EHES Working Papers in Economic History | No. 11

A Tale of Two Oceans: Market Integration Over the High Seas, 1800-1940

Giovanni Federico,
European University Institute and University of Pisa

October 2011

EHES Working Paper | No. 11 | October 2011

A Tale of Two Oceans: Market Integration Over the High Seas, 1800-1940

Giovanni Federico,
European University Institute and University of Pisa

Abstract

Long-range market integration is an essential component of globalization but it is still comparatively under-researched. The conventional wisdom relies heavily on the case of Atlantic trade in the period after 1870. This paper covers also the Indian Ocean and extends the period under consideration, from Waterloo to World War Two. Integration started in first half of the 19th century, and timing and extent of convergence differed substantially among products. The second part of the paper analyses the causes of the process with a panel regression and puts forwards a tentative estimate of its welfare effects. The key message of the paper is that simple generalizations about the first globalization are not good substitutes for empirical research.

1) Introduction

The integration of world commodity markets is widely regarded as an essential component of the first globalization (Williamson 2006, Findlay-O'Rourke 2007, Persson 2010). The conventional wisdom on its timing is neatly summed up by O'Rourke and Williamson in the Introduction of their very influential book on <u>Globalization and history</u> "the really big leap to more globally integrated commodity and factor markets took place in the second half of the [19th] century" (1999 p.2). Before 1800, price gaps between Asia and Europe remained stubbornly wide (O'Rourke and Williamson 2002, Ronnback 2009, De Vries 2010), while they opened again after World War One, and especially after 1929 (Hynes, Jacks and O'Rourke 2009). In the prevailing narrative, convergence before 1913 reflects mostly the technological progress in transportation means, while the post-war disintegration was a consequence of the protectionist backlash.

i)   This conventional wisdom suffers from four problems:

ii)   The literature tends to neglects the trends in the first half of the 19th century, a period of massive convergence in the European market (Federico 2011)

iii) Almost all works refer to integration across the Atlantic Ocean, which may not be representative enough of world-wide trends.

iv) The role of transport costs is inferred from visual inspection of trends rather than formally tested.

v)   Integration is assumed to have been very important and beneficial, but there are no hard estimates of its effects, with the partial exception of an estimate of gains from greater efficiency by Ejrnæs and Persson (2010).

This paper addresses all these shortcomings. It deals with the integration of markets for a representative sample of major commodities across the Atlantic and Indian Oceans in a very "long" 19th century, from Waterloo to World War Two and addresses four issues

i)   What happened before 1870? Did price converge, as in Europe, or not?

ii)   How much did trends differ across Oceans (Atlantic and Indian) and among products?

iii) How much did changes in transaction costs and market efficiency, and/or in policies by producing and consuming countries contribute to convergence (or divergence)?

iv) How much did integration increase the welfare of European consumers and overseas producers?

Section Two, after a short methodological discussion on measurement of integration, provides the key information about the available data and their reliability. Section Three deals with the rate and timing of integration and Section Four and Five analyze its causes. Section Four outlines the long-term changes in transaction costs, policies and market efficiency, while Section Five estimates their contribution to integration with a panel regression approach. Section Six measures, somewhat tentatively, the static effects of integration on welfare, and frames the results in the wider debate on the effects of globalization in the periphery. Section Seven concludes.

2) Sources and methods

As argued elsewhere (Federico forthcoming a) market integration consists of two separate processes, an increase in efficiency and a convergence in price levels. The state-of-the-art econometric techniques, so popular in the recent literature (cf. e.g. Jacks 2005, Sharp 2008, Dobado and Guerrero 2009), focus on the speed of reaction by traders to opportunities of profitable arbitrage, which is a measure of efficiency. In contrast, this paper deals with the long-run convergence of prices, as measured by the ratio of prices in consuming countries and producing countries. This choice is partly out of necessity, as the econometric techniques need high frequency data, while the available price series are annual, but it is mostly inspired by a methodological argument. A degree of efficiency is necessary for integration, but at the end of the day what matters is the level of prices, which determine the decisions by producers and consumers, the allocation of factors and thus ultimately the GDP.

The price ratio between two locations would be an unbiased measure of convergence and its movements could be interpreted as a direct consequence of changes in transaction costs, if i) the data refer to the same quality, or at least, the relative quality is not changing ii) the two locations must trade and iii) the market must be reasonably efficient. Constant differentials in relative quality between the two markets cause the price ratios to differ from the true, quality-adjusted, one (Broda and Weinstein 2008) and changes in relative quality can add spurious trends. If two locations do not trade but markets are efficient, price ratios could move randomly as long as they do not exceed transaction costs. If the locations trade but markets are inefficient, prices ratios can exceed transaction costs. Thus, if conditions ii) and iii) are violated, the estimates would be at best not precise and at worst positively biased.

The article considers six commodities – two, wheat and cotton, for the Atlantic Ocean, and four, sugar, pepper, coffee and tin, for the Indian one (see for more details on sources and methods Appendix A). Prices for wheat (in London and New York) and cotton (Liverpool and New York) are pieced together from a number of different sources, while those for sugar, coffee, pepper and tin in Batavia and Europe (London for sugar and tin, Amsterdam for pepper and Rotterdam for coffee) are taken from Korthals Altes (1994). To what extent do the data meet the three conditions?

> i) Only the series for cotton in New York and Liverpool undoubtedly refer to the same quality, the "middling Upland", the reference quality. The other commodities are labelled according to provenience (e.g. "Java" sugar) but without further information on the traded quality. The series for tin are the least accurate: until 1913, the Batavia prices refer to the fiscal year ending in April and afterwards are proxied by quotations in Singapore less an estimate of transport costs. On the other hand, goods traded in London or the Netherlands could differ from those traded in New York or Batavia only if the European market was supplied by other sources. Wheat and tin were produced also in the United Kingdom and could be imported from other countries (e.g. Southern Russia), but prices of colonial goods were in most cases clearly identified as specific to Indonesian products. Thus, qualitative differences had to be small. It is possible to double-check the results for coffee, sugar and tin by looking at the ratio of gross to net receipts per unit of the Nederlandsche Handel-Maatschappij, or NHM (Korthals Altes 1994) [1]. This latter was an official trade company, established in 1824, which until 1870 enjoyed a monopoly of trade between the Netherlands and its colonies. By definition, these data refer to the same commodities, purchased in Java and re-sold in the Netherlands. According to Korthals Altes (1994 p.73), the net proceeds of sales, exclusive of costs (freights, sales commissions, registration duties etc.), "may broadly be compared with the free on board prices in the Netherlands-Indies". This statement is somewhat

---

[1] Korthals Altes (1994) reports also export prices for sugar and tin according to official trade statistics. They have not been used as they refer to a mix of qualities.

5

vague and one might suspect that the delay between purchase and sale add some noise.

ii) There is no doubt that these products were traded: they accounted for about a seventh of world trade on the eve of World War One and their share remained almost as high after the war [2]. In 1913, cotton accounted for 22.5% and wheat for 5.8% of American exports (Historical Statistics 1975 series U 276 and U 281), while sugar accounted for 43.5% of Indonesian exports, tin for 17.1% and coffee for 6.5% (Mitchell 2007). The percentages on British imports were lower, but still fairly high for cotton (10.7% in 1913), wheat (7.6%) and sugar (3.5%), while coffee (0.5%) and, above all, pepper (0.05%) were comparatively minor products. Tin imports accounted for 1.9% of the total, but their growth had been a fairly recent development. In fact, the United Kingdom was a major producer of tin, thanks to Cornish mines, and it had been a net exporter for most of the 19th century (Mitchell 1988).

iii) As said, the lack of suitable data prevents a direct econometric test of market efficiency. It is however possible to resort to anecdotal evidence (Section Four) and also to interpret some econometric result (Section Five) as result of changes in efficiency.

3) When did the market integrate?

A first visual inspection to price ratios (Figure 1) shows that prices converged in the "long" 19th century and suggest that integration for all products but tin peaked in the mid-1900s or immediately after World War One [3].

---

[2] The data (Yates 1959 tab A1), omit pepper. The share of the five remaining products was 14.1% in 1913, 13.4% in 1929 and 12.7% in 1937.
[3] Here the peak of integration is defined as the year with lowest ratio of prices in a trend from Hodrick-Prescott. Integration peaked in 1853 for tin, 1906 for pepper, 1908 for coffee and wheat, 1920 for cotton and 1922 for sugar.

