers would have given up 15 per cent of their GDP in 1850 to maintain access to tea and sugar. From this perspective, the size of gains from the growth in world trade for European countries in the early modern era was of a similar order to that of the first globalization for Asian ones.

was widespread in the European population and the markets for their distribution were fairly competitive. Thus, the gains from convergence were in all likelihood evenly distributed in the consuming countries. This was not the case for producing ones. The production of most exports was geographically concentrated. In the United States, in 1913 seven states, all in the South, produced each more than 5 per cent of the whole cotton output, jointly accounting for 90 per cent of it.[23] In the Dutch East Indies, two provinces accounted for 74 per cent of exports of tin, 60 per cent of sugar and 45 per cent of pepper and coffee (Clemens et al., 1992, Tables 3 and 4). These areas were bound to benefit much more than the rest of the country from convergence. The effects of convergence in prices of staple goods, such as rice in India, depended on the level of integration of the domestic market. Our estimate assumes perfect integration –, e.g. that a change in prices in Rangoon extended to producers all over India. This is probably an unrealistic assumption, but there is strong evidence of growing integration in the second half of the 19th century in the domestic commodity market in the United States (Federico and Sharp, 2013), in India (Hurd, 1975; Studer, 2008; Andrabi and Kuehlwein, 2010) and also in the Dutch East Indies (Marks, 2010; van Zanden and Marks, 2012: 25-26).[24]

The distribution of gains within producing areas depended on the level of competition in the wholesale market for the export commodities. If the market is not competitive, most gains would accrue to merchants rather than to producers. The extreme case in point was surely the Cultivation System: the Dutch colonial administration used its power to extract a huge surplus for the far-away Dutch state. At the other end of the range, the United States have a solid reputation for being competitive, although American wheat farmers complained bitterly of being squeezed by railways companies and middlemen (Persson and Sharp, 2013). Also the markets for silk in China and Japan were broadly competitive, although far from perfect (Federico, 1997: 162-173). A source lists 32 firms exporting indigo from Bengal in 1840-1842, although six of them managed about two thirds of the total trade –, a fairly but not very high level of concentration.[25] However, indigo was extracted from a root, and thus benefits could accrue to industrialists rather than to cultivators. Indeed Ray (2011) argues that the final demise of the Bengal indigo industry was accelerated by a change in legislation to favor owners of indigo workshops over peasants. The boom of exports from the Dutch East Indies coincided with a

[23] Data from the ATICS data-base (Federico and Sharp, 2013). Wheat output was less concentrated: only 5 states (all in the West North Central) exceeded 5 per cent of production, with a total share 53 per cent.
[24] Interestingly, though, Collins (1999) finds only weak evidence of labour market integration in late ninenteenth-century India.
[25] Personal communication by M. Aldous.

boom of peasant production (Caldwell, 1964; Booth, 1988: 195-196; van der Eng, 1996: 231 ff.). These are only examples: the distribution of gains from integration is surely an important and highly promising venue for future research, but here it is impossible to pursue it further.

It is similarly beyond the scope of this paper to fully discuss the dynamic implications of integration and the Williamson's (2008, 2011, 2012) thesis. As a contribution to the debate, however, we estimate the contribution of price convergence to the improvement of terms of trade in India and the Dutch East Indies from 1850 onwards. To this aim, we compute counterfactual series of prices ratios by commodity assuming that monopolies had not been abolished, telegraphic connections had not been established, and that the duties and freight factors had remained constant at their initial level, in 1849 or 1871.[26] We extract the corresponding counterfactual series of export prices in producing countries, under the alternative hypothesis that producers got half or all the benefits from convergence (as in columns 1 and 2 of Table 9).[27] We use these counterfactual prices, as well as the actual prices for the same commodities, to compute indexes of export prices, which we divide by the import prices.[28] We thus obtain three sets of terms of trade, a "new" one with actual prices and two counterfactual ones; we can thus compute the contribution of price convergence to change in terms of trade (Table 10).[29]

Table 10
The contributions of price convergence to changes in the terms of trade (in percentage)

	India				Indonesia			
	Terms of trade		Contribution		Terms of trade		Contribution	
	Original	New	Half	All	Original	New	Half	All
1850-1870	12.3	-8.4	-76.2	-46.1	27.5	29.2	29.2	54
1870-1890	52.3	100.5	35.8	49.2	30.1	30.4	45.6	77.2
1890-1912	39.7	20.7	37.5	50.3	-25.6	-24.6	-4.4	-6.9

Sources: see the text and the Appendix B

[26] We compute the counterfactual ratio as CRP_{it}= *Exp (LOGPRit+0.70*(CEIC-*EIC_t*)+0.16*(CNHM1-*$NHM1_t$*)+0.089*(CNHM2-NHM2)+0.15*(LOGDUTY*$_{it\_0}$*-LOGDUTY*$_{it}$*)+0.17*(LOGADJFREIGHT*$_{it\_0}$*-LOGADJFREIGHT*$_{it}$*)- 0.10 (CTELEGRAPH - TELEGRAPH* $_{it}$*)*.The dummies for *CEIC* and *CNHM1* are 1 for India and Indonesia, while *CNHM2* and *CTELEGRAPH* are zero. Thus the terms *(CEIC-*EIC_t*)* and *(CNHM1-*$NHM1_t$*)* are *1* whenever the *EIC* and *NHM1* dummies are *0* (i.e. since 1817 and 1850 respectively) and the term *(CNHM2-NHM2)* is *-1* whenever the *NHM2* dummy is *1* (i.e. from 1850 until 1868) and 0 otherwise.

[27] We obtain the counterfactual export price series as $CP_{it}^{export\_all}=P_{it}^{import}/CRP_{it}$ and $CP_{it}^{export\_half}= P_{it}^{import}/[CRP_{it}-(CRP_{it}-RP_{it})*0.5]$, where *Pit* refers to the actual price series.

[28] We build separate price indexes for periods 1850-1870 and 1870-1913 to take into account the different composition of samples. The (Fisher) indexes for the Dutch East Indies include coffee, pepper, sugar and rice in 1850-1870 and coffee, pepper, sugar and tin in 1870-1913 (accounting respectively for about two thirds of exports in 1870 and for 28 per cent in 1913). For India, we compute a Laspeyres index for 1850-1870 including only jute, indigo linseed and rapeseed (using linseed as a proxy) and a Fisher for 1870-1913, adding cotton, wheat and rice. The coverage is quite poor for the first index (only 15 per cent in 1870) but it rises to 46 per cent for the 1870-1913 index in 1913. The import prices are from the sources underlying Figure 2.

[29] The contribution is computed thus: *Contribution=1-[(*$СП_t/СП_{t-1}$ *-1)*(П* $_t$ */ П* $_{t-1}$ *-1)]* where *П* and *СП* are the estimated and counterfactual indexes of terms of trade.

A look at the two columns on the right shows that our “new” index of terms of trade reproduces almost perfectly the long-term change of the original one for the Dutch East Indies, while it is less accurate for India. There, it seems, trends were significantly shaped by prices of exports to Asia, like opium and cotton manufactures, which we do not include in our data. The relevance of factors other than global market integration is also signalled by worsening in terms of trade in the Dutch East Indies in 1890-1912, and India 1850-1870 (for our subset only). In these cases, the positive effect of integration was not sufficiently large to determine the direction of change (negative sign). In 1890-1912, the contribution of integration with Europe was much lower for the Dutch Indies than for India: this difference may reflect the growth of export of petroleum and sugar from the Dutch East Indies to other Asian countries.

Yet, there is no doubt that global market integration emerges as a major determinant of the nineteenth terms of trade boom in Asia. In the baseline hypothesis of equitable division of gains (column “half”) price convergence accounted for as much as a third of improvement in terms of trade in India (after 1870) and in the Dutch Indies in 1850-1870 and for almost a half in the Dutch Indies in 1870-1890, where the overall increase was nevertheless smaller than in India at the same time. Of course, the contributions would be even higher if price rises in producing countries absorbed more than half total price convergence, up to the maximum of column “all”. Furthermore, these estimates only measure the contribution of integration of the increase in export prices, neglecting the effect of import prices. If price gaps for these latter had fallen as much as price gaps for exports, the total effect of world-wide integration would have been double.

8) Conclusion

Our results are relevant for two literatures, that on market integration and that on trade and growth in Asia, which, although clearly related, have so far remained largely distinct. Our work contributes to filling in gaps in the literature on global market integration, but our results strengthen the consensus view which is emerging from the literature on Europe (Federico, 2012). The process started early in the 19th century and it was determined to a large extent by institutional changes. Within Europe and between Europe and North America, barriers were raised essentially by protectionist trade policies, while commerce with Asia was hampered by the monopoly of Western trading companies. These

barriers were progressively abolished and, at least for the sample of products/routes we are considering, were only partially re-instated during the Great Depression. Once trade was free from institutional constraints, further convergence was mainly achieved by cutting transportation costs. These, however, at sea, in contrast to land, were fairly low already at the beginning of the 19th century and thus exhibited limited scope for improvement.

Was globalization a blessing or a curse for the Asian countries? We have shown that price convergence did imply sizeable static welfare gains, particularly in India. Future research should further illuminate how such benefits were shared between consumers in Europe and producers in Asia. Dynamic effects on the allocation of resources should have implied much more extensive gains than we were able to measure, but the same forces could have also acted as an impediment to industrialization and long-term growth in the periphery. In this latter vein, one could speculate that more significant static gains in British India than in the Dutch East Indies were achieved at the cost of a poorer performance in the long run. And yet, according to our estimates, the impact of market integration on terms of trade was about as big in the two cases, at least until the later nineteenth century. At its height, the influence of price convergence between Asia and Europe may well have been the main drive behind the nineteenth-century terms of trade boom in Asia. However, this was not the whole story. The role of intra-Asian trade, for one, would deserve to be examined, too.

Appendix A: Statistical Appendix

Table A1
Trends by series and endogenous periods: ECM regression

Good	Years	From	To	N. obs	Initial ratio	Half-life (months)	Rate (in percentage)	Cumulated change (in percentage)
Coffee	1835-1913	Batavia	Rotterdam	73	1.607	8	-0.577***	-34.37
Coffee	1835-1875	Batavia	Rotterdam	41	1.625	5	-0.591***	-21.52
Coffee	1878-1913	Batavia	Rotterdam	30	1.159	9	-0.117	-3.44
Cotton	1798-1845	Calcutta	London	48	3.162	12	-2.311***	-67.02
Cotton	1798-1817	Calcutta	London	20	3.202	4	-1.347	-23.61
Cotton	1820-1845	Calcutta	London	26	1.284	3	0.222	5.95
Cotton	1869-1938	Bombay	London	70	0.922	8	0.353***	28.02
Cotton	1869-1883	Bombay	London	15	1.197	0	-2.371***	-29.93
Cotton	1886-1938	Bombay	London	53	0.894	4	0.637***	40.17
Cotton	1803-1938	New York	Liverpool	136	1.432	16	-0.256***	-29.38
Cotton	1803-1845	New York	Liverpool	43	1.668	14	-0.689	-25.63
Cotton	1848-1938	New York	Liverpool	91	1.105	4	0.011	1.04
Indigo	1824-1931	Calcutta	London	105	1.444	25	-0.278	-25.34
Indigo	1824-1856	Calcutta	London	33	1.983	4	-1.477***	-38.59
Indigo	1859-1931	Calcutta	London	71	0.919	3	0.469***	39.50
Jute	1846-1938	Calcutta	London	93	2.054	9	-1.004***	-60.68
Jute	1846-1907	Calcutta	London	62	2.481	5	-1.760***	-66.41
Jute	1910-1938	Calcutta	London	29	1.027	7	-0.057	-1.64
Linseed	1848-1938	Calcutta	London	91	1.501	18	-0.292*	-23.34
Linseed	1848-1869	Calcutta	London	22	1.945	5	-2.053***	-36.34
Linseed	1872-1913	Calcutta	London	42	1.338	0	-0.432***	-16.60
Linseed	1916-1938	Calcutta	London	23	1.620	10	-2.111*	-38.46
Pepper	1830-1938	Batavia	Amsterdam	103	1.835	26	-0.328*	-28.68
Pepper	1830-1849	Batavia	Amsterdam	20	1.823	9	0.631	13.44
Pepper	1852-1912	Batavia	Amsterdam	55	1.721	12	-0.734***	-33.20
Pepper	1915-1938	Batavia	Amsterdam	24	2.027	9	-2.031	-38.58
Rapeseed	1873-1921	Calcutta	London	49	1.329	17	-0.140	-6.62
Rapeseed	1873-1903	Calcutta	London	31	1.394	0	-0.486**	-13.98
Rapeseed	1906-1921	Calcutta	London	16	1.045	11	2.846	57.68

