Opening to the East: Shipping between Europe and Asia, 1770-1830*

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Abstract

Shipping costs between Europe and Asia were reduced by two-thirds between the 1770s and the 1820s. Copper sheathing and other technical improvements which allowed ships to make more frequent voyages over longer lifetimes accounted for part of the cost reduction. British hegemony in the Indian Ocean, which ended an eighteenth-century arms race, accounted for the rest by allowing the substitution of smaller ships which cost less to build and required fewer men per ton. These changes were at least as important as the elimination of monopoly profits in narrowing intercontinental price differentials during the early nineteenth century.
Before the nineteenth century a trading voyage between Europe and Asia was long, arduous, and dangerous. The round trip generally took close to two years. Mortality of sailors was often high, and many ships were lost, wrecked or captured. The only commodities which could bear the cost of freight were high-value, low-volume items such as tea, spices, raw silk, and cotton and silk textiles. These goods were sold in Europe for much higher prices than they had been purchased for in Asia. Kevin O’Rourke and Jeffrey Williamson (2002) have argued that although there was a trade boom in such goods, there was little globalization before the nineteenth century, because the price spread did not decline. Their view has been challenged by Jan de Vries (2010) among others.\(^1\)

O’Rourke and Williamson (2002, p. 46) date globalization to the early nineteenth century when, they argued, there was “a dramatic discontinuity…associated with steamships, railroads, the demise of mercantilism, the rise of trade liberalization and the disappearance of trading monopolies.” Their evidence for this discontinuity was a large fall just after the Revolutionary and Napoleonic wars in price differentials for products such as cloves, pepper and coffee.\(^2\) The same phenomenon can also be seen for less exotic products: in the 1780s the price of raw cotton in Liverpool was 5-7 times higher than that in Gujarat; by 1830 it had fallen to roughly two to one (Allen, 2011, p. 60). In the 1780s the exports of this lower-value,

\(^1\) De Vries (2010) makes the important observation that the prices of Asian goods in Europe fell markedly relative to the prices of European goods. Thus, as the cost of goods purchased in Asia fell, constant price differentials meant that absolute margins between prices in Asia and Europe were indeed falling, which could have meant that trade costs were falling. The current paper might be seen as the excellent analysis of trade between Europe and Asia during the three centuries up to late eighteenth century in De Vries (2006, 2010).

\(^2\) O’Rourke and Williamson (2002, p. 33) probably exaggerate the differentials by relying on the prices paid by the Dutch East India Company, which were often the outcome of complex bargains with local rulers. At least in the case of pepper and coffee, free market prices elsewhere in Asia were considerably higher (Jacobs, 2006, pp. 72, 77, 82, 360, 372).
higher-volume item from India to Europe were negligible but by the 1820s they had risen to about a tenth of Britain’s cotton supplies (United Kingdom, 1847-48, p. 375).

This paper takes no issue with when price differentials fell; it seeks to clarify the causes. The decades of the 1810s and 1820s were far too early for steamships or railroads to have mattered in trade between Europe and Asia.3 This leaves a few alternatives. To begin with, the Dutch and French East India companies were casualties of revolution and war. The English East Company lost its monopoly on trade with India in 1813, though it kept control of the China trade until 1833.4 If the fall in price differentials came from eliminating the East India Company’s monopoly profit we would have new evidence on the impact of early joint-stock chartered trading companies. Ann Carlos and Stephen Nicholas (1988, 1990, 1996) characterize the companies as proto-multinational enterprises, with vertically integrated structures and administrative hierarchies designed to reduce transactions costs and limit opportunistic behavior. Jones and Ville (1996) suggest instead that they were primarily effective at extracting monopoly rents. Neither party has proffered much evidence on the degree of monopoly profits. Jones and Ville would be vindicated if the sharp drop in price differentials that had persisted for over two centuries was entirely due to the disappearance of excess profits. On the other hand, supporting the view that the companies were cost-reducing organizations requires both low monopoly rents and a specific set of factors behind the decline in price spreads.

This article argues that a significant reduction in the cost of shipping between Europe and Asia took place between the 1770s and the 1820s. There was certainly the potential for major cost reductions. In his survey of early modern transport Russell Menard (1991) notes

3 A possible exception here is steam tugboats, which were coming into use in European ports in the 1820s. Their effects on the costs of shipping between Europe and Asia was, however, likely to have been tiny.
4 The changes described in this paper apply to all trade with Asia, but the effects on the China trade were simply delayed by the prolongation of the monopoly.
that East Indiamen in the late eighteenth century carried only five or six tons of cargo per 
man, whereas in the Atlantic trades the ratio was between 15 and 20.\textsuperscript{5} Unfortunately, whilst 
there is a vast literature that draws on the rich archives of the chartered companies, there has 
been very little work on continental European countries’ Asian shipping after the early 
1790s.\textsuperscript{6} Most were, of course, shut off from Asian markets for about two decades by war, but 
trade did resume after 1815. Research on British shipping before the 1840s has focused on the 
East India Company (Sutton, 1981), leaving in the dark the non-Company trade that emerged 
after 1815 (Ville, 1987, pp. 7-8). Interest only tends to resume in the mid-nineteenth century 
when large-scale shipping companies, such as the Peninsular & Orient and British India lines, 
started to become important.\textsuperscript{7}