Figure 1 a)
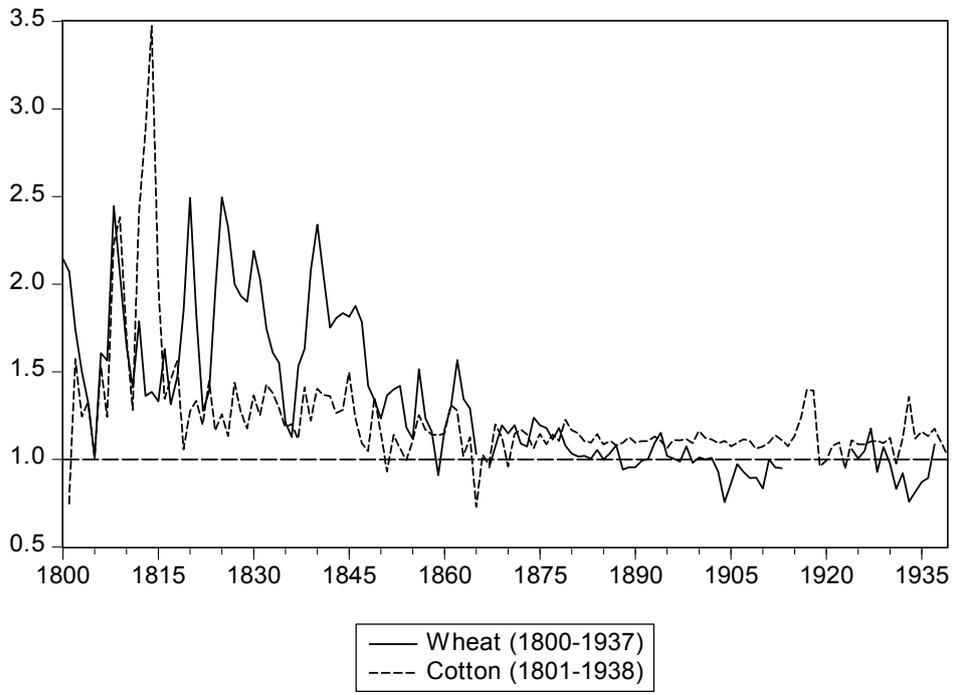Price ratios, Atlantic trade: wheat and cotton

Figure 1 b)
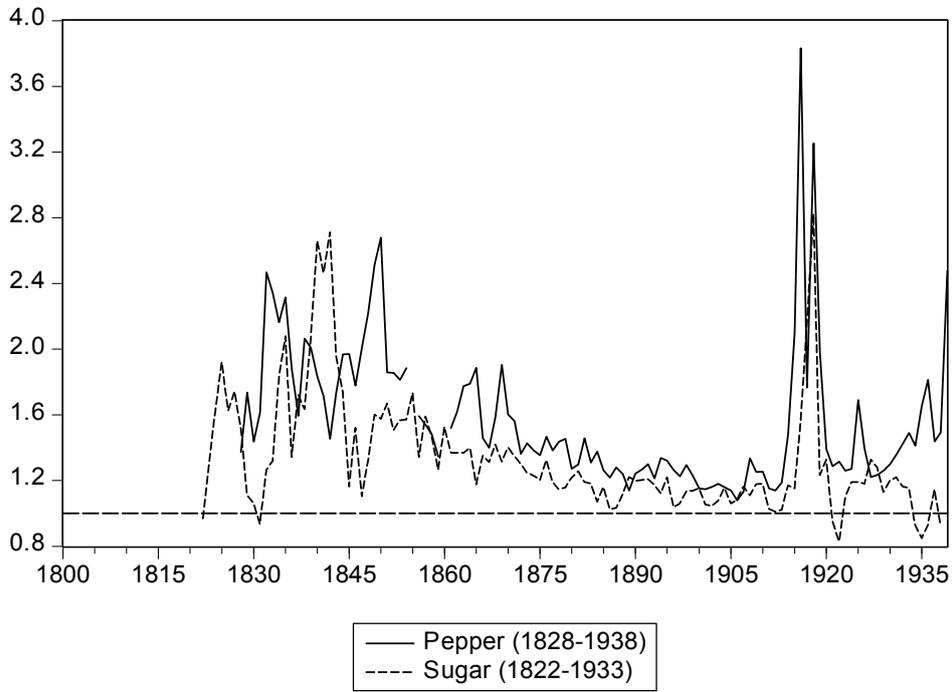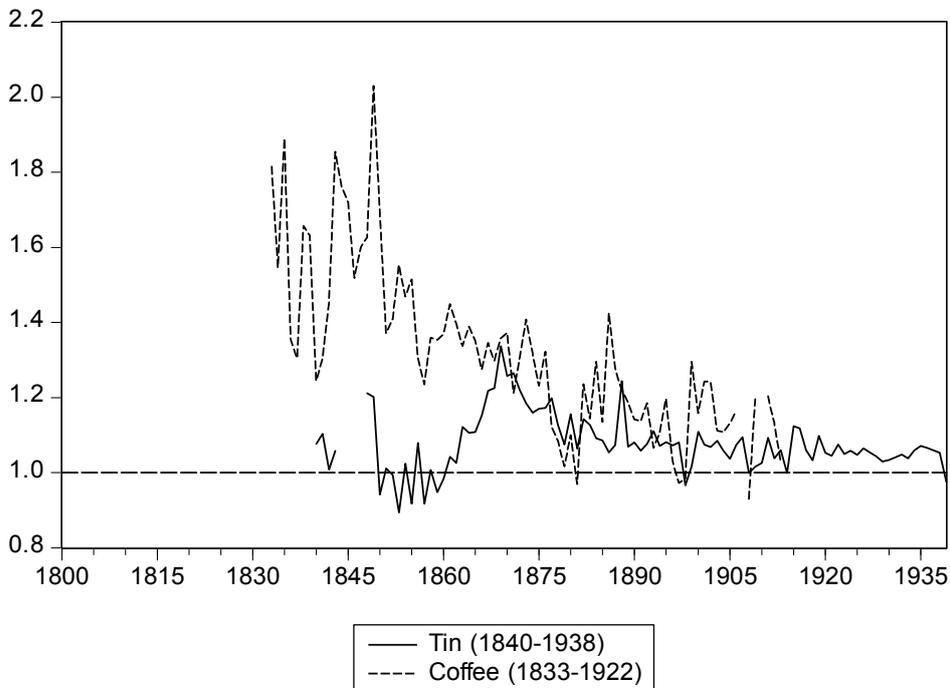Price ratios, Indian trade: pepper and sugar

Figure 1 c)
Price ratios, Indian trade: coffee and tin


```
      Tin (1840-1938)
 ---- Coffee (1833-1922)
```

On the other hand, the process seems to have unfolded mostly around the mid-century rather than after 1870, and the dis-integrating effects of the war and of the Great Depression are much less dramatic than expected. Figure 1 highlights also substantial differences among products and Oceans in the levels of integration. For the whole century 1838-1938, the average price ratios were smaller across the Atlantic (wheat 1.20, cotton 1.14) than across the Indian Ocean (pepper 1.57, coffee 1.32, sugar 1.32, tin 1.08). Cotton stands out as paragon of integration. The average price ratio for cotton before the Civil War hovered around 10%, a level reached by other products in the 1880s-1890s. On the other side, the gap in pepper prices remained stubbornly high, in the region of 30%, but for a brief interlude in the mid 1900s.

Following Razzaque et al (2007), the pattern of convergence can be explored formally by running a regression

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

where RP is the price ratio Europe/USA (or Java) and TIME is a linear trend. This specification tests jointly the existence of a deterministic trend and of an ECM to return to it after a shock (ψ ranging between -1 and 0). The lagged shock term is added to address the possible serial correlation.[4] Prices converge if there is a downward deterministic trend – i.e. if β is negative and significant. In this case, the long-run rate of change can be computed as t=- (β/ψ).

---

[4] The coefficient is significant only for tin, and it is thus omitted from Table 1

Table 1
Long-term convergence

$\Delta lnRP_t$	Period	Constant	β	Ψ	Adj R^2	t*(100)
Coffee	1835-1913	6.92***(4.2)	-0.00360***(4.2)	-0.66***(5.0)	0.30	-0.545***
Pepper	1830-1939	1.14 (1.1)	-0.00055 (1.0)	-0.26***(3.2)	0.13	-0.211
Sugar	1824-1938	2.91***(3.0)	-0.00150***(2.9)	-0.37***(4.6)	0.16	-0.406***
Tin	1842-1939	0.29 (0.8)	-0.00014 (0.7)	-0.25***(2.9)	0.28	-0.058
Cotton	1803-1939	2.03***(2.9)	-0.00105***(2.8)	-0.40***(5.0)	0.22	-0.259**
Wheat	1802-1937	4.13***(4.2)	-0.00217***(4.2)	-0.39***(5.3)	0.16	-0.561***

* significant at 10%, ** significant at 5% *** significant at 1%

The ECM coefficients ψ imply that half-lives of shocks range from eight months for coffee to 2 years and five months for tin. The return to long-run path seems quite fast, as the shocks are large enough to be captured by yearly data (i.e. not arbitraged away within the year). This can be construed as evidence for a well-functioning market, but of course this inference should be supported by further tests with suitably high-frequency data. All the β coefficients are negative, but the pattern of convergence differs between products. The standard errors for pepper and tin imply that there are respectively 33% and 45% chances that the coefficient is spurious and the true one were zero – i.e. that prices did not converge at all in the long run. Prices for all the other products did converge, but wheat stands out: the yearly rate, cumulated over the whole period, correspond to a fall by 50% for wheat and by 30% for the other three commodities. Clearly, there was no common pattern in the Indian Ocean, and probably also in the Atlantic one.