Table A1-continued

Good	Years	From	To	N. obs	Initial ratio	Half-life (months)	Rate (in percentage)	Cumulated change (in percentage)
Rice	1850-1913	Batavia	Amsterdam	64	1.989	11	-0.727***	-37.19
Rice	1850-1870	Batavia	Amsterdam	21	2.140	4	-0.746	-14.50
Rice	1873-1913	Batavia	Amsterdam	41	1.450	6	-0.135	-5.40
Rice	1872-1938	Rangoon	London	67	1.344	30	0.341	25.69
Rice	1872-1913	Rangoon	London	42	1.705	7	-0.923***	-32.13
Rice	1916-1938	Rangoon	London	23	3.030	12	-4.285***	-62.67
Rubber	1915-1938	Batavia	London	24	1.135	7	-0.358	-8.23
Rubber[a]	1913-1917	Batavia	London	5	0.974		7.518***	45.63
Rubber	1920-1938	Batavia	London	19	0.975	3	0.738	15.05
Saltpetre	1798-1853	Calcutta	London	56	5.667	46	-2.488**	-75.17
Saltpetre	1798-1815	Calcutta	London	18	4.281	16	3.036	72.71
Saltpetre	1818-1853	Calcutta	London	36	1.886	14	-0.067	-2.37
Silk	1798-1856	Calcutta	London	59	2.396	16	-1.442***	-56.67
Silk	1798-1819	Calcutta	London	22	1.875	7	1.362	34.92
Silk	1822-1834	Calcutta	London	13	1.316	3	0.704	9.59
Silk	1837-1856	Calcutta	London	20	1.461	2	-2.372**	-37.77
Silk	1859-1877	Calcutta	Lyon	17	1.178	0	-0.701	-11.24
Silk	1836-1877	Canton	London	10	1.320	0	0.233	2.35
Silk	1876-1913	China	London	38	1.258	15	-0.353***	-12.23
Silk	1876-1914	China	Lyon	39	1.178	19	-0.054	-2.07
Silk	1876-1903	China	Lyon	28	1.267	6	-0.568**	-14.71
Silk	1906-1914	China	Lyon	9	0.963	0	4.398***	48.56
Silk	1896-1938	Yokohama	New York	43	1.149	2	-0.128***	-5.47
Silk	1896-1914	Yokohama	Lyon	19	1.168	5	-0.352	-6.47
Sugar	1798-1856	Calcutta	London	59	2.422	38	-1.269**	-52.70
Sugar	1798-1817	Calcutta	London	20	2.695	8	-0.894	-16.38
Sugar	1820-1838	Calcutta	London	19	1.368	4	-0.415	-7.59
Sugar	1841-1856	Calcutta	London	16	1.440	22	-1.562	-22.11
Sugar	1824-1938	Batavia	London	115	1.641	18	-0.406***	-37.31
Sugar	1824-1842	Batavia	London	19	1.194	17	3.576	97.27
Sugar	1845-1875	Batavia	London	31	1.481	4	-0.435*	-12.61

Table A1-continued

Good	Years	From	To	N. obs	Initial ratio	Half-life (months)	Rate (in percentage)	Cumulated change (in percentage)
Sugar	1878-1914	Batavia	London	37	1.173	5	-0.214*	-7.60
Sugar	1917-1938	Batavia	London	22	1.506	7	-2.353**	-40.40
Tea	1895-1931	Calcutta	London	37	1.382	12	-0.166	-5.94
Tea	1895-1905	Calcutta	London	11	1.564	0	-1.359**	-13.88
Tea	1908-1915	Calcutta	London	8	1.055	0	2.846**	25.56
Tea	1918-1931	Calcutta	London	14	2.084	0	-5.547***	-54.00
Tea	1813-1831	Canton	England	19	2.466	4	-1.552***	-25.54
Tea	1813-1823	Canton	England	11	2.458	0	-1.631***	-16.42
Tea	1826-1831	Canton	England	6	2.095	0	-3.616**	-19.50
Tea	1821-1877	Canton	London	23	1.997	12	-1.398**	-27.50
Tea	1821-1834	Canton	London	14	1.922	11	0.659	9.67
Tea	1837-1877	Canton	London	7	1.037	5	0.076	0.53
Tea	1895-1938	Batavia	Amsterdam	44	1.154	6	0.272	12.73
Tin	1865-1913	Batavia	Amsterdam	49	1.206	3	-0.309***	-14.06
Tin	1865-1871	Batavia	Amsterdam	7	1.168	0	1.469**	10.83
Tin	1874-1913	Batavia	Amsterdam	40	1.149	0	-0.232***	-8.86
Wheat	1863-1931	Calcutta	London	54	1.632	3	-0.809***	-35.38
Wheat	1863-1894	Calcutta	London	29	1.613	0	-0.447	-12.15
Wheat	1897-1931	Calcutta	London	23	1.078	0	-0.115	-2.61
Wheat	1802-1937	New York	London	121	1.828	16	-0.584***	-50.67
Wheat	1802-1846	New York	London	45	1.541	9	0.447	22.29
Wheat	1849-1878	New York	London	27	1.318	3	-0.543**	-13.65
Wheat	1881-1937	New York	London	45	1.011	11	-0.171	-7.42

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Notes: [a] there are not enough observations for the ECM regression in this case.

Sources: see the text and Appendix B

Table A2
Stationarity tests: Augmented Dickey Fuller and Kwiatkowski-Phillips-Schmidt-Shin

			LOG_RATIO			
Good	From	To	ADF t-stat	Stationary?	LM-Stat	Stationary?
Coffee	Batavia	Rotterdam	-2.497	No	1.111***	No
Cotton	Calcutta	London	-2.445	No	0.813***	No
Cotton	Bombay	London	-5.214***	Yes	0.466**	No
Cotton	New York	Liverpool	-5.822***	Yes	0.714**	No
Indigo	Calcutta	London	-2.967**	Yes	0.568**	No
Jute	Calcutta	London	-2.174	No	1.150***	No
Linseed	Calcutta	London	-4.025***	Yes	0.593**	No
Pepper	Batavia	Amsterdam	-3.941***	Yes	0.551**	No
Rapeseed	Calcutta	London	-3.366**	Yes	0.121	Yes
Rice	Batavia	Amsterdam	-4.177***	Yes	0.977***	No
Rice	Rangoon	London	-3.553***	Yes	0.113	Yes
Rubber	Batavia	London	-3.803***	Yes	0.151	Yes
Saltpetre	Calcutta	London	-2.004	No	0.737**	No
Silk	Calcutta	London	-2.490	No	0.902***	No
Silk	Calcutta	Lyon	-3.658**	Yes	0.406*	No
Silk	Canton	London			0.183	Yes
Silk	China	London	-3.577**	Yes	0.454*	No
Silk	China	Lyon	-3.181**	Yes	0.262	Yes
Silk	Yokohama	Lyon	-1.653	No	0.372	No
Silk	Yokohama	New York	-5.370***	Yes	0.243	Yes
Sugar	Calcutta	London	-2.160	No	0.708***	No
Sugar	Batavia	London	-4.137***	Yes	0.868***	No
Tea	Calcutta	London	-4.060***	Yes	0.101	Yes
Tea	Canton	England	0.001	No	0.596***	No
Tea	Canton	London			0.762***	No
Tea	Batavia	Amsterdam	-4.957***	Yes	0.188	Yes
Tin	Batavia	Amsterdam	-3.849***	Yes	0.766***	No
Wheat	Calcutta	London	-4.057***	Yes	0.979***	No
Wheat	New York	London	-1.582	No	1.256***	No

Table A2-continued

			LOG_DUTY			
Good	From	To	ADF t-stat	Stationary?	LM-Stat	Stationary?
Coffee	Batavia	Rotterdam	-2.259	No	0.304	Yes
Cotton	Calcutta	London	-0.957	No	0.663**	No
Cotton	Bombay	London			0.425*	No
Cotton	New York	Liverpool	-2.623*	Yes	0.752***	No
Indigo	Calcutta	London	-1.568	No	0.875***	No
Jute	Calcutta	London	-3.954***	Yes	0.472**	No
Linseed	Calcutta	London	-2.865*	Yes	0.445*	No
Pepper	Batavia	Amsterdam	-2.401	No	0.228	Yes
Rapeseed	Calcutta	London			0.405*	No
Rice	Batavia	Amsterdam	-2.302	No	0.643**	No
Rice	Rangoon	London			0.401*	No
Rubber	Batavia	London	0.072	No	0.468**	No
Saltpetre	Calcutta	London	-5.448***	Yes	0.520**	No
Silk	Calcutta	London	-1.067	No	0.694**	No
Silk	Calcutta	Lyon	-0.524	No	0.503**	No
Silk	Canton	London				
Silk	China	London				
Silk	China	Lyon				
Silk	Yokohama	Lyon				
Silk	Yokohama	New York				
Sugar	Calcutta	London	-2.328	No	0.236	Yes
Sugar	Batavia	London	-2.046	No	0.673**	No
Tea	Calcutta	London				
Tea	Canton	England				
Tea	Canton	London				
Tea	Batavia	Amsterdam	-4.719***	Yes	0.422*	No
Tin	Batavia	Amsterdam	-2.774*	Yes	0.268	Yes
Wheat	Calcutta	London			0.676**	No
Wheat	New York	London	-2.616*	Yes	0.847***	No

Table A2-continued

			LOG_FREIGHT			
Good	From	To	ADF t-stat	Stationary?	LM-Stat	Stationary?
Coffee	Batavia	Rotterdam	-1.353	No	1.138***	No
Cotton	Calcutta	London	-1.715	No	0.728**	No
Cotton	Bombay	London	-3.200**	Yes	0.280	Yes
Cotton	New York	Liverpool	-2.791*	Yes	0.626**	No
Indigo	Calcutta	London	-2.837*	Yes	0.803***	No
Jute	Calcutta	London	-2.789*	Yes	1.089***	No
Linseed	Calcutta	London	-2.950**	Yes	0.754***	No
Pepper	Batavia	Amsterdam	-2.165	No	0.921***	No
Rapeseed	Calcutta	London	-2.674*	Yes	0.159	Yes
Rice	Batavia	Amsterdam	-1.289	No	0.995***	No
Rice	Rangoon	London	-3.145**	Yes	0.215	Yes
Rubber	Batavia	London	-2.697*	Yes	0.383	No
Saltpetre	Calcutta	London	-1.598	No	0.783***	No
Silk	Calcutta	London	-1.635	No	0.817***	No
Silk	Calcutta	Lyon	-1.819	No	0.149	Yes
Silk	Canton	London				
Silk	China	London				
Silk	China	Lyon				
Silk	Yokohama	Lyon				
Silk	Yokohama	New York				
Sugar	Calcutta	London	-1.729	No	0.764***	No
Sugar	Batavia	London	-4.308***	Yes	0.431*	No
Tea	Calcutta	London	-2.455	No	0.146	Yes
Tea	Canton	England				
Tea	Canton	London				
Tea	Batavia	Amsterdam	-3.382**	Yes	0.073	Yes
Tin	Batavia	Amsterdam	-1.277	No	0.852***	No
Wheat	Calcutta	London	-3.544**	Yes	1.097***	No
Wheat	New York	London	-2.653*	Yes	1.216***	No

Table A2-continued

			LOG_FREIGHT_ADJ			
Good	From	To	ADF t-stat	Stationary?	LM-Stat	Stationary?
Coffee	Batavia	Rotterdam	-3.323**	Yes	0.523**	No
Cotton	Calcutta	London	-3.633***	Yes	0.373*	No
Cotton	Bombay	London	-3.200**	Yes	0.280	Yes
Cotton	New York	Liverpool	-2.791*	Yes	0.626**	No
Indigo	Calcutta	London	-2.837*	Yes	0.803***	No
Jute	Calcutta	London	-2.789*	Yes	1.089***	No
Linseed	Calcutta	London	-2.950**	Yes	0.754***	No
Pepper	Batavia	Amsterdam	-3.007**	Yes	0.438*	No
Rapeseed	Calcutta	London	-2.674**	Yes	0.159	Yes
Rice	Batavia	Amsterdam	-2.209	No	0.630**	No
Rice	Rangoon	London	-3.145**	Yes	0.215	Yes
Rubber	Batavia	London	-2.697**	Yes	0.383*	No
Saltpetre	Calcutta	London	-3.410**	Yes	0.338	Yes
Silk	Calcutta	London	-4.013***	Yes	0.685**	No
Silk	Calcutta	Lyon	-1.819	No	0.149	Yes
Silk	Canton	London				
Silk	China	London				
Silk	China	Lyon				
Silk	Yokohama	Lyon				
Silk	Yokohama	New York				
Sugar	Calcutta	London	-3.600***	Yes	0.181	Yes
Sugar	Batavia	London	-3.805***	Yes	0.968***	No
Tea	Calcutta	London	-2.455	No	0.146	Yes
Tea	Canton	England				
Tea	Canton	London				
Tea	Batavia	Amsterdam	-3.382**	Yes	0.073	Yes
Tin	Batavia	Amsterdam	-0.842	No	0.647**	No
Wheat	Calcutta	London	-3.544**	Yes	1.097***	No
Wheat	New York	London	-2.653**	Yes	1.216***	No