The wars partly masked the improvements in shipping to Asia that occurred between 
the 1770s and the 1820s. Conflict pushed up insurance rates until the mid-1810s and it 
constrained ships to travel in convoys. Other changes only took place after the India 
monopoly ended in 1813. But long-term progress, as will be seen here by comparing the 
peacetime period of 1783-92 with that of the 1820s, was impressive. By the 1820s ships were 
making more frequent and faster voyages over longer lifetimes, and they carried twice as 
much cargo per crew member. In addition, losses of shipping in peacetime years fell, 
bringing down insurance costs. These cost reductions came partly from technological 
changes and partly from changes in the economic and political environment faced by 
shippers, notably in the rise of British naval hegemony in Asia. The end of the chartered 
companies did play a role, but it was a subsidiary and derivative one.

\textsuperscript{5} But see also Lucassen and Unger (2011).
\textsuperscript{6} See, for example, Bruijn, et al. (1979); Velschow (1972); Feldbaek (1978); and Kjellberg 
(1974). I am very grateful to Johan Söderberg for supplying me with a scan of the data in 
Kjellberg.
\textsuperscript{7} An important exception is Ville (1993).
The focus of the paper will be on British shipping to Asia during this period partly because Britain came to dominate the trade and partly because in certain respects it has been less well studied than that of the continental countries. But, where possible, information on the experience of the French and the Dutch, Britain’s main rivals in the eighteenth century, as well as that of lesser players like the Danes and Swedes, will be integrated so as to tell as a European story. The United States, which was to become Britain’s major nineteenth-century rival in Asian trade, will also play a part.

The end of the East India Company monopoly: were there huge rents at stake?

There are several reasons to think that monopoly profits in Asian trade may not have large enough to drive the fall in price differentials. First, with a few exceptions, the companies had incomplete control over the quantities of Asian goods available to their home markets: they competed against each other in third markets, and smuggling of exotic goods was not uncommon (Bowen (2006), pp. 237, 241; De Vries (2010), pp. 724-25). The English East India Company also left room on its ships for private trade, which accounted for a significant share of imports. In K.N. Chaudhuri’s (1983, pp. 806, 816-147) view, the English company’s attempt to create a monopoly “was largely unsuccessful mainly through the connivance of the Company’s own servants in India to illegal trading by private merchants”. Second, the English East India Company’s monopoly was a temporary one, with its charter up for renewal in 1793, 1813 and 1833. Had exorbitant profits accounted for the huge price differentials, they would certainly have undermined the case for renewal in a political climate that was increasingly influenced by liberal principles (Mui and Mui, 1984, pp. 133-34).

Third, the English East India Company, at least, did not seem to behave like a classic monopolist. Hoh-Cheung Mui and Lorna Mui (1984, pp. 130-33), in their detailed

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8 See, for example, the relatively sparse discussion of Britain in the comparative work by Gaastra and Bruijn (1993).
investigation of how the monopoly in Chinese tea was managed, argue that the Company’s guiding principle was to ensure sufficient supplies of the various varieties of tea at reasonable and stable prices. The Company kept large stocks of tea in London and rather than restricting supply, released stocks to keep prices from rising too much. It consulted with buyers to forecast demand and to make sure that sufficient supplies were available. On tea, at least, the company’s monopoly profit, relative to the prime cost in China was estimated to be only about 40 per cent (Mui and Mui, 1984, p. 152). The price differential for tea was only two to one and stayed at that level from the 1780s to the 1820s.

Finally, any loss of huge monopoly profits from the India trade had no echo in the Company’s stock price (Figure 1). To be sure there is a dip during the period in which the renewal of the charter was under discussion, but afterward prices reverted fairly quickly to their earlier level. In any case the stock price only fell by about 15 per cent, and it shows the same movement as Bank of England stock prices. Nor did the stock price fall with the onset of competition; on the contrary, it rose in the late 1810s, as did that of the Bank of England. These facts are not definitive because the loss of privilege in the India trade could have been compensated for either by additional profits in the still monopolized China trade or by revenues arising from the Company’s political position in India. In addition, with the loss of the monopoly the Company was able to give up the export of British woolens to India and to get out of the saltpeter trade, two often loss making activities mandated by parliament (Bowen, 2006, p. 254; Frey, 2009). Still, resilience of the Company’s stock price remains a prima facie indicator that no huge pool of profits was dissipated by competition. Moreover, the rises in stock prices that took place after the Indian monopoly ended in 1813 and the Chinese monopoly in 1833 might suggest that investors thought the Company well out of commercial activity. As De Vries (2010, p. 727) observed of the Dutch Company, an investor

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9 Bowen (2006, p. 55) has a graph of stock prices that shows a very sharp peak in the early 1810s, but no trace of such a peak can be found in the quotation published in Lloyd’s List.
in “1648, or almost any date thereafter, is unlikely to have profited from his/her VOC share (i.e. government bonds would have paid as well)”.