The rates of Table 1, referring to the whole period, might conceal actual trends if the conventional wisdom is right. In fact, the measured trend would average out the (allegedly) fast convergence during the first globalization with a possible stagnation in the first decades of the century and the divergence of the 1930s. The received view implies the existence of structural breaks around 1870 and just before World War One or around 1929. Actually, a Bai-Perron (2003) test do not confirm this hypothesis [5]. It fails to detect any break for cotton and coffee, while for the other four goods, breaks coincide with expectations only in some cases (Table 2)

Table 2
Pattern of convergence

| $\Delta lnRP_t$	Period	B	Ψ	t*(100)
Pepper	1830-1913	-0.00373***	-0.49***	-0.762**
Pepper	1914-1939	-0.00510	-0.53**	-0.969
Sugar	1824-1842	0.01384**	-0.39**	3.576**
Sugar	1843-1875	-0.00328	-0.67**	-0.489
Sugar	1876-1914	-0.00215*	-0.83*	-0.259*
Sugar	1915-1938	-0.01424*	-0.66***	-2.164*
Tin	1842-1861	-0.00378	-0.56*	-0.671
Tin	1862-1876	-0.00338	-0.14	-2.363
Tin	1877-1939	-0.00109***	-0.97***	-0.112***
Wheat	1802-1846	0.00275	-0.62***	0.447
Wheat	1847-1904	-0.00412***	-0.62***	-0.663***
Wheat	1905-1937	-0.00008	-0.48**	-0.017

* significant at 10%, ** significant at 5% *** significant at 1%

---

[5] The test has been executed on a simplified model with only linear trend, using a sequential approach and looking for breaks in both constant and time coefficient.

Re-running equation 1) for the selected periods yields a rather varied picture. Convergence of prices of pepper and wheat, as of cotton and coffee, started well before the conventional dates of the first globalization. Convergence for tin did start in the 1870s, but it continued in the interwar years, with no clear effect of the war or of the Great Depression. The case of sugar is similar, but it features also a significant divergence in the first twenty years of the period. The record rate of convergence in interwar years compensates a sharp increase in price differential at the outbreak of the war.

As said, it is possible to double-check these results with the NHM data for coffee, sugar and tin, although the series for the latter two products are fairly short (Figure 2).

Figure 2
Price ratios, Indian trade: NHM data
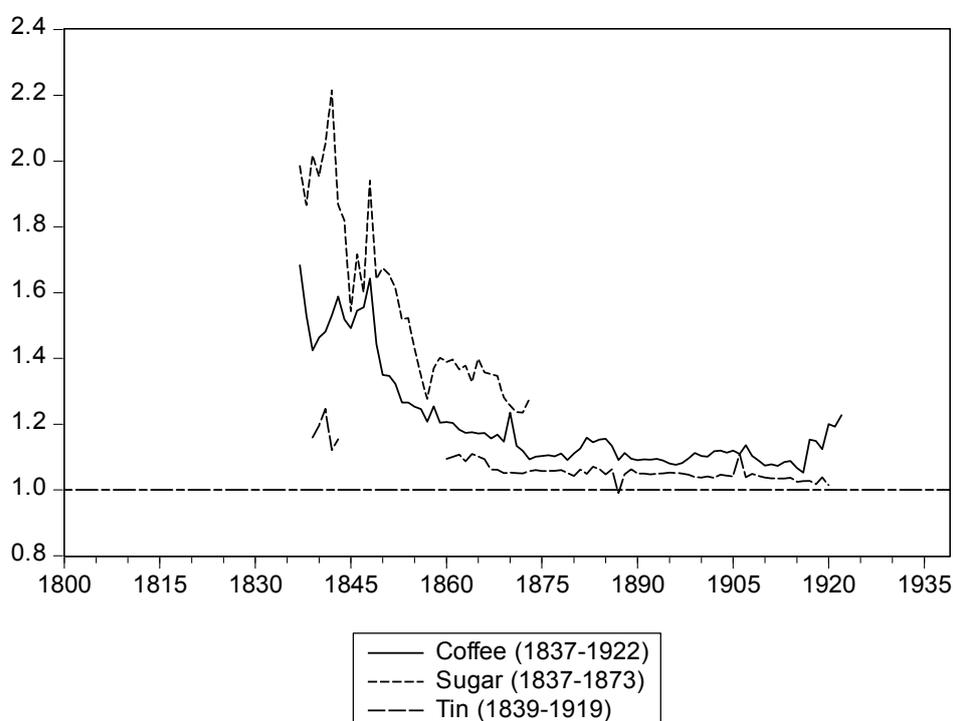
When overlapping, the coefficients are almost identical for sugar, while the implicit rate for the NHM series is decidedly lower for tin [6]. The case of coffee is more complex. The long-run rate of convergence is broadly comparable (-0.28% per annum vs -0.36 per annum over the period 1839-1913), but the time pattern is somewhat different: convergence was very quick at the beginning of the period (-1.3% from 1839 to 1864) and slowed down afterwards (-0.9% from 1865 to 1909).

Figure 1 highlights also the very high volatility of (market) price ratios, especially in the first half of the 19th century. The variance of residuals around a Hodrick-Prescott filtered series fell by 80% from 1801-1825 to 1889-1913 for wheat and by 95% for cotton. The fall was less impressive in absolute terms, but still quite substantial, for price ratios for Indian trade (over shorter periods of time). Volatility fell by three quarters for sugar from 1822-1846 to 1889-1913),

---

[6] The rates of change are -1.45% for the market data and -1.42% for the NHM ones for sugar (1837-1873), and respectively -0.23% and -0.07% for tin (1862-1920).

halved for coffee and pepper (from respectively 1839-1857 and 1828-1852 to 1889-1913) and declined by two fifths for tin (from 1848-1872).

The measured variance increased sharply during war years, and it did not return to pre-war low levels in the 1920s and 1930s. It is also worth noting that, in quite a few cases, especially for wheat and tin, the ratios fell below one – i.e. yearly average prices were lower in Europe than in Java or in the United States. In theory, traders were losing money, at least on the. This eventuality is not uncommon in business, but the persistence of the ratio below one for several years in a run, as for wheat in the 1910s and in the 1930s and for tin in the 1850s and 1860s, needs an explanation. They might reflect differences in quality. At least for wheat, there is evidence that of a qualitative superiority of American exports over the average British wheat in the 1890 (Ejrnæs, Persson and Rich 2008).

To sum up, the quantitative analysis of trends highlights three main stylized facts
- i) The transoceanic markets did integrate in the long run, with huge differences between commodities in the extent and timing of convergence.
- ii) The timing does not tally with conventional wisdom.
- iii) The price differentials were initially very volatile, and the width of fluctuations fell sharply towards the end of the period.


4) On the causes of integration: long-run trends

As anticipated in the Introduction, the conventional wisdom explains integration in the "long" 19th century as the consequence of technical progress in shipping, which caused the fall in transportation costs, and of the abolition of barriers to trade. To what extent does the available evidence confirm these statements for the transatlantic trade?

The fall in transportation costs, unless prevented by barriers to trade, caused the wedge between prices at origin and in Europe to shrink. Data on freights are fairly abundant, and it is possible to build product-specific series for coffee, sugar, wheat and cotton (Appendix B).Product-specific series are to be preferred not only because, as obvious, distance differed (8576 miles between Amsterdam and Batavia or 8506 between London and Batavia versus "only" 3342 between New York and London) but also because freights on the same route could vary according to the opportunities for a return leg, to the available stowage techniques, on the type of ship (steam versus sail) and so on (Harley 1988, 1989, 2008). Figure 3 reports the ratio of freights to price at origin (the so-called freight factor) [7]

---

[7] For the sake of readability, the figure omits the war years, when freights for Indian trade soared, up to a maximum of 242% for sugar in 1918.

Figure 3
Freight factors
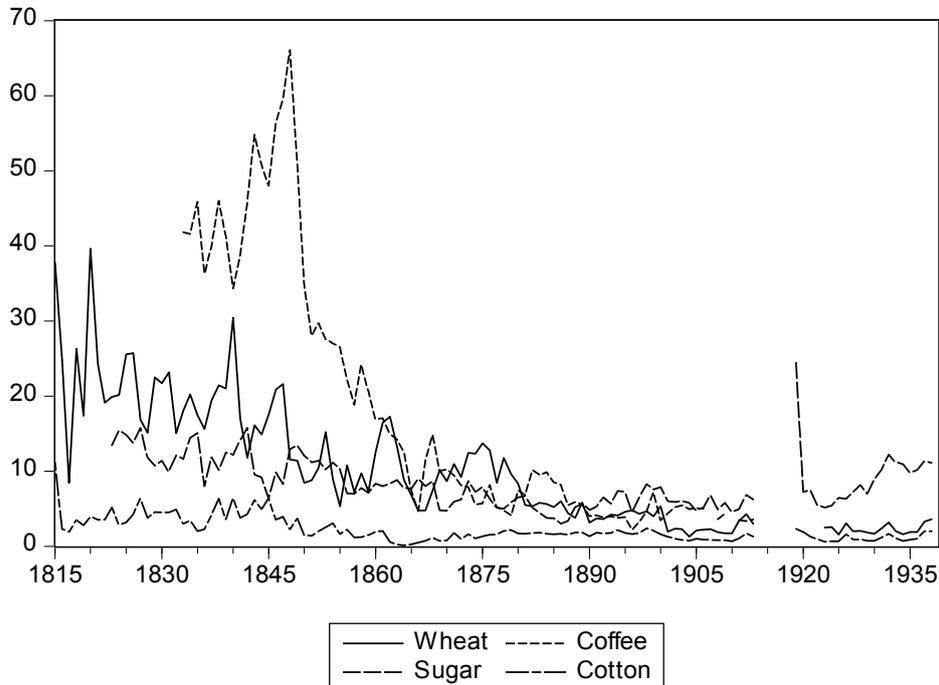
The main message is clear: sea transport was rather cheap, even in the first half of the 19th century, but its costs were pretty volatile. Freigths for cotton never exceeded 10% of the New York price, and even coffee ones, the highest ones, exceeded 40% only before 1850 (and during World War One). On average throughout the period, freights accounted for 11% of prices of sugar, 18% of coffee, 2.5% of cotton and for 10.5% of prices for wheat. Thus, they can explain only a part of the price gaps – a sixth for cotton and a half for the other three [8]. For this reason, freight factors were much less volatile than relative prices, although in absolute terms freights were as volatile as European prices[9].