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and Appendix B

Table A3
Panel regression: descriptive statistics

	Description	N. obs	Mean	Std. Dev.	Min	Max
LOG_RP	Log of price ratio	1534	0.313	0.337	-0.704	2.168
LOG_DUTY	Log of duty factor+1	1534	0.123	0.262	0	1.680
ATLANTIC	Dummy for Atlantic trade	1534	0.151	0.358	0	1
INDIA	Dummy for Indian trade	1534	0.535	0.499	0	1
INDONESIA	Dummy for Indonesian trade	1534	0.314	0.464	0	1
EIC	Dummy for the EIC, 1797-1816, Indian trade	1534	0.052	0.222	0	1
NHM1	Dummy for the NHM, 1823-1850, Indonesian trade	1534	0.044	0.206	0	1
NHM2	Dummy for the NHM, 1851-1868, Indonesian trade	1534	0.048	0.213	0	1
AAA	Dummy for the AAA on cotton exports, 1934 ff., Atlantic trade	1534	0.003	0.057	0	1
VJSP	Dummy for the private marketing board for Java sugar, 1918-1931	1534	0.009	0.095	0	1
NIVAS	Dummy for the private marketing board for Java sugar, 1932 ff.	1534	0.005	0.067	0	1
LOG_FREIGHT	Log of freight factor	1534	-2.721	1.506	-7.044	1.972
LOG_FREIGHT_ADJ	Log of freight factor net of monopolies' mark-ups	1534	-2.935	1.420	-7.044	1.972
LOG_FREIGHT_HP_SMOOTH	HP smoothed trend of log of freight factor	1534	-2.723	1.473	-6.897	0.959
LOG_FREIGHT_ADJ_HP_SMOOTH	HP smoothed trend of log of freight factor net of monopolies' mark-ups	1534	-2.937	1.383	-6.898	0.644
LIGHT	Dummy for freight factors less than for wheat	1534	0.613	0.487	0	1
BULKY	Dummy for freight factors equal or more than for wheat	1534	0.387	0.487	0	1
TELEGRAPH	Dummy for telegraphic connection, 1867 ff. for Atlantic and 1875 ff. for Indian Ocean trades	1534	0.578	0.494	0	1
YEAR	Year	1534	1878.226	35.921	1797	1938
JAVA_WAR	Dummy for Java War, 1825-1827, Indonesian trade	1534	0.002	0.044	0	1
MUTINY	Dummy for Indian mutiny, 1857-1859, Indian trade	1534	0.005	0.067	0	1
SLAVE	Dummy for ban on West Indian sugar, Java and Indian sugar, 1840-1845	1534	0.008	0.088	0	1
CIVIL_WAR	Dummy for American Civil War, 1861-1865, Atlantic trade	1534	0.007	0.081	0	1
WWI	Dummy for World War I, 1914-1918	1534	0.038	0.192	0	1

Sources: see the text and Appendix B

Table A4
Panel regression: correlation matrix of the independent variables

	LOG_DUTY	LOG_DUTY*ATLANTIC	LOG_DUTY*INDIA	LOG_DUTY*INDONESIA	EIC
LOG_DUTY	1.000	0.362	0.492	0.714	0.217
LOG_DUTY*ATLANTIC	0.362	1.000	-0.046	-0.046	-0.037
LOG_DUTY*INDIA	0.492	-0.046	1.000	-0.088	0.494
LOG_DUTY*INDONESIA	0.714	-0.046	-0.088	1.000	-0.070
EIC	0.217	-0.037	0.494	-0.070	1.000
NHM1	0.320	-0.034	-0.064	0.472	-0.051
NHM2	0.030	-0.035	-0.066	0.105	-0.052
AAA	-0.027	-0.009	-0.017	-0.017	-0.013
VJSP	0.162	-0.015	-0.028	0.235	-0.023
NIVAS	0.140	-0.011	-0.020	0.199	-0.016
LOG_FREIGHT	0.187	0.116	0.182	0.042	0.286
LOG_FREIGHT_ADJ	0.060	0.146	0.084	-0.065	0.052
LOG_FREIGHT*LIGHT	0.038	0.150	0.044	-0.066	0.121
LOG_FREIGHT*BULKY	0.202	-0.121	0.181	0.189	0.186
LOG_FREIGHT*ATLANTIC	0.084	-0.184	0.118	0.119	0.094
LOG_FREIGHT*INDIA	0.183	0.116	-0.068	0.221	0.062
LOG_FREIGHT*INDONESIA	-0.093	0.097	0.184	-0.307	0.146
TELEGRAPH	-0.314	-0.158	-0.346	-0.058	-0.275
YEAR*ATLANTIC	-0.018	0.360	-0.125	-0.125	-0.099
YEAR*INDIA	-0.170	-0.167	0.260	-0.319	0.202
YEAR*INDONESIA	0.181	-0.105	-0.200	0.436	-0.159
JAVA_WAR	0.217	-0.007	-0.013	0.290	-0.010
MUTINY	-0.031	-0.011	-0.019	-0.020	-0.016
SLAVE	0.280	-0.014	0.138	0.262	-0.021
CIVIL_WAR	-0.034	-0.003	-0.024	-0.024	-0.019
WWI*ATLANTIC	-0.024	-0.008	-0.015	-0.015	-0.012
WWI*INDIA	-0.072	-0.024	-0.045	-0.045	-0.036
WWI*INDONESIA	0.028	-0.018	-0.034	0.070	-0.027
LOG_RATIO1	0.187	0.057	0.267	0.010	0.550

Table A4-continued

	NHM1	NHM2	AAA	VJSP	NIVAS
LOG_DUTY	0.320	0.030	-0.027	0.162	0.140
LOG_DUTY*ATLANTIC	-0.034	-0.035	-0.009	-0.015	-0.011
LOG_DUTY*INDIA	-0.064	-0.066	-0.017	-0.028	-0.020
LOG_DUTY*INDONESIA	0.472	0.105	-0.017	0.235	0.199
EIC	-0.051	-0.052	-0.013	-0.023	-0.016
NHM1	1.000	-0.048	-0.012	-0.021	-0.015
NHM2	-0.048	1.000	-0.013	-0.022	-0.015
AAA	-0.012	-0.013	1.000	-0.006	-0.004
VJSP	-0.021	-0.022	-0.006	1.000	-0.007
NIVAS	-0.015	-0.015	-0.004	-0.007	1.000
LOG_FREIGHT	0.143	0.089	-0.024	0.026	0.023
LOG_FREIGHT_ADJ	-0.060	-0.045	-0.017	0.042	0.034
LOG_FREIGHT*LIGHT	0.039	0.028	-0.038	-0.012	-0.005
LOG_FREIGHT*BULKY	0.135	0.077	0.037	0.061	0.043
LOG_FREIGHT*ATLANTIC	0.086	0.089	-0.167	0.038	0.027
LOG_FREIGHT*INDIA	0.160	0.166	0.043	0.072	0.050
LOG_FREIGHT*INDONESIA	-0.111	-0.175	0.036	-0.087	-0.057
TELEGRAPH	-0.252	-0.262	0.049	0.082	0.058
YEAR*ATLANTIC	-0.091	-0.094	0.141	-0.040	-0.029
YEAR*INDIA	-0.231	-0.240	-0.061	-0.103	-0.073
YEAR*INDONESIA	0.307	0.323	-0.039	0.146	0.104
JAVA_WAR	0.206	-0.010	-0.003	-0.004	-0.003
MUTINY	-0.015	-0.015	-0.004	-0.007	-0.005
SLAVE	0.197	-0.020	-0.005	-0.009	-0.006
CIVIL_WAR	-0.017	-0.018	-0.005	-0.008	-0.006
WWI*ATLANTIC	-0.011	-0.011	-0.003	-0.005	-0.004
WWI*INDIA	-0.033	-0.034	-0.009	-0.015	-0.010
WWI*INDONESIA	-0.025	-0.026	-0.007	0.049	-0.008
LOG_RATIO1	0.136	0.088	-0.025	-0.019	-0.054

Table A4-continued

	LOG_FREIGHT	LOG_FREIGHT_ADJ	LOG_FREIGHT*LIGHT	LOG_FREIGHT*BULKY	LOG_FREIGHT*ATLANTIC
LOG_DUTY	0.187	0.060	0.038	0.202	0.084
LOG_DUTY*ATLANTIC	0.116	0.146	0.150	-0.121	-0.184
LOG_DUTY*INDIA	0.182	0.084	0.044	0.181	0.118
LOG_DUTY*INDONESIA	0.042	-0.065	-0.066	0.189	0.119
EIC	0.286	0.052	0.121	0.186	0.094
NHM1	0.143	-0.060	0.039	0.135	0.086
NHM2	0.089	-0.045	0.028	0.077	0.089
AAA	-0.024	-0.017	-0.038	0.037	-0.167
VJSP	0.026	0.042	-0.012	0.061	0.038
NIVAS	0.023	0.034	-0.005	0.043	0.027
LOG_FREIGHT	1.000	0.936	0.862	-0.198	0.058
LOG_FREIGHT_ADJ	0.936	1.000	0.868	-0.305	0.002
LOG_FREIGHT*LIGHT	0.862	0.868	1.000	-0.667	-0.047
LOG_FREIGHT*BULKY	-0.198	-0.305	-0.667	1.000	0.176
LOG_FREIGHT*ATLANTIC	0.058	0.002	-0.047	0.176	1.000
LOG_FREIGHT*INDIA	0.561	0.513	0.452	-0.050	-0.297
LOG_FREIGHT*INDONESIA	0.272	0.303	0.337	-0.253	-0.248
TELEGRAPH	-0.248	-0.087	-0.052	-0.264	-0.055
YEAR*ATLANTIC	0.007	0.071	0.104	-0.190	-0.953
YEAR*INDIA	0.104	0.149	0.132	-0.103	0.428
YEAR*INDONESIA	-0.129	-0.218	-0.224	0.244	0.270
JAVA_WAR	0.032	-0.010	0.010	0.028	0.018
MUTINY	0.048	0.061	0.048	-0.022	0.027
SLAVE	0.038	0.003	-0.001	0.057	0.036
CIVIL_WAR	-0.015	-0.004	0.001	-0.023	-0.207
WWI*ATLANTIC	0.028	0.037	0.004	0.033	-0.076
WWI*INDIA	0.121	0.152	0.059	0.064	0.061
WWI*INDONESIA	-0.004	0.013	-0.041	0.074	0.046
LOG_RATIO1	0.527	0.363	0.298	0.199	0.216

Table A4-continued

	LOG_FREIGHT*INDIA	LOG_FREIGHT*INDONESIA	TELEGRAPH	YEAR*ATLANTIC	YEAR*INDIA
LOG_DUTY	0.183	-0.093	-0.314	-0.018	-0.170
LOG_DUTY*ATLANTIC	0.116	0.097	-0.158	0.360	-0.167
LOG_DUTY*INDIA	-0.068	0.184	-0.346	-0.125	0.260
LOG_DUTY*INDONESIA	0.221	-0.307	-0.058	-0.125	-0.319
EIC	0.062	0.146	-0.275	-0.099	0.202
NHM1	0.160	-0.111	-0.252	-0.091	-0.231
NHM2	0.166	-0.175	-0.262	-0.094	-0.240
AAA	0.043	0.036	0.049	0.141	-0.061
VJSP	0.072	-0.087	0.082	-0.040	-0.103
NIVAS	0.050	-0.057	0.058	-0.029	-0.073
LOG_FREIGHT	0.561	0.272	-0.248	0.007	0.104
LOG_FREIGHT_ADJ	0.513	0.303	-0.087	0.071	0.149
LOG_FREIGHT*LIGHT	0.452	0.337	-0.052	0.104	0.132
LOG_FREIGHT*BULKY	-0.050	-0.253	-0.264	-0.190	-0.103
LOG_FREIGHT*ATLANTIC	-0.297	-0.248	-0.055	-0.953	0.428
LOG_FREIGHT*INDIA	1.000	-0.463	0.005	0.313	-0.698
LOG_FREIGHT*INDONESIA	-0.463	1.000	-0.216	0.262	0.667
TELEGRAPH	0.005	-0.216	1.000	-0.010	-0.054
YEAR*ATLANTIC	0.313	0.262	-0.010	1.000	-0.452
YEAR*INDIA	-0.698	0.667	-0.054	-0.452	1.000
YEAR*INDONESIA	0.504	-0.923	0.100	-0.285	-0.726
JAVA_WAR	0.033	-0.020	-0.052	-0.019	-0.048
MUTINY	-0.010	0.042	-0.079	-0.029	0.062
SLAVE	0.013	-0.002	-0.104	-0.037	-0.008
CIVIL_WAR	0.060	0.050	-0.095	0.191	-0.087
WWI*ATLANTIC	0.038	0.032	0.044	0.125	-0.055
WWI*INDIA	-0.013	0.095	0.131	-0.064	0.149
WWI*INDONESIA	0.086	-0.139	0.098	-0.048	-0.123
LOG_RATIO1	0.201	0.134	-0.475	-0.177	0.151