The evidence is, unfortunately, much less abundant on transport costs other than freights (insurance, port handling fees, sale commission etc.). The most comprehensive data refer to expenditure for insurance and commission by the NHM: it paid 12% of the net proceeds (the "price" in Batavia) in the 1830s, 8% in the 1840s, 5% in the 1860s and 3.5% in the 1870s (Van Zanden-Van Riel 2004 tab. 5.1)[10]. The sparse evidence on the Atlantic trade suggests that the

---

[8] To avoid biases, the averages (0.51 for sugar, 0.54 for coffee, 0.48 for wheat and 0.15 for cotton) are computed omitting years when the price ratio is below one and thus the denominator of the ratio negative. For wheat only, we omit also outliers – i.e. the years when freights exceeded 3 times the price differential.

[9] The freight factor and relative price share the denominator and thus any difference in variance of residual depends on the absolute volatility of the numerator (freights vs. prices in Europe) and on the average ratio between freights and European prices. For the entire period, the variance of price ratios was 13.7 times that of freight factor for cotton, 4 times for wheat, 2.7 for pepper. In contrast, in the case of sugar, the variance is only marginally higher for prices than for the freight factor.

[10] The decline is confirmed by the rate of insurance for trade from Antwerp to the East Indies (Scholler 1951). They declined from 4-5% of the value of the cargo in the 1820s to 2.75% in the 1850s

other costs were lower than on the Indian Ocean. North (1960) adds a flat 5% for "primage" to his estimate of American exports before 1860. The insurance rates for export from Antwerp to the United States decreased from 2.5-3% of the value of shipment in the 1820s to less than 2% in the 1850s and to 1% in the 1920s (Scholler 1951, Persson 2004). According to Harley (1980), the "other" transaction costs, including port charges, accounted for 8.1% of New York wheat prices in 1868-1872, 7.2% in 1880-1884 and collapsed to 1.9% on the eve of World War One, but Persson (2004) deems the initial estimate too high. Anyway, it seems clear that these "other" transaction costs accounted only for a fraction of freights – about one third in the Indian trade, and possibly a bit higher in the Atlantic trade [11]. A quick computation show that total transportation costs (freights and other) could have accounted fully for the price gaps, especially in the Atlantic trade, only if other costs had been absurdly high[12]. Thus, one has to conclude that the fall in transaction cost can explain integration only very partially. This conclusion is not really novel. The same point had been made forcefully by Persson (2004) for wheat trade across the Atlantic, although he referred to freights, while including other transaction costs in the residual to be explained.

Barriers to trade (and their abolition) were indeed important for some poroducts, most notably wheat. Imports in the United Kingdom were subject to an almost prohibitive duty from 1815 to 1828, and to a quite high one from 1828 to 1846. By the way, its abolition (the Repeal of Corn Laws) coincides in time with a break in the series (Table 2). Wheat imports remained free until the adoption of the Imperial preference system after the Ottawa conference in 1932, which complemented substantial subsidies to domestic producers (Rooth 1992). The 1930s featured also, for the first time, a massive intervention of the American federal government in the markets for agricultural goods. The Agricultural Adjustment Act (1933), one of the first measures of the Roosevelt administration, set a minimum price for the key agricultural commodities, and thus it reduced the incentives to export. Prices of Indonesian exports were affected by the Cultivation system, which the Dutch government adopted in 1830 in order to increase its revenues (Fasseur 1992, Houben 2002, Van Zanden 2010). The Dutch colonial administration forced Indonesian peasant to grow coffee, sugar and other primary products, in exchange for money which could be used to pay land tax and (Dutch) manufactures[13]. The trade was monopolized by the NHM, which awarded contracts for transport to Dutch companies, at freights higher than the free market ones and the net revenues were directly cashed by the government (Batig Slot). Since the 1850s, shipping contracts was gradually liberalized, and freights converged to free market levels. In fact in the late 1860s, the freights from Java to the Netherlands fell by two thirds, while Atlantic ones fluctuated without any clear trend. In the 1860s, trade was liberalized and the System was gradually wound down, to be formally abolished in 1870, although some forced cultivation remained. For the whole period of the first globalization, production and trade of Indonesian exports remained free from state interference or regulation. In 1918 the sugar producers set up a private Association (VJSP) to manages sales, which was substituted in 1932 by a governmental organization (NIVAS) - Korthal Altes 1994. This short narrative shows that the state intervention was the exception, not the rule. The listed policies affected trade only in about one observation out of ten (75 years/product out of 691).

Scholars tend to neglect the two other possible causes of price gaps, quality differentials and market inefficiency. As said, the former is not likely to have mattered much for cotton and colonial goods, but the case might be different for wheat. The quality of American wheat traded on the London market rose steadily relative to the domestic product in the last fifty years of the 19th century (Ejrnæs, Persson and Rich 2008). This movement, if it affected to all grain traded in New York rather than only exports to England, would account for up to three quarters of the

---

[11] The Harley (1980) estimates imply a ration other costs/freights 0.77 in 1868-1872 (freight factor 14.2%), 0.98 in 1880-1884 (freight factor 8.6%) and 0.40 (freight factor 1.9%).

[12] Increasing the freight factor in Indian trade by a third, would augment the coverage ratio (total costs/price ratios) over the whole period to 0.67 for sugar and to 0.70 for coffee. For Atlantic trade, data are too uncertain, but it is possible to compute the ratio other costs/freights which would suffice to explain entirely for the gap. Other costs should have been twice freights for wheat and 6.7 times higher for cotton.

[13] Tin, as a mining product, was not subject to the Cultivation system, but the NHM still had a monopoly on its transportation.

convergence in those years [14]. Unfortunately the lack of quality-adjusted price series makes it impossible to explore trends before 1850 or after 1900, but further massive changes seem unlikely.

Without a specific test, it is impossible to rule out the possibility that prices exceeded commodity points – i.e. of some degree of market inefficiency. This case is not necessarily evidence of failure by traders. Perfectly rational, profit-maximizing traders would refrain from arbitrage if a slow transmission of information and orders increases the uncertainty about the sale prices of their wares and thus the risk of losses. In this case, the high initial level of price ratios would be a consequence of a slow circulation of information, and the convergence reflects its improvement. The time to send letters from Java to the Netherlands and get an answer dropped from 9 to 2 months, after the institution of mail service via Suez in 1844 (Fasseur 1992). Communications across the Atlantic was obviously faster – about 14 days for a round trip in the 1850s (Hoag 2006). This time was drastically cut to few hours, and then to few minutes (Headrick 1988) by the connection between USA and UK by the telegraph cable across the Atlantic (1866) and the Indian (1875). Lew and Cater (2006) argue that the telegraph reduced the market frictions and thus increased trade.

5) On the causes of integration: econometric evidence

The discussion so far shows that none of the possible causes of convergence can be ruled out on the basis of evidence. Their contribution can be assessed by running a regression

Log P_i/P_j=F($\mathbf{T_c}$, $\mathbf{E_m}$, $\mathbf{P}$)   2)

where transaction costs ($\mathbf{T_c}$), market efficiency ($\mathbf{E_m}$) and policies ($\mathbf{P}$) are measured as listed in Table 3 [15]

---

[14] The estimate is based on a comparison of (quality-adjusted) prices of American wheat in the United Kingdom with the so-called Gazette series, which is an unweighted average of prices in markets all over England from 1850 to 1900. The ratio increased at 0.35% per year, corresponding to a massive 19% 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% (yearly rate 0.60%). Thus, if prices for New York referred to export-quality wheat, the improvement could have accounted for about three quarters of the convergence (19%/26%). This paper does not use the Gazette price, but a series of London prices which is on average 5% higher. However, the two series are correlated at 0.998 and thus the difference does not affect results.