Table A4-continued

	YEAR*INDONESIA	JAVA_WAR	MUTINY	SLAVE	CIVIL_WAR
LOG_DUTY	0.181	0.217	-0.031	0.280	-0.034
LOG_DUTY*ATLANTIC	-0.105	-0.007	-0.011	-0.014	-0.003
LOG_DUTY*INDIA	-0.200	-0.013	-0.019	0.138	-0.024
LOG_DUTY*INDONESIA	0.436	0.290	-0.020	0.262	-0.024
EIC	-0.159	-0.010	-0.016	-0.021	-0.019
NHM1	0.307	0.206	-0.015	0.197	-0.017
NHM2	0.323	-0.010	-0.015	-0.020	-0.018
AAA	-0.039	-0.003	-0.004	-0.005	-0.005
VJSP	0.146	-0.004	-0.007	-0.009	-0.008
NIVAS	0.104	-0.003	-0.005	-0.006	-0.006
LOG_FREIGHT	-0.129	0.032	0.048	0.038	-0.015
LOG_FREIGHT_ADJ	-0.218	-0.010	0.061	0.003	-0.004
LOG_FREIGHT*LIGHT	-0.224	0.010	0.048	-0.001	0.001
LOG_FREIGHT*BULKY	0.244	0.028	-0.022	0.057	-0.023
LOG_FREIGHT*ATLANTIC	0.270	0.018	0.027	0.036	-0.207
LOG_FREIGHT*INDIA	0.504	0.033	-0.010	0.013	0.060
LOG_FREIGHT*INDONESIA	-0.923	-0.020	0.042	-0.002	0.050
TELEGRAPH	0.100	-0.052	-0.079	-0.104	-0.095
YEAR*ATLANTIC	-0.285	-0.019	-0.029	-0.037	0.191
YEAR*INDIA	-0.726	-0.048	0.062	-0.008	-0.087
YEAR*INDONESIA	1.000	0.062	-0.046	0.033	-0.055
JAVA_WAR	0.062	1.000	-0.003	-0.004	-0.004
MUTINY	-0.046	-0.003	1.000	-0.006	-0.006
SLAVE	0.033	-0.004	-0.006	1.000	-0.007
CIVIL_WAR	-0.055	-0.004	-0.006	-0.007	1.000
WWI*ATLANTIC	-0.035	-0.002	-0.004	-0.005	-0.004
WWI*INDIA	-0.103	-0.007	-0.010	-0.014	-0.012
WWI*INDONESIA	0.174	-0.005	-0.008	-0.010	-0.009
LOG_RATIO1	-0.048	0.029	0.013	0.110	-0.023

Table A4-continued

	WWI*ATLANTIC	WWI*INDIA	WWI*INDONESIA	LOG_RATIO1
LOG_DUTY	-0.024	-0.072	0.028	0.187
LOG_DUTY*ATLANTIC	-0.008	-0.024	-0.018	0.057
LOG_DUTY*INDIA	-0.015	-0.045	-0.034	0.267
LOG_DUTY*INDONESIA	-0.015	-0.045	0.070	0.010
EIC	-0.012	-0.036	-0.027	0.550
NHM1	-0.011	-0.033	-0.025	0.136
NHM2	-0.011	-0.034	-0.026	0.088
AAA	-0.003	-0.009	-0.007	-0.025
VJSP	-0.005	-0.015	0.049	-0.019
NIVAS	-0.004	-0.010	-0.008	-0.054
LOG_FREIGHT	0.028	0.121	-0.004	0.527
LOG_FREIGHT_ADJ	0.037	0.152	0.013	0.363
LOG_FREIGHT*LIGHT	0.004	0.059	-0.041	0.298
LOG_FREIGHT*BULKY	0.033	0.064	0.074	0.199
LOG_FREIGHT*ATLANTIC	-0.076	0.061	0.046	0.216
LOG_FREIGHT*INDIA	0.038	-0.013	0.086	0.201
LOG_FREIGHT*INDONESIA	0.032	0.095	-0.139	0.134
TELEGRAPH	0.044	0.131	0.098	-0.475
YEAR*ATLANTIC	0.125	-0.064	-0.048	-0.177
YEAR*INDIA	-0.055	0.149	-0.123	0.151
YEAR*INDONESIA	-0.035	-0.103	0.174	-0.048
JAVA_WAR	-0.002	-0.007	-0.005	0.029
MUTINY	-0.004	-0.010	-0.008	0.013
SLAVE	-0.005	-0.014	-0.010	0.110
CIVIL_WAR	-0.004	-0.012	-0.009	-0.023
WWI*ATLANTIC	1.000	-0.008	-0.006	-0.028
WWI*INDIA	-0.008	1.000	-0.018	0.035
WWI*INDONESIA	-0.006	-0.018	1.000	-0.002
LOG_RATIO1	-0.028	0.035	-0.002	1.000

Sources: see the text and Appendix B

Table A5
The causes of integration: panel least squares results

	(1)	(2)	(3)	(4)
	PCSE	PCSE	PCSE	PCSE
C	0.524	-1.117	0.487	0.533
	(17.27)***	(-1.65)*	(16.61)***	(16.88)***
LOG_DUTY	0.073	0.082	0.063	
	(3.34)***	(3.65)***	(2.83)***	
LOG_DUTY*ATLANTIC				0.102
				(2.74)***
LOG_DUTY*INDIA				0.003
				(0.04)
LOG_DUTY*INDONESIA				0.082
				(2.65)***
EIC	0.389	0.160	0.216	0.106
	(11.75)***	(4.53)***	(6.19)***	(2.73)***
NHM1	0.112	-0.037	-0.026	-0.007
	(4.80)***	(-1.12)	(-1.04)	(-0.25)
NHM2	0.082	-0.032	-0.030	0.005
	(3.84)***	(-1.27)	(-1.48)	(0.20)
AAA	0.030	-0.020	0.016	0.020
	(0.64)	(-0.41)	(0.36)	(0.45)
VJSP	-0.087	-0.147	-0.064	-0.053
	(-2.29)**	(-3.51)***	(-1.67)*	(-1.39)
NIVAS	-0.210	-0.292	-0.187	-0.172
	(-4.06)***	(-5.14)***	(-3.63)***	(-3.30)***
LOG_FREIGHT		0.138		
		(14.17)***		
LOG_FREIGHT_ADJ	0.130			
	(13.89)***			
LOG_FREIGHT*LIGHT			0.094	
			(9.97)***	
LOG_FREIGHT*BULKY			0.180	
			(14.46)***	
LOG_FREIGHT*ATLANTIC				0.109
				(8.20)***
LOG_FREIGHT*INDIA				0.175
				(11.40)***
LOG_FREIGHT*INDONESIA				0.084
				(8.39)***
TELEGRAPH	-0.023	-0.050	-0.018	-0.014
	(-1.34)	(-2.25)**	(-1.06)	(-0.77)
YEAR*ATLANTIC		0.001		
		(2.75)***		

Table A5-continued

	(1) PCSE	(2) PCSE	(3) PCSE	(4) PCSE
YEAR*INDIA		0.000		
		(0.66)		
YEAR*INDONESIA		0.002		
		(3.63)***		
JAVA_WAR	0.073	0.091	0.078	0.058
	(0.95)	(1.14)	(1.00)	(0.74)
MUTINY	-0.060	-0.073	-0.078	-0.084
	(-0.68)	(-0.83)	(-0.90)	(-0.96)
SLAVE	0.246	0.243	0.239	0.245
	(5.78)***	(5.65)***	(5.57)***	(5.67)****
CIVIL_WAR	0.005	0.003	-0.024	0.007
	(0.14)	(0.09)	(-0.64)	(0.20)
WWI*ATLANTIC	-0.084	-0.125	-0.048	-0.064
	(-1.55)	(-2.31)**	(-0.98)	(-1.22)
WWI*INDIA	0.071	0.061	0.057	0.015
	(1.67)*	(1.38)	(1.34)	(0.33)
WWI*INDONESIA	0.163	0.148	0.195	0.205
	(5.38)***	(4.74)***	(6.58)***	(6.89)***
LOG_RATIO1	0.444	0.440	0.403	0.428
	(17.76)***	(17.70)***	(15.79)***	(17.15)***
N	1534	1534	1534	1534
Adjusted R-squared	0.79	0.79	0.80	0.80
F	155.62***	145.67***	158.98***	145.16***
LLC t-stat	-33.38***	-35.42***	-33.16***	-34.20***

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and Appendix B

Table A6
The causes of integration: econometric analysis by trade route

	Atlantic PCSE/IV	India PCSE/IV	Indonesia PCSE/IV
C	0.293	0.482	0.386
	(6.09)***	(8.28)***	(8.28)***
LOG_DUTY	0.087	0.033	0.104
	(2.26)**	(0.54)	(3.24)***
EIC		0.168	
		(3.84)***	
NHM1			0.025
			(0.79)
NHM2			0.012
			(0.45)
AAA	0.009		
	(0.20)		
VJSP			-0.037
			(-0.97)
NIVAS			-0.170
			(-3.26)***
LOG_FREIGHT	0.079		
	(4.65)***		
LOG_FREIGHT_ADJ		0.117	0.066
		(5.58)***	(5.86)***
TELEGRAPH	-0.021	-0.046	-0.047
	(-0.97)	(-1.50)	(-2.08)**
JAVA_WAR			0.029
			(0.36)
MUTINY		-0.071	
		(-0.80)	
SLAVE		0.330	0.110
		(5.88)***	(1.77)*
CIVIL_WAR	-0.014		
	(-0.37)		
WWI	-0.026	0.086	0.233
	(-0.47)	(1.70)*	(7.75)***
LOG_RATIO1	0.545	0.484	0.348
	(10.29)***	(15.05)***	(8.64)***
N	231	821	482
Adjusted R-squared	0.75	0.80	0.76
F	79.35***	140.06***	81.17***
LLC t-stat	-16.81***	-27.33***	-22.33***

Table A6-continued

	Atlantic PCSE/IV	India PCSE/IV	Indonesia PCSE/IV
Wooldridge exogeneity test chi-squared stat	3.16*	29.91***	19.37***
Wooldridge exogeneity test F stat	3.30*	30.48***	20.15***
Adjusted R-squared first stage	0.93	0.98	0.93
Partial R-squared first stage	0.79	0.70	0.83
F first stage	973.77***	1366.66***	1306.13***

Significant at * 10 per cent; ** 5 per cent; *** 10 per cent

Sources: see the text and Appendix B

Table A7
The welfare effect of price convergence: results by product

	1 Equitable division	2 100 per cent producers	3 100 per cent consumers		1 Equitable division	2 100 per cent producers	3 100 per cent consumers
1870-1913				1816-1913			
India							
Cotton	0.00	0.00		Cotton	0.54	1.33	
Indigo	0.00	0.00		Indigo	0.01	0.02	
Jute	0.08	0.30		Jute	0.56	1.36	
Linseed	0.00	0.02		Linseed	0.05	0.14	
Rice	1.31	4.29		Rice	1.07	3.73	
Tea	0.02	0.06		Tea	0.09	0.19	
Wheat	0.36	1.08		Wheat	0.55	1.59	
Total	1.77	5.74		Total	2.86	8.36	
Indonesia	0.43	0.89		Indonesia	0.6	1.28	
United States							
Cotton	0.00	0.01		Cotton	0.14	0.32	
Wheat	0.03	0.08		Wheat	0.11	0.36	
Total	0.03	0.08		Total	0.25	0.68	
United Kindgom							
Coffee	0.01		0.02	Coffee	0.02		0.05
Cotton	0.01		0.02	Cotton	0.40		0.86
Indigo	0.00		0.00	Indigo	0.00		0.00
Jute	0.06		0.13	Jute	0.11		0.25
Linseed	0.03		0.06	Linseed	0.09		0.21
Rice	0.02		0.03	Rice	0.02		0.03
Pepper	0.00		0.00	Pepper	0.00		0.00
Sugar	0.10		0.20	Sugar	0.04		0.09
Tea	0.07		0.15	Tea	0.07		0.15
Wheat	0.22		0.47	Wheat	0.60		1.40
Total	0.51		1.10	Total	1.35		3.05

Sources: see the text and Appendix B

Appendix B: data sources

1. Prices

Coffee. Korthals Altes (1994) reports two prices only for Indonesia: the NHM net series (1833-1922, series n.05) and the average price of exports (1833-1913, series n.01). Here, as in other cases, given the choice, we avoided relying on NHM series because according to Korthals Altes (1994: 73), the net proceeds of sales, exclusive of costs (freights, sales commissions, registration duties etc.), "may [only] broadly be compared with the free on board prices in the Netherlands-Indies". This statement is somewhat vague and one might suspect that the delay between purchase and sale add further noise. The NHM series for coffee in particular exhibits significant differences with the one we used in the analysis. All prices from Korthals Altes (1978, 1994) are yearly means (with the only exception of the tin series, cf. below) and, except for tea, whose prices are quoted in Dutch gulden per 0.5 kg, are in Dutch gulden per quintal. The average price of export is related to the average price in Rotterdam for "good ordinary Java" (1830-1913, series n.07). The resulting ratio is thus not adjusted for quality changes.

Cotton, Calcutta-London. The prices in Calcutta are from the *Bengal Commercial Reports* (henceforth BCR), and have been converted from rupees per maund into shillings per lb. All the prices from this source are drawn from yearly issues from 1795/96 to 1845/46 and have been adjusted from fiscal to calendar years; the computations are based on averages between highest and lowest yearly prices (monthly for 1795/96 only). Specifically, the prices used are of "Naugpore" in 1795/96 and 1797/98, "cotton" in 1796/97, and between 1798/99 and 1828/29, and "Talloon" between 1829/30 and 1845/46. Hence, the quality is not homogeneous; nonetheless years with overlapping series evidence small differences in price between qualities. The prices in London compared with those in Calcutta are from Tooke and Newmarch (1928). All prices from this source are also based on averages between highest and lowest prices, which are reported up to four times during each year. The cotton prices are in shillings per lb and all refer to "Cotton wool, Bengal and Surat". Thus, we can be sure that they are prices of cotton imported from India.

Cotton, Bombay-London. Until 1922 the Bombay prices are from *Prices and Wages in India* (henceforth, P&W). As with the other goods relying on this source, the prices have been drawn from various issues (1891, 1902, 1913, 1915, 1920 and 1923) and are for selected months, usually January and July; at times, they refer to the yearly average of the available monthly data. From 1923 the source becomes the *Statistical Abstract of British India* (henceforth, SABI). Both for cotton and the other goods relying on this source, the prices are drawn from the 1933, 1938, 1941 and 1949 issues, which report prices in selected months and

yearly averages based on them. In 1867-1869 and 1899-1939 the prices have been quality-adjusted to "Dohllera fair" on the basis of "Broach", in 1870-1898 the prices refer to "Dohllera Fair". Here, as with the other series, the quality-adjustment is made on the basis of the average of the ratios between prices of different qualities when the series overlap. The Bombay prices have been converted into shillings per lb from rupees per candy. The London series is all from Sauerbeck (1886 and ff.) and refers to "Fair Dohllera" in shillings per lb. In short, the assumption of homogeneous quality within and across markets is reasonable for this series.

Cotton, New York-Liverpool. The prices in New York in US $ per lb are for “middling Upland” and are from Carter et al. (2006, series cc 222-223). In Liverpool the prices in pence per lb are for “middling American” and are from Mitchell (1988: 760-761). Hence it is reasonable to assume that the quality is homogeneous both within and between markets, for these series.

Indigo. The Calcutta prices for 1822 to 1845 are from BCR (in rupees per maund), for 1846-1910 are from P&W (in rupees per factory maund), and for 1911-1931 are from SABI. Both series are (in rupees per factory maund). Various qualities have been used to construct the series: 1821/22-1824/25: "Indigo, 1st sort", 1825/26-1828/9: "Indigo", 1829/30: "Indigo fine purple violet", 1830/31-1833/4: "Indigo fine purple", 1834/35-1845/46: "Indigo purple"; 1846-1857: quality-adjusted to "Bengal, good" on basis of "good and middling", 1859-1872, 1874-1885: quality-adjusted to "Bengal, good" on basis of "good", 1886-1910: quality-adjusted to "Bengal, good" on basis of "good, middling to good", 1873, 1911-1931: "Bengal, good". In particular, there is a major dividing line after 1845; until that date the prices refer to indigo of high quality; henceforth to indigo of only good quality. Nonetheless, efforts have been made to ensure that the exported quality matched the imported one as closely as possible. Thus, the London series for 1822 to 1845 is based on monthly data from Gayer, Rostow, and Schwartz (1953); it refers to “East Indies Indigo” and matches closely the series of prices of “superior” East India indigo from Tooke and Newmarch (1928); the London series for 1845 to 1931 is from Sauerbeck (1886 and ff.) and refers to "Bengal, good". Hence, although the requirement of homogenous quality within markets is only imperfectly met, the assumption that quality is homogenous across markets is reasonable for the indigo series.

Jute. The Calcutta series has been converted from rupees per bale and has been drawn from three sources: P&W (1844-1920), SABI (1921-1936), and *International Yearbook of Agricultural Statistics* (henceforth IYAS) (1937-1938). As with all the prices drawn from the latter source, we consulted the volumes for 1930/1, 1934/5 and 1939/40; the prices are yearly averages of weekly data. Although it would have been possible to draw from this source data back to 1927, in an effort to minimise the variety of sources used (and hence, of

collection methods) and to rely as much as possible on primary sources, we only used the IYAS for years not covered by the other sources; in practice, the actual difference implied by this choice is negligible. The quality of jute is not homogenous: "serajgunge" in 1844-1858, "picked" in 1859-1903, adjusted to "picked" on the basis of “C.D.M.” in 1904-1921, "reds" in 1922-1931, adjusted to "reds" on the basis of “raw” in 1932-1936, and "first marks" in 1937-1938. The London series is drawn from Sauerbeck (1886 and ff.) until 1936 and from the IYAS for 1937 and 1938. These prices are in UK £ per long ton and refer to "Good to medium" and "first marks" jute, respectively. As there are only tiny differences in price across qualities, both within Calcutta and London, and between them, in practice, it is as if the quality were homogenous.

Linseed. The Calcutta sources for this series are: until 1910 P&W (in rupees per bazar maund); and, for 1911 to 1938 SABI (in rupees per bazar maund). The quality is unspecified until 1858; henceforth it is as follows: 1859-1890: "fine, bold, clean", 1891-1898: "bold", 1899-1931: adjusted to "fine, bold, clean" on the basis of “small to medium”, and 1932-1938: adjusted to "fine, bold, clean" on the basis of “small grain, 5 per cent, refraction”. The London series is from Sauerbeck (1886 and ff.); it does not specify the quality and is in shillings per quarter. As there are only tiny differences in price across qualities, in practice, it can be assumed that the quality were homogenous both within Calcutta and London, and between them.

Pepper. Korthals Altes (1994) reports export prices for “black pepper” for the period 1828-1832 (series n.31) and two series of market quotations for the same good, without specifying the difference (series n.31 for 1833 to 1855 and n.32 from 1848 to 1939). The final series is obtained by extrapolating the series n.32 to 1832 with the series n.31. Notably, the two series are fairly well correlated when overlapping and the level is almost identical. The market price for “black pepper” in Amsterdam (1828-1939, series n.33) is our proxy for the European price (Korthals Altes reports also a series for “black pepper” in London 1885-1939; its coefficient of correlation with the Amsterdam series is 0.862). The ratio is therefore not quality-adjusted.

Rapeseed. Both the Calcutta and the London series are from P&W. The quality in Calcutta is as follows: 1871-1904: "Yellow, mixed", 1905-1914: "Yellow, medium mixed, Patna 4 percent", and 1915-1921: "Brown 5 per cent"; the prices are in rupees per bazar maund until 1888 and shillings per quarter henceforth. The quality in London is: 1871-1899: "Calcutta", and 1900-1921: "Cawnpore". The prices are in shillings per quarter in 1871-1872 and 1874-1888; in 1873 and in 1888-1921 are in shillings per cwt. There are only tiny differences in prices across quality and thus the assumption of homogenous quality within and across markets is reasonable. It would have been possible to extend the series to cover the years 1930-1938 with data from IYAS, but we decided not to since the Indian price reproduced by this source is for Karachi, instead of Calcutta.

Rice, Batavia-Amsterdam. The source for Batavia is Korthals Altes (1978). The series has been quality-adjusted to "billiton tenders" on the basis of "no. 1 quality, Batavia" for 1848 to 1862 and is "billiton tenders" henceforth. The Amsterdam series is from van Zanden (on-line data-base http://www.iisg.nl/hpw/prijzen19earthur.xls) and refers to "hulled Java rice" (in Dutch gulden per quintal). Thus, only the Batavia series can be considered of homogenous quality. Nonetheless, there are only small differences in price across qualities at Batavia, and we can be confident that the Amsterdam prices refer to qualities imported from there.

Rice, Rangoon-London. The Rangoon prices have been drawn from P&W (until 1922), SABI (until 1932) and IYAS (henceforth). The quality is "Ngatsain" until 1932 (prices in rupees per cwt) and "N. 2" between 1933 and 1938 (prices in rupees per 3402 kg). The London series is from Sauerbeck (1886 and ff.) for 1870-1931 ("from Rangoon", prices in shillings per cwt) and IYAS for 1932-1938 ("N. 2", also in shillings per cwt). The assumption of homogenous quality is strongly met in Rangoon until 1932 and across Rangoon and London between 1933 and 1938. Still, there were non-negligible differences in export price across qualities in Rangoon that are bound to introduce an element of noise before 1933.

Rubber. Prices in both Batavia and London are from Korthals Altes (1994). The Batavia series is of homogeneous quality: "standard sheets & crepe" (series number 51: rubber, Batavia). That in London is formed of two qualities: "standard crepe" between 1913 and 1917, and "standard quality ribbed smoked sheet" henceforth. Nonetheless, there is no break in the level of the London series, suggesting that for practical purposes the quality can be considered homogenous across markets. By contrast, changes in the quality of the Indonesian series (number 53) between 1900 and 1922 would have introduced a sudden break in the price ratios in 1912; since this is probably spurious, we decided against including these data.

Saltpetre. The Calcutta prices are from two sources: BCR between 1796 and 1845 (in rupees per maund) and P&W from 1846 until 1849 (in rupees per factory maund). The qualities are as follows: 1795/96-1827/28: "Aubee", 1828/29, 1834/35: quality-adjusted to "3rd sort" on basis of "2nd sort", 1829/30-1833/34, 1835/36-1843/44: "3rd sort", 1844/45-1845/46: "unrefined", 1846: "Bengal", 1847-1849: quality-adjusted to "Bengal" on basis of "Chupra". Although the quality is heterogeneous, the prices all refer to the lowest quality cited in the sources in each period. The London prices also refer to poor quality saltpetre: "Rough (East Indies)" between 1796 and 1850, and "East India, Rough" between 1851 and 1853. Hence it is reasonable to expect little noise introduced by differences in quality for this price ratios series. The sources for London are: Gayer,

Rostow, and Schwartz (1953) until 1850 and Tooke and Newmarch (1928) for 1851 to 1853. Both sources report prices in shillings per cwt.

Silk, Calcutta-London. The Calcutta series is from BCR (in R per seer). The qualities are as follows: 1795/96-1818/19, 1825/26-1828/29, 1831/32-1843/44, 1845/46, 1846-1856: "Cossimbazar", 1819/20-1825/26, 1844/45: "silk", 1829/30-1830/31: quality-adjusted to "Cossimbazar" on basis of "Radangore". Although to some extent the quality is heterogeneous, the prices all refer to the highest quality cited by the source for each period. The London series refers to "Bengal raw". Hence, it is not quality-adjusted; yet at Calcutta differences in price between different qualities tend to be relatively small; therefore quality is expected to impact only to a limited extent on the reliability of the comparison. The source of the London series is Tooke and Newmarch (1928); the unit is shillings per lb.

Silk, Calcutta-Lyon. The Calcutta prices are from P&W and are in rupees per factory seer. The series is formed of the following qualities: 1857-1861: quality adjusted to "Surdah" on the basis of "Cossimbazar", 1862-1877: "Surdah". This matches the quality in Lyon: “Bengal Surdah 12/16”. The source of the Lyon series is the *Bulletin des Soies et Soieries* (various issues), which quotes prices in French Francs per kg.

Silk, Canton-London. The prices in Canton are from various HPP. Specifically, 1834 to 1838 and 1842 to 1846: HPP (1847b: 30-33), 1865: HPP (1865: 97), 1867: HPP (1868a: 53), 1868: HPP (1869: 39), 1869: HPP (1870: 56-57), 1871-1872: HPP (1873: 13, 15), 1876: HPP (1877: 5), and 1877: HPP (1878: 22-23). We compute the yearly means on the basis of the highest and the lowest prices in selected months. The prices are in Spanish $ per picul, except in 1871 and 1872, when they are in UK £ per picul. The price series has been quality-adjusted to “Tsatlee” as follows: 1834-1846, 1871-1872: "Tsatlee", 1847, 1855, 1856, and 1858: extrapolated on the basis of Shangae prices of "Tsatlee", 1865-1869: quality-adjusted to "Tsatlee" on basis of "How-kong no. 1", 1876-1877: "Tsatlee no. 4". The sources for the Shangae prices are HPP (1849: 66, 1856: 50-52, 1861: 20, 1870: 21, 1871a: 13, 1875: 158, 1877, 31-32, 1878: 15). The London prices are from Gayer, Rostow, and Schwartz (1953) until 1850 and from Sauerbeck (1886 and ff.) henceforth. Like the Cantonese prices, they all refer to “Tsatlee” silk; they are in shillings per lb.