[15] Dummies have been transformed by adding 1 before carrying out the transformation into logs. Freights for pepper and tin are proxied with the generic index for "Indian" trade by Korthal Altes (1994)

Table 3
Description of variables

Variable	
FREIGHT	Log of index freight factor (1869=1)
TREND_A	Time trend for Atlantic Ocean trade
TREND_I	Time trend for Indian Ocean trade
WWI_A	Dummy for World War One, Atlantic Ocean trade
WWI_I	Dummy for World War One, Indian Ocean trade
CL_1815	Dummy for the 1815 British Corn Laws, 1815-1827
CL_1828	Log of average nominal duty on wheat according to the 1828 Corn Laws (Federico forthcoming b)
CULTIVATION1	Dummy for the Cultivation system with monopoly of shipping, 1830-1849
CULTIVATION2	Dummy for the Cultivation system with monopoly of shipping, 1850-1870
IP	Dummy for the Imperial Preference on wheat import in the United Kingdom, 1932 ff
AAA	Dummy for the AAA on wheat and cotton exports, 1933 ff
VJSP	Dummy for the private marketing board for Java sugar, 1918-1931
NIVAS	Dummy for the private marketing board for Java sugar, 1932 ff

All regressions use a fixed effects specification with panel corrected standard errors to address cross-section heteroskedasticity and contemporaneous correlation. The specification includes a lagged value of the dependent variable to reduce auto-correlation, but its omission does not affect qualitative results. As freights can be endogenously determined by the demand for transport of commodities, we estimate also an instrumental variable version of the basic regression, using as instrument for freights the lagged values. We have also performed some robustness tests, omitting from the panel tin before 1876, wheat before 1828 and in the 1930s, to take into account the possibility of no trade in those years, and adding dummies for the US Civil War and for the existence of a telegraphic connection. The results do not change or are worse than in the baseline specification.

Table 4
Regression results

	(1)	(2)	(3)	(4)
Estimation	PCSE	PCSE/IV	PCSE	PCSE/IV
C	0.144 (0.25)	0.694 (1.15)	0.972 (1.99)**	1.247 (2.50)**
CL_1815	0.211 (3.69)***	0.217 (3.66)***	0.222 (3.87)***	0.228 (3.81)***
CL_1828	0.222 (3.60)***	0.225 (3.52)***	0.231 (3.71)***	0.235 (3.65)***
CULTIVATION1	0.109 (2.69)***	0.133 (3.24)***	0.090 (2.25)**	0.095 (2.30)**
CULTIVATION2	0.029 (0.99)	0.049 (1.69)*	0.017 (0.60)	0.042 (1.46)
IP	-0.108 (-1.38)	-0.111 (-1.38)		
AAA	0.087 (1.49)	0.088 (1.47)		
VISP	-0.102 (-1.56)	-0.057 (-0.85)		
NIVAS	-0.247 (-2.79)***	-0.176 (-1.94)*		
FREIGHT	0.056 (6.08)***	0.027 (2.44)**	0.044 (5.17)***	0.018 (3.44)***
TREND_A*100	-0.045 (-1.56)	-0.072 (-2.38)**	-0.051 (-1.93)*	-0.075 (-2.71)***
TREND_I*100	0.002 (0.54)	-0.010 (0.22)	-0.044 (-1.27)	-0.055 (-1.54)
WWI_A	0.020 (0.26)	0.079 (1.04)	0.050 (0.66)	0.092 (1.20)
WWI_I	0.199 (4.10)***	0.259 (5.22)***	0.241 (5.22)***	0.290 (6.20)***
RP__1	0.493 (14.88)***	0.536 (15.18)***	0.508 (15.44)***	0.551 (15.77)***
_N_ observations	621	617	621	617
Adj R^2	0.75	0.75	0.74	0.74
F	97.9	90.7	120.9	113.74
DW	1.96	2.09	1.95	2.09
LL t-stat	-21.6***	-23.0***	-21.5***	-24.17***

The last row of table 4 reports the results of the Levin, Liu and Chu (2002) test for the presence of a unit root in the residuals. The null of unit root is rejected at 1% in all regressions - i.e. all series are co-integrated. A comparison between OLS and IV specifications show that differences were small for all variables but FREIGHT.

The results confirm that the decrease in transportation costs fostered integration, but, consistently with their low(ish) ratio to export prices, the effect was fairly small. The coefficient of FREIGHT is the short-run elasticity, while the long-run one is about twice as large (i.e. around 0.1 in the OLS specification and 0.05 a half in the IV one). In the long run, a 1% change in freights reduced the price gap at its mean (around 1.30) by about 0.0012-0.0014 points.

The effect of policies in the 1930s is nil or, in the case of the NIVAS marketing board for Dutch sugar, marginally positive. In contrast, as expected, both the Corn Laws and the Cultivation system affected negatively transoceanic integration. Protection to wheat augmented price gaps, at the mean, by about 0.4-0.5 points and the Cultivation system by 0.2-0.3, but only before 1850. The dummy for the System after 1850 is marginally significant only in one specification. In other words, the key feature of the system, at least from the point of view of long-range integration, was the reservation of transport to Dutch shipping.

The negative and significant coefficient of the trend for the Atlantic Ocean suggests that market efficiency increased, although by not much (less than 10% if cumulated over the whole period). World War One had a very negative impact on integration in the Indian Ocean, increasing

price gaps by 0.5-0.7 points according to the specification. In contrast, the war time dummy is not significant for the Atlantic Ocean. This result may appear surprising, as the Netherlands were a neutral country, while the Atlantic trade was subject to the onslaught of German submarines. However, the dummy measures the additional effect of the war beyond the pure risk to be sunk, which should already be priced in freights. This effect is likely related to the increased risks of arbitrage and overall loss of market efficiency.

The discussion so far shows that the model works. Most variables are significant and have the expected sign. However, the size of the coefficient is not a sufficient guide to the relevance of a variable: the aggregate effect can still be substantial, notwithstanding a low elasticity, if the change of the variable is large enough (and vice-versa). Therefore, Table 5 reports the share of each relevant variable on total convergence, computed as its change times the long-run elasticity from the reduced OLS specification (i.e. from Table 4 column 3) [16]

Table 5
Decomposition of changes

	All	Indian	Atlantic	Coffee	Pepper	Sugar	Tin	Cotton	Wheat
Period	1841-1938	1841-1938	1841-1937	1834-1913	1832-1938	1830-1937	1841-1938	1841-1938	1841-1937
Δ in dep var.	-28	-26	-33	-35	-20	-35	-6	-27	-41
CL_1828	14		38						59
CULTIVATION1	30	49		36	63	35	231		
FREIGHTS	41	50	29	64	76	8	430	38	36
TREND_A	12		30					47	24
TREND_I	20	34		20	48	27	160		
% accounted for	119	134	98	120	187	72	821	85	124

The last row shows that the model performs fairly well at an aggregate level and extremely well for the Atlantic Ocean. The results for individual commodities are mixed. As predictable, they are poor for pepper and particularly bad for tin, which feature no convergence at all. The results for the other commodities are acceptable. Re-running a separate regression for each product rather than a six-commodities panel improves the accuracy of predictions for most commodities, although tin remains an outlier [17].

The overall message is fairly clear: the decline in freight – i.e. technical progress in shipping- accounted for less than half of total convergence, with huge differences by commodity. The contribution is even lower if we use the coefficient from the IV specification. This conclusion tallies well with the recent results by Jacks and Pendakur (2010) and Jacks, Meissner and Novy (2010) about the contribution of fall in transaction costs to the growth of trade. The results from product specific regression are more erratic: the contribution of freights to overall change is greater than in the panel approach for coffee, pepper and wheat, and lower for tin, sugar and cotton. Both the Corn Laws and the Cultivation system (in the 1830s and 1840s) had a substantial negative impact, so that their abolition accounts for a sizeable share of integration. Last but not least, time trends matter a lot. They are designed to proxy the overall increase in

---

[16] The table omits 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 dummy). The change in the dependent variable is the rate of change from Table 1 cumulated over the period (the first row).

[17] The accounted- for share is 84% for coffee, 123% for pepper, 106% for sugar, 39% for tin, 66% for cotton and 90% for wheat. The time trend is positive and significant (i.e. it implied a divergence in prices) for pepper and wheat.

efficiency, which would have contributed substantially to integration. However this conclusion is only tentative, as the variable might capture other effects, including changes in relative quality for wheat.

6) Welfare effects

How much did <u>transatlantic</u> integration (or the lack of it) during the very long 19th century contribute to the welfare of producers in Java or in the Midwest, and of European consumers? A comprehensive answer would need an extremely complex CGE model for Europe and two overseas countries. It is however possible to estimate the welfare gains from integration with a variant of the well-know Haberger triangles, under the assumption that transaction costs acted as duties (Hufbauer, Warren and Wada 2002). Federico 2008 demonstrates that the effect of a percentage change in commodity prices (ΔP) on deadweight losses as a percentage of GNP can be proxied by

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

where η is the (absolute value of the) price elasticity of demand, ε is the price elasticity of supply, and α and β are the shares on production and consumption.

To keep the computation simple, and to emphasize its back-of-the-envelope nature, we consider three products only, wheat, cotton and a single composite good for Indian Ocean and we assume that all price gaps fell by 30% (cf. Table 5). In the baseline estimate, we assume that this fall was evenly divided between consumers and producers – i.e. that market integration caused prices in 1929 to be 15% lower in Europe and 15% higher in exporting countries that they would have otherwise been. As a sensitivity test, we also consider two alternative scenarios – with all benefits accruing to producers (a 30% increase in their prices with unchanged prices in Europe) or to consumers (vice-versa). The computation has to refer to 1929 because the national accounts for the United States are incomplete for earlier years [18]. Elasticity of supply is conservatively assumed to be 1 for all goods, while demand elasticities vary from 0.5 for wheat, 1 for cotton and 1.5 for Indonesian products. Increasing these parameters augments the impact of integration, but results could be qualitatively different only with implausibly high elasticities.

---

[18] All data are at current prices, and domestic consumption is always estimated as production less net exports. It is assumed that changes in value of raw material affected only the final sale price and not the Value Added. The value of production of wheat and cotton in the United States is from Strauss and Bean 1940 tabs 13 and 25), while GDP and total consumption are from Historical Statistics 1975 (series F226 and G416). For the United Kingdom the gross output wheat is from Ojala 1952 pp.208-209, total consumption and GDP from Feinstein (1972 T9), imports from Mitchell 1988 (extrapolating the missing data on tin and pepper from Annual Statement 1920). For Indonesia, value of cash and estate crops is from Van der Eng (1992 tab A4), and consumption is assumed to account for 85% of GDP. The value of exports is from Mitchell 2007. The aggregate data from Van der Eng 1992, in billions 1983 rupees, are converted in millions 1929 guldens via a coefficient obtained by comparing the data from Van der Eng 1992 and 1996).

Table 6
Estimates of welfare gains

Gains (% GDP)	Division of price changes		
	50%-50%	100% producers	100% consumers
United States			
Wheat	0.04	0.10	
Cotton	0.15	0.35	
Total	0.18	0.44	
Java	0.74	1.64	
United Kingdom			
Wheat	0.31		0.78
Cotton	0.37		0.67
Tropical goods	0.11		0.24
Total	0.80		1.69

Sources: see text

In the baseline estimate, as expected, consumers gain more than producers, as they benefit from integration on both Oceans, and Java farmers gain more than American ones, as export crops accounted for a higher share of their output and for a lower share of their consumption. Of course, benefits for either side are greater in the extreme assumption about the division of price changes. The total welfare gains, however divided, may seem quite small, but the estimates have to be considered a lower bound. In fact they omit gains from integration of the market of other products and from domestic integration, as well as gains from reduced volatility. /NB: static gains what to be get from integration of commodity markets – as dynamic effects likely small (Estevadeordal and Taylor 2008)/

The gains from integration of the other products were in all likelihood sizeable, but any estimate needs a measure of the extent of price convergence, which Here we will refrain from estimating gains from integration of markets for products other than the six ones, as the exercise would need too many difficult assumptions, mostly about the extent of integration in other products. However, it is likely that they had been sizeable. It is also likely that gains from domestic integration were greater than from international ones, whenever goods could not be moved by water. For instance, the freight factor for the transport of tin between the mines, in the islands of Bangka, Batavia, over the whole period 1839 to 1928, never exceeded 2% and it declined from about 1.5% in the 1870s-1880s to 0.7-0.8% in the interwar years[19]. In contrast, overland transportation costs fell dramatically. There are no data on Java, but it is well known that the convergence of prices within the United States during the 19th century dwarfs the transatlantic one. The freight factor for transport wheat from Chicago to New York by rail fell from over 50% in the 1850s to about 10% on the eve of World War One, to rebound in the interwar years as a consequence of rail regulation (Federico-Sharp 2011).

Furthermore, the focus on transatlantic trade downplays the benefits from abolition of the Cultivation system for Java producers. In fact, the (significant) dummy captures the losses from the monopoly of shipping. It leaves aside the gains for the Dutch government from its political power towards Javanese peasants. According to the traditional view, these latter would have preferred to grow food crops (or simply enjoy leisure) rather than produce for the world market. This argument, as pointed out by several authors, contrasts with the expansion of these exports after the abolition of the system (Booth 1988, Van der Eng 1996). But, even if peasants were producing without any coercion, they were selling to a monopsonist, and thus they were bound to

---

[19] The Bangka price is proxied by the Batavia price (Korthals Altes 1994 Appendix A) less the transport cost itself.

lose relative to what they would have obtained under in competitive market. As it is well known, the ratio between prices under monopsony (P_M) and perfect competition (P_{PC}) is

$$P_M/P_{PC}=(\varepsilon/1+\varepsilon) \quad 4)$$

where, as above, ε is the elasticity of supply. Under the baseline assumption of $\varepsilon=1$, peasants would get half the competitive market price. This estimate is confirmed by the data on the budget of the System (Table 7).

Table 7
The budget of the Cultivation System

	1830s	1840s	1850s	1860s
Gross proceeds from sales	227.0	473.9	652.7	641.8
Net proceeds	139.0	308.5	514.0	527.1
Expenditures in the East Indies	18.2	147.2	264.7	272.2
Revenues for the Treasury (Batig Slot)	79.8	133.4	238.7	250.5
Extra-legal expenditures	41.0	27.9	10.6	4.6
Implicit hidden subsidy on shipping	29.8	54.3	40.1	21.6
Total income for Netherlands (minimum)	120.8	161.3	249.3	255.1
% GDP Netherlands	2.3	2.8	3.8	3.0
Total income for Netherlands (maximum)	150.6	215.6	289.4	276.7
% GDP Netherlands	2.9	3.7	4.4	3.3

Source: Van Zanden Van Riel (2004) tab 5.1 (million current Guldens) GDP from Smits et al (2000).

Net proceeds are the best available proxy of the value of export goods in Batavia, while the expenditures in the East Indies include payments to growers, to local élite and to Dutch administrators. Thus the ratio of the latter to the former is an upper bound of the share of peasants' income from exports. The share is very low in the 1830s, but then it settles around a half. Losses for Indonesian peasants were however greater, as they had to pay land tax, and also to provide forced transport. Van Zanden (2010) estimates that losses to Java amounted to about 6% of GDP, with peaks over 8% in some years. The net proceeds accrued mostly to the Dutch government (Batig Slot), accounting for between a third and a half of its total revenues. The Dutch business got the rest ("extra-legal expenditures"), plus the extra-profits from shipping ("hidden subsidies"). The total gains for the Netherlands, as share of GDP, were large both including ("minimum") and excluding ("maximum") these profits.

The dynamic effects of integration for producers are more controversial. The conventional wisdom (e.g. Reynolds ??) regarded it as a major source of long-term growth, but this view has been recently contested by Williamson (2011). He notes that all peripheral countries experienced a spectacular improvement in their terms of trade in the first decades of 19th century (Williamson 2006 and 2008). Indonesian terms of trade increased by ten times from 1825 to the 1890s (Korthal Alters 1994 Appendix A). Price convergence contributed to this improvement, jointly with the spectacular rise in industrial productivity in core countries. In countries, such as India (Clingingsmith and Williamson 2008) the Ottoman Empire (Pamuk and Williamson 2011) and, to a lesser extent, Mexico (Dobado Gomez Galvarriato and Williamson 2008), this upward trend coincided with a period of de-industrialization. In Java, the share of textile production on GDP fell from 15% in 1820s to 6-7% in the early 1850s, while production of cash crops increased from 4% to 12% (Van Zanden 2010). Williamson argues that this process of de-industrialization harmed long-run growth prospects and that these dynamic losses outweighed the welfare gains from specialization.

7) Conclusions:

To sum up, the paper makes four main points:

i) World market did integrate, but the process stretched on the whole "long" 19th century rather than concentrating in the few years of the globalization

ii) The extent and timing of integration differed widely among products: wheat was an outlier in many ways

iii) The fall in transaction costs did contribute substantially to integration of transatlantic markets, as posited by the conventional wisdom, but the joint effect of liberalization and improvement in market efficiency was as much important, on average, and much more important for some products.

iv) Welfare gains from transatlantic integration were sizeable, but not huge and probably smaller than those from domestic integration, because water transportation was comparatively cheap.

From the point of view of commodity market integration, the key message is simple. The differences among product and across Oceans are substantial and thus one should be wary of any broad generalization based on specific cases, most notably wheat trade across the Atlantic Ocean.

Appendix A

Sources on prices

Coffee. Korthals Altes (1994) reports two prices only for Indonesia, the NHM net series (1833-1922, series n.05) and for the average price of exports (1833-1913, series n.01). The former is then 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

Pepper. The source 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[20]. The European price is proxied by the market price for 'black pepper' in Amsterdam (1828-1939, series n.33)[21]. As in the previous case, the ratio is not quality-adjusted.

Sugar For Batavia, 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 adjusting the Batavia prices to a common quality for the period 1848-1913 and then extrapolated backwards it to 1837 with the NHM series and then to 1822 with the series of export prices and forwards to 1939 with the "wholesale prices" [22]. For London, he 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 ratio seems more accurate for the period since 1848 than for earlier years.