Silk, China-London. The export prices of Chinese silk are computed on the basis of the yearly values (in Haikwan taels) and quantities (in piculs) of exports reported by Hsiao (1974: 102-103). Specifically, they refer to "Raw Silk, White, not re-reeled and not steam filature". These prices are matched with those of “Tsatlee” in London taken from Sauerbeck (1886 and ff.). As before, these prices are in shillings per lb. Although it would have been possible to extend the series up to 1938, we decided against it since exports of this quality of silk were sharply falling and we lack evidence that Chinese silk was exported to the UK in

these years; hence, the marked disintegration that the figures would imply for 1914-1938 may well be spurious, or, at any rate, unrepresentative. While, strictly speaking, only in London the quality can be considered as homogeneous, that in China should be similar.

Silk, China-Lyon. The export prices of Chinese silk are the same as for the China-London series. “Tsatlee no. 4” prices in French Francs per kg at Lyon are from the *Bulletin des Soies et Soieries* (various issues). The same source reports also prices for “white” silk; using this series yields the same trend, though the level is somewhat lower. The same remarks about quality as for China-London apply to this series.

Silk, Yokohama-Lyon. The Yokohama series is from Fujino et al. (1979: 296-297). It refers to the "Quoted Yokohama price of silk" in Yen per kg. The Lyon series is formed of monthly data and is from the *Bulletin des Soies et Soieries* (various issues). It refers to “Japan” silk quoted in French Francs per quintal. Hence, although the import price refers to silk imported from Japan, neither the import nor the export series are qualitatively homogenous.

Silk, Yokohama-New York. Until 1927 the source of the Yokohama prices is the same as for Yokohama-Lyon. Henceforth, the source is IYAS; these prices are in yen per 60 kg and refer to "D grade". Silk prices in New York refer to "Japanese best filature" or "Japanese filature, 1st" in US $ per lb and are taken from Coyle (1926) for 1894-1914 and 1919-1923 and from the *Annual Report of the Silk Association of America* for 1915-1919 and 1924-1926. The source for 1927-1938 is IYAS, which reports prices of "Japan, crack, xx (78per cent) 13/15" in US $ per lb. Hence, although the qualities should be comparable, both within and between places, they are nevertheless diverse, and there is a break from 1927.

Sugar, Calcutta-London. The Calcutta series is from BCR (in rupees per maund) until 1845 and from P&W (in rupees per bazar maund) henceforth. The quality is pretty homogenous: 1795/96-1819/20: "Benares", 1820/21-1828/29, 1844/5-1845/6: "Benares 1st sort", 1829/30-1843/44: "Benares 1st sort new", 1846-1856: "Benares 1st quality". The London series is in shillings per cwt and is from Tooke and Newmarch (1928). It refers to "East India, white"; the prices of this quality were significantly higher than those of “East India, brown” and should be directly comparable to the Calcutta series, which also refers to high quality sugar.

Sugar, Batavia-London. For the Dutch East Indies, Korthals Altes (1994) reports four different series, the NHM net prices 1837-1873 (series n.66), the average export price according to trade statistics 1822-1936 (series n.65), a series of prices for specific qualities in Batavia 1848-1913 (series n.62, referring to n.16 from 1848 to 1868, to n.14 1869-1894, n.15 1895-1913) and a series of “wholesale price Batavia second hand” 1913-1939 (series n.63, referring to a mix of qualities over n.16). The final series is obtained by, firstly, adjusting the Batavia prices to a common quality for the period 1848-1913; secondly, extrapolating

backwards to 1837 with the NHM series and to 1822 with the series of export prices, and forward to 1939 with the “wholesale prices”. When the two series overlap, the coefficient of correlation between the baseline series and the NHM net prices (0.794) is somewhat higher than the same series and the export prices (only 0.611). For London, Korthals Altes (1994) provides only two series, referring to generic raw sugar for the period 1820-1845 (series n.68) and to Java sugar 1845-1939 (series n.69). Thus, the ratios seem more accurate for the period since 1848 than for earlier years.

Tea, Calcutta-London. The Calcutta prices are from P&W and SABI (in rupees per lb). The prices are quality adjusted to good/fair “Souchong” as follows: 1893-1910: "Good Sochoung", 1911-1922: "Fair (Cachan and Syleth) Pekoe Souchoung", 1923-1931: quality-adjusted to "Fair (Cachan and Syleth) Pekoe Souchoung" on basis of "Fair (Assam) Pekoe Souchong". The London prices are from Sauerbeck (1886 and ff.); they are in shillings per lb and refer to “Indian good and medium”. Although it would have been possible to extend the series backward to 1871 on the basis of the London “Congou” prices, we decided against it since the latter tends to have a significantly lower level (about 50 per cent) than and is only imperfectly correlated (the correlation coefficient is 0.73) with the series of Indian prices; evidently it is influenced by qualities of tea coming from China and the upward trend detected in 1871-1893 may well have been spurious. With the exception of “Fine Pekoe”, which is consistently and significantly higher than the others, all quoted prices in Calcutta are similar. Hence, the matching of medium/good Indian qualities implies that quality is not expected to be a major issue for these ratios.

Tea, Canton-England. Both the Canton and the England series are drawn from the same sources: HPP (1829, 1831,1833). The export and import prices are computed on the basis of the yearly “prime cost” and “sale amount” (in UK £), respectively, and quantities (in lb). The estimated prices are then adjusted form fiscal to calendar years. Although the quality is mixed at both ends, since all these figures refer to tea imported and sold at auctions by the East India Company, we expect the quality mix to be similar in the same year (though not necessarily across years).

Tea, Canton-London. The sources for the Canton prices are as follows: MacGregor (1850: 64): 1818/19 (in taels per picul), 1829 (in shillings per lb), 1831/32 (in taels per picul) and 1833/4 (in taels per picul), HPP (1824: 5): 1819/20-1822/23 (in UK £ per lb), HPP (1830: 1072-1073): 1823/24-1828/29, 1830/31 (in shillings per lb), HPP (1847b: 30-33, 494): 1832, 1834-1838, 1842-1846 (selected days, in taels per picul), HPP (1868a: 43): 1867 (in taels per picul), HPP (1869: 39): 1868 (eight quotes, in taels per picul), HPP (1870: 56-57): 1869 (monthly data, in taels per picul), HPP (1879: 13, 15): 1871-1872 (in UK £ per picul), HPP (1878: 23): 1877 (in taels per picul). The prices have been quality-adjusted to “Congou” thus: 1819-1843, 1845-

1846, 1871-1872: "Congou", 1844: quality-adjusted to "Congou" on basis of "Congou, new", 1855-1858, 1875-1876: extrapolated on basis of prices of "Congou" in Shangai, 1867-1869: quality-adjusted to "Congou" on basis of "Orange Pekoe, scented", 1877: "Mok-Lei". The sources of the Shangae prices are: HPP (1856: 31-32, 1857: 50-52, 1861: 20, 1877: 31-32, 1879: 10). The sources for the London series are Gayer, Rostow, and Schwartz (1953) until 1846 and Sauerbeck (1886 and ff.) henceforth 1819-1846 (both in pence per lb); their qualities are "Middling (Congou)", 1855-1877: quality-adjusted to "Middling (Congou)", on basis of "Congou, common". In short, the assumptions of homogeneous quality within and across markets are reasonable in this case.

Tea, Batavia-Amsterdam. Both series are for Korthals Altes (1994). Although the qualities are mixed at both ends, the Amsterdam price refers to tea imported from Java and years with quality-specific prices evidence only tiny differences in price, either between themselves or as compared to the average. Hence, quality heterogeneity is not expected to significantly affect the reliability of the series.

Tin. Korthals Altes (1994) provides a series of export prices, from official statistics (1823-1936, series n.82), a net NHM series (series n.84, 1839-1920) and two market quotation, a series called “tin from Belitung”, traded in Batavia (1862-1913 series n. 81), and a series for “tin in Singapore“, allegedly net of transport costs (1913-1939, series n.83). European markets are represented by a series of prices of “East Indian tin” in Amsterdam from Posthumus (1840-1914, series n.87) and two series for London, one for “Straits” – i.e. Malayan- tin from Sauerbeck (1886 and ff.) and another from the average sales in all the market as reported by the Tin Bulletin (1871-1940 series n. 89). Quality is clearly a decisive factor in determining price, and to mitigate this issue only the “tin from Beilitung”, adjusting it from fiscal years (ending April 30st) to calendar years, and “East Indian tin” Amsterdam series have been used.

Wheat, Calcutta-London. The prices in Calcutta are from P&W and SABI (in rupees per bazar maund). The quality can be considered as homogeneous, given that it has been adjusted to “doodiah” thus: 1861-1922: "doodiah", 1923-1931: quality-adjusted to "doodiah" on the basis of "club, no. 2". This remark, however, does not apply to the London prices, whose source is the same as for New York-London ratios.

Wheat, New York-London. The prices series in New York and London 1800-1913 have been kindly provided by David Jacks (Jacks, 2005). For the post-war period, the prices in New York 1924-1937 are from the *Statistisches Jarhbuch* (1939 issue) and in London from the *Journal of Wheat Studies* ad annum (originally from IYAS) – both in dollars per quintal. Unfortunately, none of these sources allow controlling for quality differentials. The quality-adjusted series by Persson (2004), however, covers only the period 1850-1900 and are converted in gold (rather than paper) dollars from 1862 to 1878. The ratio is similar to that yielded by

Jacks' data (0.96) and the two series are co-integrated at 2 per cent; the coefficient of correlation for the whole period is 0.565 and for 1878-1900 is 0.872.

Weight conversion rates. 1 bazar maund=82.286 lb (from P&W), 1 bale=400 lb (from P&W), 1 candy=784 lb (from SABI), 1 cwt=112 lb, 1 factory maund=74.67 lb (from P&W), 1 factory seer=1.86 lb (from P&W), 1 maund=82 lb (from P&W), 1 picul=133.3333 lb (from Hsiao, 1974: 297), 1 lb=0.4536 kg (from IYAS), 1 quarter=416 lb (from P&W) and 1 seer=2.05 lb (from Chakrabarti, 2004: 14).

Exchange rates. US $ into British £: Carter et al.'s (2006) series for 1800-1913 and Global Financial Data (at *http://www.globalfinancialdata.com/*, henceforth GFD) for 1914-1939. Indian rupees (Sicca rupees until 1835) to British £: 1797-1801: BCR (1795-1802 and 1796-1802 volumes, adjusted from financial to calendar years); 1802-1818: interpolated; 1819-1843: Denzel (2010: 500); 1844 to 1922: P&W (1891, 1902, 1920 and 1923 issues, selected months); 1912 to 1938: SABI (1922, 1933, 1938, 1941 and 1948 issues, yearly averages of monthly data). French francs into UK £ (1857-1877) and Italian £ into US $ (1894-1897): GFD. Spanish $ into British £ at Canton: 1834-1838: Denzel (2010:517-518), 1842-1844, 1867-1868, 1876-1877: interpolated; 1845: HPP (1847a: 18); 1846: HPP (1848a: 12); 1865: HPP (1865: 105), 1869: HPP (1870: 47). Spanish $ into British £ at Shangae: 1844, 1846: interpolated, 1845: HPP (1847a: 75), 1855-1856: extrapolated on the basis of exchange rates of Sahangae taels into UK £ reported in HPP (1856: 18, 45). Canton tael into UK £: 1832, 1834, 1835, 1838, 1842, 1843, 1844, 1846, and 1877: interpolated, 1836: HPP (1847b: 38); 1845, and 1869: extrapolated on the basis of exchange rates of Spanish $ into UK £ at Canton reported in HPP (1847a: 18) and HPP (1871a: 147), 1867: HPP (1868a: 178), 1876: (HPP, 1877: 2). Shangae tael into UK £: 1855 and 1856: HPP (1856: 18, 45), 1858: HPP (1861: 20), 1875: interpolated, 1876: HPP (1878: 13), 1877: HPP (1879: 8). Chinese Haikwan taels in US $, UK £ and French francs between 1874 and 1932 and Chinese $ in US $ and UK £ from 1933 are from Hsiao (1974: 190-192). Japanese yen in US $ (1893-1938) and French Francs (1893-1914) are from Statistics Bureau (1988: 104-107) (averages of highest and lowest yearly values).

2. Duties

Atlantic. The wheat import duties in the UK until 1868 are from Sharp (2010). They are in shillings per quarter, except for 1815-1816 and 1819-1824 when importing wheat was allowed only at selected times, and thus duty rates are not directly comparable with those in other years. For the purpose of the analysis this are assumed to be 200 per cent of the export price, so as to capture unusually high barriers to trade. After being abolished from 1869, import duties on non-imperial wheat were revived by the UK government from 1932.

For these years we relied on various issues of the *Annual Statement of Trade of the United Kingdom of Foreign Countries and British Possessions* (henceforth ASTUK), which report yearly values of non-imperial imports and revenues from tariffs on them, yielding a duty of 2 shillings per quarter. Import duties on cotton are from Tooke and Newmarch (1928); they refer to cotton from Georgia and are in shilling per 100 lb, except for 1821-1831, when they are quoted as six per cent of the sale price.

India. Banerjea (1922) reports export duties on cotton, indigo, jute, linseed, rapeseed, rice, sugar, silk, tea and wheat from 1800 to 1920. At times they are in rupees or anna per maund or seer; usually, however, they are quoted as a percentage of the export price; until the 1843 they varied across presidencies. We assumed that: duties did not change between 1796 and 1800, and exports remained duty-free between 1921 and 1938. Although such assumptions may introduce some noise, in India export duties were of a fiscal nature and thus they were small; on average, the duty factor was about only 5 per cent, when positive; hence, the assumptions are not expected to significantly harm the precision of the analysis. Import duties were usually more substantial than export duties; those on Indian cotton (in shillings per 100 lb, except for 1823-1827, when the duty was 6 per cent of the sale price), indigo (in shillings per 100 lb), saltpetre (in shillings per cwt) and silk (in shillings per lb) are from Tooke and Newmarch (1928). As some of the figures reported by this source for sugar are un-plausibly high, the duty rates on sugar are drawn from HPP (1851: 4-5, 1868b: 4), where they are reported in UK £ per cwt, distinguishing by origin and quality; we assumed that duty rates in 1796-1799 were the same as in 1800-1802. Finally the import duties on wheat before they were abolished in 1869 are from Sharp (2010), as before.

Indonesia. Between 1830 and 1873 Korthals Altes (1991) reports export duties only on coffee and sugar, differentiated by destination/flag. Table 8a reports percentage ad valorem duties for three cases a) Dutch flag Dutch port, b) Dutch flag foreign port; c) foreign flag foreign port. We selected the destination according to the European series and assumed Dutch flag. Duties applied only on exports on private account, and not to export on government account. Thus, we assumed that until 1868 they applied to Java to London, but not Java to Rotterdam, which should have been a NHM monopoly. After 1874, in table 8b, Korthals Altes (1991) reports gross revenues for coffee, rubber, sugar and tin. The implicit duty is derived as revenue/exports on private account for coffee and tin, and to total export for sugar and rubber, since the source does not provide series for trade on private account in these cases. Apparently, there were no duties on rice and pepper, while the duties on coffee and sugar were abolished in 1898 and 1902, respectively. The duty on tin is reported until 1930; that on rubber until 1938. Interpolation was used for rubber for 1931-1933, sugar for

1888-1893 and tin for 1869-1873. As for India, the fiscal nature of the export duties implies that they were mostly very small; again, on average about 5 per cent of the export price, when positive.

Import duties on Java sugar in the UK until 1874, when they were temporarily abolished, are from HPP (1851: 4-5, 1868b: 4, 1871b: 2, 1874a: 2); they are in UK £ per cwt and distinguish by origin and quality of the sugar. Between 1901 and 1938, the source is ASTUK, which reports values of imports and revenues. Unfortunately, this source reports revenues on either refined/non refined sugar, lumping together preferential and non-preferential duties, or full/preferential for both refined and unrefined. Thus, it is possible to estimate either duty on all non-refined sugar or preferential duty on all sugar, but not separate series for preferential and full duty on refined and unrefined sugar. Nonetheless, the issue is not too serious: as the great majority of sugar imported from Java was unrefined, the implicit duty rate on unrefined sugar is a good proxy. ASTUK is used also for computing implicit UK import duties on rubber between 1932 and 1938 (before it was duty free).

The Netherlands abolished most import duties from 1862, but revived them in 1924, to increase them in 1930. In the absence of detailed information on the evolution of duties before 1862, we assumed that tariffs on rice, coffee, pepper and tin remained the same as in 1822; for that year they are reported by Wright (1955: 226-229) in Dutch gulden per quintal; coffee directly imported from Batavia was exempt. The hypothesis that duties on colonial goods remained stationary is confirmed for pepper, whose duty remained at 1.5 Dutch gulden per quintal between 1868 and 1913, the Dutch commercial statistics (*Statistiek van den In-, Uit-en Doorvoer*, henceforth SD, various issues) report. The latter source also reports import duties on tea for 1893-1913 in Dutch gulden per quintal. For the inter-war years we relied on Bacon and Schloemer (1940), who reports changes in duties on pepper (as a percentage of the sale price) and on tea (in Dutch gulden per quintal).

3. Freights

Atlantic. There are at least eight available series of freights for transport of wheat across the Atlantic, from six works, by five different authors i) North (1958) freight factor for American (East Coast), 1826-1913, which can be transformed back into shilling/quarter by multiplying by the Gazette price (Mitchell 1988), which North used as denominator; ii) Harley's (1988) "New York grain series", for 1855-1872, presumably in cents/bushel; iii) Shah-Williamson's (2004) indexes (1884=1) of freights from East North America, 1869-1938 and from the Gulf Coast 1884-1939; iv) Persson (2004) freights from Liverpool to London, 1850-1900 in shillings/quarter; v) Klovland's (2006) series of freights from New York to London or Liverpool, 1848-1861 in pence/bushel; vi)

Harley's (2008) rates for "Cork for order" (i.e. for specialized tramp shipping) for 1863-1908 and for "New York Liverpool berth" (i.e. for transport as supplementary cargo in ships carrying live animals or frozen meat) for 1868-1913. Table B1 reports the coefficients of correlation among the five most important (in terms of length and representativeness) series, by North, Persson, Harley (1 stands for "Cork for order" and 2 for liner) and Shah-Williamson (1 stands for East Coast, 2 for the Gulf).

Table B1
Correlation coefficients between Atlantic freights for wheat

	North	Harley 1	Harley 2	Persson	Shah-W 1
North					
Harley 1	0.952				
Harley 2	0.920	0.968			
Persson	0.932	0.935	0.988		
Shah-W 1	0.761	0.760	0.747	0.672	
Shah-W 2	0.778	0.830	0.717	0.671	0.526

Sources: see the text

The coefficients of correlation between the series by North, Harley and Persson are quite high, and thus ultimately the choice of any of them would not affect the long-term trends. However, the levels differ hugely, as the transport by liners cost about half: the average ratio of Harley 1 to Harley 2 is 0.60 (DS 0.15), to Persson is 0.44 (DS 0.05) and to North is 0.51 (DS 0.07). Thus, any change in the market share of liners would affect the average freight. Although data are very scarce, the anecdotal evidence suggests a sharp increase in that share since in the 1880s, up to about 60-70 per cent in the mid-1890s (Harley 2008). To capture this effect, the final series of freights to 1913 is a weighted average of the series of tramp freight by North and of liners rates by Harley, assuming the weight of the latter to have increased from 1 per cent in 1860 to 10 per cent in 1880, and to 66 per cent in 1890. The tramp freights are taken from North (1958), which extends back to 1832, with a ten years break from 1833 to 1842. In those years, and in the years 1814-1832, the series is interpolated, *faute de mieux*, with the series of overall freight by North (1968). Last but not least, the series is extrapolated forward to 1939 with Shah-Williamson (2004) East Coast grain index.

The published evidence on freights for cotton is decidedly less abundant than for wheat. It includes i) Harley's (1988) series of tramp from Charleston (1812-1860), New Orleans (1817-1860) and New York (1823-1860), probably in cents/lb; ii) Shah-Williamson's (2004) index (1884=100) for Gulf cotton 1878-1910; iii) Klovland's (2006) series for transport of cotton from New York and New Orleans, in pence/lb; iv) North (1965) series of freight factor (computed as freight/CIF import price) 1810-1906 One can add the index by North (1968), which Harley reckons to cover mostly cotton (1988 p. 856) -, a statement which is buttressed

by the very high coefficient of correlation with Harley's New York series when overlapping (0.92). The starting point for building the series is Harley's series of freights from New York, suitably extended backwards to 1814 with his own series from Charleston. Unfortunately, there are no cotton-specific series until 1878 and after 1911. The gaps had to be filled in with data for wheat – respectively the North (1958) index for 1861-1877 (when there are no gaps) and the Shah-Williamson East Coast index for 1911 onwards.

China. The sources for freights from Canton to London are as follows (all in UK £ per long ton): generic freight rates, yearly data: HPP (1824: 4): 1822-23, HPP (1830: 671): 1824-1829, freight rates for tea, monthly data: HPP (1847b: 505): 1846-1847, HPP (1855: 15): 1854, HPP (1856: 32): 1855, HPP (1857: 25): 1856, generic freight rates, selected days: the *Asiatic Journal and Monthly Register for British and Foreign India, China, and Australasia* (1835, vol. 18: 128, 256, 1836, vol. 20: 185-246, 1839, vol. 28: 54, 310, vol. 30: 165, 1840, vol. 32: 351, 1842, vol. 38: 330): 1835-1836, 1838-1840, 1842. Although only in June 1846 data for silk is also available for this route, that freight rates on silk tended to be about 1.25 times those on tea is broadly corroborated by monthly data for Shangae-London in 1855-1858 (HPP, 1856: 32, 1857: 54, 1861: 21), which detects ratios ranging from 1.09 to 2.66 and averaging 1.63. Hence, generic freight rates can be only imperfectly compared to product-specific freight rates. Yet, by a long shot, such noise falls short of accounting for the 71 per cent downward level shift in nominal freights observed in the aftermath of the end of the monopoly of the East India Company in 1833.

India. The Indian freights have been constructed drawing on a range of sources (unless otherwise specified the freight rates are in UK £ per long ton, equal to 2240 lb, and the data is yearly): BCR: generic freight rates from Calcutta to London in 1795/96 to 1801/1802, HPP (1810a: 4-5): generic freight rates from India to England for 1798-1809, HPP (1810b: 1-4): generic freight rates from Calcutta to London in 1803-1805 and from Bombay to London in 1806, HPP (1814: 88-89): generic freight rates from India to England in 1813, HPP (1821a: 28): generic freight rates from India to England in 1816 and 1821, the *Asiatic Journal and Monthly Register for British India and its Dependencies* (1817, vol. 4: 541, 1819, vol. 8: 308, 501, 1820, vol. 9: 90, 189, 309, 509, 625, 1821, vol. 11: 389, 1822, vol. 14: 607, 1823, vol. 15: 419, 533, 1825, vol. 19: 179, vol. 20: 453, 1828, vol. 25: 511, 1829, vol. 27: 239, 372, vol. 28: 104, 221, 354, 488, 602, 623, vol. 29: 344, 475, 734): generic freight rates (mostly selected days) for: India-England (1817), Bombay-London (1819, 1828, 1829) and Calcutta-London (1819, 1820, 1822-1825, 1827-1829), the *Asiatic Journal and Monthly Register for British and Foreign India, China, and Australasia* (1830, vol. 1: 32, 37, 103, 155, 161, 234, 239, vol. 2: 32, 37, 98, 159, 220, 1831, vol. 4: 36, 102, 105, 145, 161, 221, vol. 5: 35, 39, 88, 144, 1832, vol. 8: 39, 49, 53, 110, 158, vol. 9: 35, 39, 94, 145, 149, 192, 1833, vol. 10: 46, 79, 123, 156, vol. 11: 38, vol. 12:

20, 27, 112, 116, 237, 240, 1834, vol. 11: 39, 118, 122, 203, 269, 272, vol. 15: 100, 172, 234, 1835, vol. 16: 65, 136, 144, 213, 270, vol. 18: 32, 36, 127, 188, 243, 250, 255-256, 1836, vol. 20: 46, 53, 105, 112, vol. 21: 37, 163, 188, 1837, vol. 24: 105, 207, 281, 1838, vol. 25: 44, 179, 297, vol. 26: 44, 52, 104, 248, 1839, vol. 28: 52, 153-154, 233, 309, vol. 29: 62, 73, 306, 316, vol. 30: 49, 52, 72, 155, 164, 338, 354, 1840, vol. 31: 73-74, 83, 186, 255, 397, vol. 32: 60, 70, 178, vol. 33: 75, 147, 149, 238, 311, 373, 1841, vol. 34: 60, 64, 1842, vol. 37: 167, vol. 39: 312, 1843, vol. 40: 69, 81, 146, 159, 325, 428): generic freight rates (selected days) for: Bombay-London (1829-1843) and Calcutta-London (1829-1835), freight rates (selected days) for Calcutta-London for: cotton (1836, 1839, 1842), indigo (1831, 1835-1842), jute (1837, 1839-1842), linseed (1835-1836, 1839), rice (1835-1842), saltpetre (1835-1842), silk (1831, 1835-1842), and sugar (1835-1842), Statistics of British India , Part II Commercial, 1909 and 1912 issues, freight rates in selected months for: Bombay-London: wheat (1887-1911), Bombay-Liverpool: cotton (1872-1911), Calcutta-London: jute (1872, 1874-1911), linseed (1871-1911), rice (1871-1911), tea (1871-1911), and wheat (1871-1911), Shah-and Williamson (2004): freight index (1884=1) for grain (1869-1917, 1919-1938) and lighter commodities (1871-1873, 1879-1920) from Calcutta to London, Jacks (on-line data-base http://www.sfu.ca/~djacks/data/publications/index.html, accessed 10 October 2010): freight rates (in pence per long ton) for jute between Calcutta and London (1871-1873, 1879-1913) and rice between Rangoon and London (1869-1913), Klovland (2006): generic freight rates (in shillings per long ton) for Bombay-London (1872-1913) and Calcutta-London (1849-1861).