Tin Korthal 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 '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). The final series is obtained by adjusting the 'tin from Beilitung' series from fiscal year (ending April 30st) to calendar year and then extrapolating it backward, to 1839 with the NHM net series and subsequently to 1823 with the export prices, and forward to 1939 with the 'tin in Singapore'. European markets are represented by a series of prices of 'East Indian tin' in Amsterdam from Posthumus 1943 (1840-1914, series n.87) and two series for London, one for "Straits" – i.e. Malayan- tin from Sauerbeck 1846-1879, (series n.88) and another from the all-market average, as reported by the Tin Bulletin (1871-1940 series n. 89). The correlation between these series is almost perfect (0.987 between Posthumus and Sauerbeck and 0.995 for the two London series). Thus the final series is obtained by splicing the two London series, and extrapolating backwards the resulting series to 1840 with the Amsterdam one

Cotton. Prices in New York for 'middling Upland' from Carter et al 2006 series Cc222-223, in Liverpool for 'middling American' Mitchell 1988 pp.760-761, converted into US dollars with the exchange rates from Carter et al (2006) series 1800-1913 and Globalfinancialdata (..) 1914-1939

Wheat. The prices series in New York and London 1800-1913 have been kindly provided by David Jacks (Jacks 2005) [23]. They have been converted into US dollars with the exchange rates from Carter et al (2006) series. For the post-war period, the prices in New York 1924-1937 are

---

[20] The two series are fairly well correlated when overlapping and the level is almost identical

[21] Korthals Alter (1994) reports also a series for "black pepper" in London 1885-1939 (series n.34). The simple coefficient of correlation is 0.862 and the series are cointegrated at 1%.

[22] 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).

[23] The recent series by Solar-Klovland (2011) refer to production years and are not strictly comparable to calendar year. The two series are cointegrated at 2% and the simple coefficient of correlation is 0.90.

from Statistisches Jarhbuch (1939) and in London from the journal Wheat studies ad annum (originally from IIA Yearbook) – both in dollars per quintal. Unfortunately, none of these sources allow to control 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 similar Jacks data (0.96) and cointegrated at 2%, and the coefficient of correlation for the whole period 0.565 and 1878-1900 0.872.

Appendix B
Sources on freights

Wheat
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'' New York grain series' (1988), for 1855-1872, presumably in cents/bushel; iii) Shah-Williamson (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 shilling/quarter ; v) Klovland's (2006) series of freights from New York to London or Liverpool, 1848-1861 in pence/bushel ; vi) Harley (2008) rates 'Cork for order' (i.e. for specialized tramp shipping) for 1863-1908 and to rates 'New York Liverpool berth' (i.e. for transport as supplementary cargo in ships carrying live animals or frozen meat) for 1868-1913
   Table B.1 reports the coefficients of correlation among the five most important (in terms of lenght and representativeness) series, by North, Persson, Harley (1 'Cork for order' and 2 liner) and Shah-Williamson (1 for East Coast, 2 for the Gulf).

Table B.1
Coefficient of correlation, wheat freights

	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

        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. On the other hand, the transport by liners was much cheaper than tramp shipping. The ratio of freights on liner (Harley 1) to freights on tramp shipping over the whole period is 0.60 for Harley 2, 0.44 for Persson 0.44 and 0.51 for North. 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% in the mid-1890s (Harley 2008). To capture this effect, the final series of freights to 1913 is a weigthed 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% in 1860 to 10% in 1880 to 66% 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
Cotton
        The evidence on freights for cotton is decidedly less abundant than for wheat . it includes i) Harley (1988) series of exports from Charleston (1812-1860), New Orleans (1817-1860) and

New York (1823-1860), probably in cents/pound; ii). Shah-Williamson (2004) index (1884=100) for Gulf cotton 1878-1910 ; iii) Klovland (2006) series for transport of cotton from New York and New Orleans, in pence/pound; iv) North (1965) series of freight factor (computed as freight/CIF import price) 1810-1906. Last but not least, Harley (1988 p. 856) suggests that the index of freights on American exports by North (1968) covers mostly cotton [24].

The starting point for building the series is Harley's series of freights from New York, suitably extended backwards to 1814 with the series from Charleston. Unfortunately, there are no cotton-specific series until 1878 and after 1911. The gaps has been filled with data for wheat – respectively the North (1958) index for 1861-1877 and the Shah-Williamson East Coast index for 1911 onwards [25].

Sugar.

Korthals Altes reports two distinct series for freight for sugar. The series 1832-1870 refers to the transport to the Netherlands ('homeward') on behalf of the NHM (series n.02 for 1832-1870 and n.03 for 1868-1876). Since 1869 he provides a series labelled 'Java-UK'(1869-1929, series n.04), which is taken from Faiplay. The two series overlap in 1869 and the latter is about a third lower. To avoid a possible spurious discontinuity, consistently with the method used for the price series, the series of sugar freights is obtained by extrapolating the 'Java-UK' series. The data are extrapolated backward to 1832 with the homeward freight series, while for the periods 1823-1831 and 1930-1938 we use the 'generic'freight index from Korthals Altes (1994 Appendix A) [26].

Coffee

Korthals Altes reports a series of freights for transport with liners (Tab.4 series n10) for the period 1871-1931. The series is extrapolated backwards to 1823 and forward to 1938 with the 'generic'freight index from Korthals Altes (1994 Appendix A)

Pepper and tin

There are no data on freights for pepper or tin and thus they proxied by the 'generic'freight index from Korthals Altes (1994 Appendix A).

---

[24] This statement is buttressed by the very high coefficient of correlation with Harley's New York series when overlapping (0.92).

[25] The North index has been preferred to other tramp shipping ones as it does not feature any gap in the relevant years.

[26] This series is correlated at 0.99 with freights from South East Asia from Shah-Williamson (2004) – so it is indifferent which one used…

25

References

Annual Statement (1920) Statistical Office of the Customs and Excise Department. *Annual statement of the trade of the United Kingdom with foreign countries and British possessions. 1920 compared with the years 1913 and 1919*. Volume I. HMS Stationery Service, London

Bai Jushan and Pierre Perron (2003) 'Computation and analysis of multiple structural change models' *Journal of applied econometrics* 18 pp.1-22

Booth Anne (1988) *Agricultural development in Indonesia*, Allen and Unwin Sydney 1988

Broda Christian and David E. Weistein (2008) 'Understanding international price differences using barcode data' NBER WP 14017

Carter Susan et al (2006) *Historical Statistics. Millennium edition.* Cambridge: Cambridge University Press

Clingingsmith David and Jeffrey Williamson (2008) 'Deindustrialization in 18th and 19th century India: Mughal decline, climate shocks and British industrial ascent', *Explorations in economic history*, 45, pp. 209-234

De Vries Jan (2010) 'The limits of globalization in the early modern world' *Economic history review,* 63, pp.710-733

Dobado Rafael, Aurora Gomez Galvarriato and Jeffrey Williamson (2008) 'Mexican exceptionalism: globalization and de-industrialization, 1750–1877' *Journal of economic history* 68, p.758-811

Dobado Rafael and Guerrero, D. (2009) 'The Integration of Western Hemisphere Grain Markets in the Eighteenth Century: Early Progress and Decline of Globalization' Instituto Complutense de Estudios Internacionales, Universidad Complutense de Madrid WP09/09.

Ejrnæs Mette and Karl Gunnar Persson (2010) 'The gains from improved market efficiency: trade before and after the transatlantic telegraph'*European Review of Economic history 14* pp.361-381.

Ejrnæs Mette, Karl Gunnar Persson and Søren Rich (2008) 'Feeding the British: convergence and market efficiency in the nineteenth century grain trade'Economic History Review 61 S1 pp.140-171

Fasseur C. (1992) *The politics of colonial exploitation. Java, the Dutch and the Cultivation system* South-East Asia program Cornell University Ithaca

Federico Giovanni (2008) 'The first European grain invasion: a study in the integration of the European market 1750-1870' EUI History Department Working paper n.1

Federico Giovanni (2011) 'When did the European market integrate?' *European Review of Economic History*, 15, pp. 93-126

Federico Giovanni (forthcoming a) 'How much do we know about market integration in Europe?' *Economic history review*

Federico Giovanni (forthcoming b) 'The Corn Laws in continental perspective' *European Review of Economic history*

Federico Giovanni and Paul Sharp (2011) 'The Cost of Railroad Regulation: The Disintegration of American Agricultural Markets in the Interwar Period', unpublished ms

Feinstein, Charles (1972). *National Income, Expenditure and Output of the United Kingdom, 1855-1965.* Cambridge: Cambridge University Press.

Findlay Roland and Kevin O'Rourke (2007) *Power and plenty* Princeton, Princeton University Press

Harley Knick (1980) 'Transportation, the world wheat trade and the Kuznets cycle 1850-1913' *Explorations in economic history*, 18, pp.218-250

Harley Knick (1988) 'Ocean freight rates and productivity, 1740-1913: the primacy of mechanical invention reaffirmed' *Journal of Economic History* 48, pp. 851-876

Harley Knick (2008) ' Steers afloat: the North Atlantic meat trade, liner predominance and freight rates, 1870-1913'*Journal of Economic History* 68 pp.1028-1058

Headrick Daniel (1988) *The tentacles of progress: technology transfer in the age of imperialism, 1850-1940* Oxford: Oxford University Press

Historical statistics (1975) US Department of Commerce. Bureau of the Census. *Historical statistics of the Unites States. Colonial times to 1970*. Washington: Government Printing Office.

Hynes, W., David Jacks, and Kevin O'Rourke (2009) 'Commodity market disintegration in the interwar period', IIIS Discussion paper n. 285.

Hoag Christopher (2006) 'The Atlantic cable and capital market information flows' *Journal of Economic History* 66 pp. 342-353

Houben Vincent J.H. (2002) 'Java in the 19th century: consolidation of a territorial state' In Howard Dick, Vincent J.H. Houben, J.Thomas Lindblad and Thee Kian Wie *The emergence of a national economy. An economic history of Indonesia 1800-2000* AASA SouthEast Asia Publication Series KITLV Press Leiden 2002 pp. 56-81

Hufbauer Gary, Erika Wada and Tony Warren (2002) *The benefits of price convergence: speculative computations* Washington: Institute for international economics 2002

Klovland, Jan Tore (2006) 'A Repeat Sailings Index of Ocean Freight Rates for the 1850s' Norwegian School of Economics and Business Administration SAM Working paper n.40

Korthals Altes W.L. (1994) *Changing economy in Indonesia vol 15 Prices (non rice) 1814-1940* Royal Tropical Institute – The Netherlands The Hague

Jacks David (2005) 'Intra – and international commodity market integration in the Atlantic economy' *Explorations in economic history* 42 pp. 381-413

Jacks David, Christopher Meissner and Dennis Novy (2010) 'Trade costs in the first wave of globalization' *Explorations in economic history,* 47, pp.127-141

Jacks David and Krishna Pendakur (2010)**,** 'Global trade and the maritime transport revolution', *Review Economics and Statistics* 92 pp. 745-755

Levin, A., C. F. Lin, and C. Chu (2002). "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties," *Journal of Econometrics*, 108 pp. 1–24.

Lew Byron and Bruce Cater (2006) 'The telegraph, co-ordination of tramp shipping and growth in world trade 1870-1910' *European Review of Economic History*, 10, pp.147-173

Mitchell Brian (1988) *British historical statistics* Cambridge: Cambridge University Press

Mitchell Brian (2007) *International historical statistics. Africa, Asia and Oceania 1750-2005* Basingstoke ; New York : Palgrave Macmillan

North Douglass (1958) 'Ocean Freight Rates and Economic Development 1750-1913' *Journal of Economic History*,18, pp. 537-555

North Douglass (1960) 'The United States balance of payments 1790-1860' In *Trends in the American economy in the Nineteenth century* Studies in income and wealth XXIV Princeton UP for NBER pp.573-627

North, Douglass (1965) 'The role of transportation in the development of North America' in Les *grandes voies maritimes dans le monde XV-XIX siécles* SEVPEN Paris pp.209-246

North, Douglass (1968) 'Sources of Productivity Change in Ocean Shipping, 1600-1850' *Journal of Political Economy*, Vol. 76, pp. 953-970

Ojala, E.M. (1952) *Agriculture and economic progress,* Oxford: Oxford University Press.

O'Rourke, Kevin and Jeffrey Williamson (1994) 'Late nineteenth-century anglo-american factor price convergence: were Heckscher and Ohlin right?', *Journal of economic history,* 54, pp. 892-916.

O'Rourke, Kevin and Jeffrey Williamson (1999) *Globalization and history*, Cambridge (Mass): MIT Press

O'Rourke, Kevin and Jeffrey Williamson (2002) 'When did globalization begin?', *European review of economic history*, 6, pp.23-50.

O'Rourke, Kevin and Jeffrey Williamson (2004) 'Once more: when did globalization begin?', *European review of economic history*, 8, pp.109-117.

Pamuk Sevket and Jeffrey Williamson (2011) 'Ottoman de-industrialization, 1800-1913: assessing the magnitude, impact and response' *Economic History Review* 64 S1 pp.159-184

Persson Karl Gunnar (2004) 'Mind the gap! Transport costs and price convergence in the nineteenth century Atlantic economy', *European review of economic history* , 8 pp.125-147

Persson Karl Gunnar (2010) *An economic history of Europe*, Cambridge: Cambridge University Press

Posthumus N.W. (1943) *Nederlandsche Prijsgeshiedenis* Vol 1 Leiden: Brill

Razzaque, Mohammad, Philip Osafa-Kwaako and Roman Grynberg (2007)
'Long-run trend in the relative price: empirical estimation for individual commodities' in Roman Grynberg and Samantha Newton (eds) *Commodity prices and development*, Oxford University Press Oxford 2007 pp. 35-67

Reynolds Lloyd (1985) *Economic growth in the Third world 1850-1980*, New Haven: Yale University Press

Ronnback, Klas 'Integration of global commodity markets in the early modern era' (2009), *European review of economic history,* 13, pp. 95-120.

Rooth Tim (1999) *British protectionism and the international economy* Cambridge: Cambridge University Press

Scholler Paul (1951) 'L'evolution seculaire des taux des fret et d'assurances maritimes de 1819 a 1940', Bulletin de l'Institute des recherches économiques et sociales du Louvain, 17 n. 5, pp. 539-558

Shah Mohammed, Saif I. and Jeffrey G. Williamson (2004) 'Freight rates and productivity gains in British tramp shipping 1869-1950' *Explorations in economic history* 41 pp.174-203

Sharp, Paul (2008) 'The Long American Grain Invasion of Britain: market integration and the wheat trade between North America and Britain from the Eighteenth Century' Discussion Papers Department of Economics University of Copenhagen No. 08-20.

Smits, J.P., E. Horlings and J.L. van Zanden (2000) *The Measurement of Gross National Product and its Components 1800-1913* (Groningen Growth and Development Centre Monograph series no 5, 2000 (data available at: http://nationalaccounts.niwi.knaw.nl/, Accessed January 2009)

Solar Peter M. and Jan Tore Klovland 'New series for agricultural prices in London, 1770-1914' Economic History review 64 (2011) pp.72-87

Statistisches Jahrbuch (1939) Statistisches Amt. *Statistisches Jahrbuch für des Deutsche Reich*. Berlin

Strauss, Frederick and Bean, Lois H. (1940). *Gross farm income and indices of farm production and prices in the United States 1869-1937*. United States Department of Agriculture Technical Bulletin n. 703 (dec., 1940). US Government Printing Office

Van der Eng, Pierre (1992) 'The real domestic product of Indonesia 1880-1939' *Explorations in economic history*, 29, pp. 343-373

Van der Eng, Pierre (1996) *Agricultural growth in Indonesia*, Macmillan London and Basingstoke, 1996

Van Zanden Jan Luiten and Arthur Van Riel (2004) *The strictures of inheritance. The Dutch economy in the nineteenth century* Princeton: Princeton University Press

van Zanden, Jan Luiten (2010) 'Colonial state formation and patterns of economic development in Java, 1800-1913', *Economic History of Developing Regions*, 25, pp.155-176

Yates Lamartine (1959) *Forty years of foreign trade* London: George Allen and Unwin

Williamson, Jeffrey (2006) *Globalization and the poor periphery before 1950* Cambridge (Mass) MIT Press 2006

Williamson, Jeffrey (2008) 'Globalization and the great divergence: terms of trade booms, volatility and the poor periphery,' *European Review of Economic history* 12 pp.355-392

Williamson Jeffrey (2011) *Trade and poverty. When the Third World fell behind*

29

Cambridge (Mass) MIT Press.

EHES Working Paper Series

Recent EHES Working Papers

2011

EHES.2   Bondholders vs. Bond-Sellers? Investment Banks and Conditionality Lending in the London Market for Foreign Government Debt, 1815-1913.
Marc Flandreau and Juan Flores

EHES.3   The Labor Market Integration of Migrants: Barcelona, 1930.
Javier Silvestre, Mª Isabel Ayuda, and Vicente Pinilla

EHES.4   Forced Labour in Franco's Spain: Workforce Supply, Profits and Productivity
Fernando Mendiola Gonzalo

EHES.5   Was the Emergence of the International Gold Standard Expected? Melodramatic Evidence from Indian Government Securities.
Marc Flandreau and Kim Oosterlinck

EHES.6   Communal Responsibility and the Coexistence of Money and Credit under Anonymous Matching.
Lars Boerner and Albrecht Ritschl

EHES.7   Where It All Began: Lending of Last Resort and the Bank of England During the Overend, Gurney Panic of 1866
Marc Flandreau and Stefano Ugolini

EHES.8   Human Development in Africa: A Long-Run Perspective
Leandro Prados de la Escosura

EHES.9   Taking Technology to Task: The Skill Content of Technological Change in Early Twentieth Century United States
Rowena Gray

EHES.10   Landownership Concentration and the Expansion of Education
Francesco Cinnirella and Erik Hornung

All papers may be downloaded free of charge from: www.ehes.org