Whenever there was an overlap, primary sources have been preferred to secondary ones. The estimation proceeded as follows. Firstly, a Calcutta general freight rate was constructed extrapolating on the basis of India-England (1802, 1806-1809, 1813, 1816-1817, 1821), indigo (1836-1842), Bombay-London (1843), the grain index (1869-1871, 1912-1917, 1919-1938), wheat (1872-1911), and the index for lighter commodities (1918); interpolation was used for 1810-1812, 1814-1815, 1818, 1826, 1844-1848, and 1862-1868. Secondly, to exploit the available information on differential trends across goods, whenever possible, the indexes were used to extrapolate the trend of product-specific freight rates, using the lighter commodities index for cotton, indigo, and tea. Thirdly, for the other missing years, the Calcutta-London general series was used, assuming that the freight rate for silk between Calcutta and Lyon was the same as for Calcutta-London, and that for rapeseed was the same as for linseed. The following normalising rates obtained: 1 (India-England, general/Calcutta-London, general), 1.30 (Calcutta-London, indigo/general and silk/general), 1.03 (Calcutta-London, saltpetre/general), 1.07(Calcutta-London, sugar/general), 0.88 (Calcutta-London, jute/general), 1.17 (Calcutta-London, linseed/general), 1.02 (Calcutta-London, cotton/general), 0.97

(Calcutta-London, wheat/general), 0.83 (general, Calcutta-London/general Bombay-London), and 1.18 (cotton, Bombay-London/general, Calcutta-London). The sizes of these normalising rates suggest a relatively small noise introduced by the use of the general freight rates to estimate product-specific rates: freight rates tended to be quite close across products.

Indonesia. Korthals Altes (1994) reports a generic freight index (1912=100) for 1823-1938, as well as specific freight rates in Dutch gulden per quintal for sugar for 1832-1929 (with gaps in 1874-1875, 1913 and 1926) and for coffee for 1870-1931 (with a gap in 1913). On the basis of this data, product-specific freight rates have been extrapolated following two principles. Firstly, freight rates tend to increase with the value to bulk ratio. Accordingly, coffee freight rates are used to estimate those for rubber, tea and tin; sugar freight rates are used to estimate the levels for pepper; the levels of rice freight rates are also estimated on the basis of those for sugar, but they are normalised with the average ratio between freight rates on sugar and wheat from Calcutta to London between 1869 and 1871 (0.873). Secondly, the trend depends on the extent to which the NHM enjoyed a monopoly in the transport of the product. Thus, for sugar, both the series referring to the transport to the Netherlands ("homeward") on behalf of the NHM (series n. 02 for 1832-1870 and n.03 for 1868-1876) detect a sudden drop in 1869, when the level became close to that of the "Java-UK" series (1869-1929, series n. 04). By contrast, the generic freight index, which refers also to goods whose production was not managed by state monopolies, and therefore with a looser connection to the national trading company, detects a more gradual fall than for sugar from the mid-1850s. Accordingly, until 1869, the sugar series is used to extrapolate trends for coffee, which was under the cultivation system, and tin, whose trade was carried out solely by the NHM; the generic freight index is used to estimate trends for rice and pepper, as the latter ceased being under the cultivation system from 1863 and even before then was not as central to it as sugar and coffee. To minimise discontinuities, the sugar series has been constructed by using series n. 02 until 1868 and n. 04 from 1869 onwards. The remaining gaps were filled in by extrapolating from the generic freight index.

4. Quantities

Atlantic. Until 1853 the sources for cotton are: HPP (1809: 1, 1848b:2, 1854a: 255). These report continuous imports in the UK from the US of "cotton wool" in lb from 1806, but with a hole in 1809-1814. The sources for wheat are: HPP (1827a: 9, 1827b: 2-3, 1832: 2-5, 1843a: 59, 64, 1844: 6, 1847c: 8, 1854a: 4). These report continuous imports in the UK from the US of "wheat", "wheat meal and flour" or "wheat and wheat flour" in

quarters since 1800. From 1854, our source is ASTUK, for both “raw cotton” (in cwt or centals of 100 lb) and “wheat” (in cwt). In both cases, the series of exports from the US to the UK are without holes.

Far East. Continuous series of data on silk exports from China to the UK in lb from 1786 until 1858 can be found in HPP (1806: 3, 1818, 1819, 1820, 1821b: 368-369, 1823: 6-7, 1828:24, 1829: 38, 47, 1840: 128-142, 1859: 7). Continuous series of data on tea exports from China to the UK in lb from 1792 until 1858 can be found in HPP (1813: 4, 1818, 1820, 1821b: 368-369, 1823: 6-7, 1828: 24, 1829: 38, 47, 1831: 10, 18, 1833: 16, 19, 1840: 128-142, 1859: 7). ASTUK reports tea and silk exports from China to the UK in lb until 1913, with holes in 1910 and 1911. The series resumes in 1919, but only in 1920 more data is published. The data therefore suggests that after 1913 trade in these goods between China and the UK ceased, or at any rate became sluggish. Although we did not collect data on French imports of silk from China and Japan, there is little doubt that trade was taking place between 1874 and 1914, when China and increasingly Japan were major players in the world silk market and Lyon was the main trading centre for silk in Europe. Continuous data on Japanese silk exports to the US in thousands of lb from 1892 to 1937 is published by Fujino et al. (1979: 308-309).

India. Continuous exports into the UK of cotton wool (in lb) for 1792-1848 with gaps only in 1812 and 1813 are documented in HPP (1813: 2, 1827c: 16, 1828: 4, 1840: 47, 1843b: 16, 1847d: 12, 1848b: 4, 1850: 4). Continuous data on exports of Indian indigo into the UK in lb from 1785 until 1857, with just one hole in 1813, can be found in HPP (1813, 1818, 1820, 1821b: 368-369, 1823: 6-7, 1827c: 15, 1827d: 2, 1828: 24, 1832: 19, 1833: 5-18, 1836: 2, 1840: 42, 1847d: 10, 1848c: 3, 1850: 3, 1854b: 5, 1858: 5). Continuous data on exports of jute from Bengal (in cwt) between 1828/1829 to 1872/73 can be found in HPP (1874b: 63-65). Although the source usually does not specify the destination, the figures for the US and France are very small in comparison to the total, suggesting that the great bulk of these exports was destined to the UK. This is also confirmed by ASTUK data from 1855 (cf. below). Continuous data on exports to the UK of linseed and flaxseed in quarters for 1844-1857 were found in HPP (1854c: 4-5, 1858: 6). Continuous data on exports to the UK of saltpetre in cwt for 1792-1857, with gaps only in 1793, 1795 and 1812-1813, were found in HPP (1813: 4, 1818, 1820, 1821b: 368-369, 1823: 6-7, 1828: 24, 1831: 19, 1833: 7, 18, 1836: 3, 1840: 42, 1847d: 11, 17, 1848c: 4, 1850: 4, 1854b: 6, 1858: 6). Continuous exports into the UK of silk (in lb) for 1786-1857 are documented in HPP (1806: 2, 1817: 2, 1819, 1820,1821b: 368-369, 1823: 6-7, 1828: 24, 1829: 39, 1840: 42, 1847d: 11-16, 1848c: 4, 1850: 4, 1854b: 6, 1858: 6). Continuous exports into the UK of sugar (in cwt) for 1792-1857 with gaps only in 1812 and 1813 are documented in HPP (1813: 4, 1818, 1821: 368-369, 1823: 6-7, 1820, 1828: 24, 1831: 19, 1833: 7, 18, 1840: 42, 1847d: 12, 17, 1847e, 1848c: 4, 1850: 4, 1854b: 6,

1858: 5-7). ASTUK reports continuous data on exports to the UK from 1855 (unless otherwise specified) to 1938 for cotton (in cwt, data from Bombay starts in 1864), indigo (in cwt), jute (in cwt or long ton), linseed (in quarters or long tons, flax and linseed for 1855-1858, 1871 ff.), rapeseed (in quarters or long ton), rice (in cwt, data from Burma starts in 1871), tea (in lb) and wheat (in cwt or quarter, the data starts in 1856, but becomes continuous, with gaps only in 1932 and 1933, from 1871). Finally, data on French imports of Indian raw silk in kg for 1857-1877 (with gaps only in 1861-1862) can be found in *Tableau Général du Commerce de la France avec ses Colonies et les Pussances Ètrangérs* (various issues).

Indonesia. De Bruijn Kops (1857: 132-137, 166-169, 186-190, 198-201) documents continuous exports of coffee, pepper and tin from Java and Madura to the Netherlands (in pikols of 67.7613 kg) for 1825 to 1856. The same source reports data on exports of sugar to the UK (also in pikols) for the same years, but with gaps from 1826 to 1832. SD reports data on Dutch imports from the Dutch East Indies (in ponds of 1 kg) from 1846 for coffee, pepper, rice, tea and tin; in our years the only gaps are found in 1871, 1881, 1891, 1898, 1913, and for pepper in in 1917 and 1918. Continuous data on exports of rice from Java to the Netherlands (in 1000s tons) between 1827 and 1916 can be found also in Korthals Altes (1978). ASTUK reports data on imports of Java sugar into the UK (in cwt) from 1855, with gaps in 1864-1867, 1902 and 1936 and on UK imports of rubber from the Dutch East Indies (in centals of 100 lb) between 1913 and 1934, with just one gap in 1918.

5. Welfare analysis

The parameter α (Formula 3) is the share of the *i-th* product on total GDP. The numerator should be the value added (VA), but all sources report the gross output, inclusive of expenditures. We thus estimate the VA by product by multiplying gross output by a country-specific ratio gross output/VA from Federico (2004). We estimate β under the assumption that consumers buy raw materials (cotton, wheat etc.) separately from processing and selling services. We compute the consumption as gross output less net exports, which is equivalent to imports for goods not produced in the country (e.g. tea in the United Kingdom).

In all cases but the Dutch East Indies, we compute the welfare gains separately by product. We cover ten products for European consumers (coffee, cotton, indigo, jute, linseed, pepper, rice, sugar, tea and wheat), two for American producers and seven for Indian ones (coffee, cotton, indigo, jute, linseed, rice and wheat). For the United States, we obtain data on gross output of wheat and cotton from Strauss and Bean (1940, Tables 13 and 25) and on GDP, consumption and net exports from Carter et al. (2006, Tables Ca188, Cd1, Ee571 and Ee575). The ratio VA/output is 0.84. We get data on gross output of wheat in the United

Kingdom, from Ojala (1952: 208-209) and we use a VA/GDP ratio of 0.66.[30] Imports are from ASTUK (1913 issue); total consumption and GDP are from Feinstein (1972, Table T9). For India, we assume a VA/output 0.95 and we take data on gross output by product and total GDP from Sivasubramonian (2000, Tables 3 (c) and 6.10), averaging two consecutive crop years and on value of trade from SABI (1913 issue).[31]

The Dutch Indies are an exception because the estimates of national accounts by van der Eng (1992, Table A4) divide total agricultural production in three categories, food crops, cash crops and estate crops. We use the sum of the two last categories as proxy of the share of the production of exportable goods on total VA.[32] We assume that all products were exported and we compute the price change as an average of product-specific changes weighted with the shares on trade in 1913.

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[30] The production of sugar beet was irrelevant before the war.
[31] The source does not report data on trade in linseed. We assume exports accounted for 15 per cent of gross output, as for rapeseed.
[32] The sum covers coffee, copra, palm oil, rubber, sugar, tea, and tobacco (van der Eng, 1992: 255). Thus it includes four products we do not consider (copra, rubber, palm oil and tobacco), but it does not consider tin and rice.

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