**Changes in East India shipping, 1770-1830**

Figure 2 displays the numbers of ships leaving Britain shipping for Asia, and Figure 3 shows the tonnage of these ships. The series come from several sources. Official statistics start in 1814 and over time provided an increasingly detailed breakdown of shipping by destination (though ships ultimately headed for China but stopping first in India were often included in the Indian figures). The other series are aggregates from data on individual voyages. One series for East India Company shipping draws on Anthony Farrington’s *Catalogue of East Company Ships’ Journals and Logs* (1999), which is more complete than the contemporary compilations by the Hardys (1811, 1835). In cases in which Farrington did not give tonnages, they have been filled in where possible from *Lloyd’s Register*. The second series for East India company ships and the series for non-Company ships underlying the alternative series for all ships come from tables included in *Lloyd’s Register* from 1818 onwards. These tables listed both “Ships in the East India Company’s Service” (the Company hired, rather than owned, the ships, but they will hereafter be referred to as “Company ships”) and what were variously described as “Licensed India Ships” and “Ships Trading to India” (the “non-Company ships”). “India” clearly includes ships destined for Indonesia, China and other Asian destinations. Information on tonnage that was missing from these tables has been supplied by reference to the general listings in the *Register*. Since tonnage measurements

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10 It is, of course, possible that, as Marshall put it, that “the best of all monopoly profits is a quiet life”, with the gains going, for example, to officials with good salaries.
11 Shipping to Mauritius, a specialized trade that developed largely in the 1820s, has been excluded.
12 For an interesting network analysis of the Farrington data, mainly for an earlier period, see Erikson and Bearman, “Malfeasance.”
were often updated, the tonnages have been standardized to those found for the latest entry for any given ship.

Figure 2 shows the rapid and continuing expansion of non-Company shipping after 1814 and the slow fall in the number of Company ships during the same period. The tabulations from individual voyages show a much larger increase than the official figures. Checks using the reports of clearances in *Lloyd’s List* indicate that the official statistics do seem to significantly understate the number of voyages that took place, though the reason for this understatement is not evident.

Figure 3 shows the tonnages cleared from Britain to Asia expressed in logarithmic form. The discontinuity after the wars is still present, but a longer-term perspective suggests that the 1780s, 1790s, 1820s and 1830s were on a common trend line. The intervening discontinuity had two elements. First, cargo volumes stagnated in the first fifteen years or so of the nineteenth century, which might be attributed to effects of war. This, however was followed by a sharp recovery from 1815 to 1818 driven by unusually large imports of raw cotton from India.

After 1814 the number of non-Company ships increased far more than did the tonnage they carried. This is because the non-Company ships averaged slightly over 400 tons, as against the average Company ship of about 1000 tons. Although the Company had occasionally employed smaller ships before 1814, they still tended to be in the 500-700 ton range. The same change took place in Dutch shipping to Asia. In the 1780s the average Dutch East Indiaman measured 867 tons. In the late 1820s it was only 488 tons (*Dagblad van ’s Gravenhage*, 28 May 1830). In the analysis that follows we track productivity separately for the large Company ships over the entire period from 1770 to 1830 and for the smaller ships after 1814. The specialized ships used by the companies were unusually large, compared to
the ships used in the European and Atlantic trades (Menard, 1991, p. 260). The move to smaller ships will be a central element in the fall in shipping costs.

Beyond the shift from large to smaller ships, there were six major changes affecting shipping between Europe and Asia: 1) East India Company ships became larger in size; 2) ships, both Company and non-Company, made more frequent voyages to Asia; 3) ships came to have longer working lives; 4) ships made faster passages; 5) fewer ships were lost or wrecked; and 6) ships employed fewer men per ton.

Table 1 shows that the size distributions of ships for the Dutch and English companies. In the 1780s the English company’s ships were somewhat smaller (820 tons) than the Dutch company’s (860); both were between the Danish company’s ships (787) tons and the Swedish company’s (907).\(^\text{13}\) The size of the EIC’s ships grew over the period. The mean tonnages do not tell the whole story because from the 1790s the Company started engaging more “extra ships” for one voyage, and these were almost always smaller than regular ships. Setting aside the extra ships, the standard Company ship expanded from about 800 tons in the 1780s to 1200 tons in the 1820s.

Ships were used more intensively over the period (Figure 4). In the 1770s and 1780s English East India Company ships were making roughly one voyage every three years, which was also the case for the ships of the other companies.\(^\text{14}\) Frequency increased gradually until in the 1820s the English company’s ships were making an outward voyage every two years.\(^\text{15}\) Non-company ships were used even more intensively: of the ships making at least four voyages between 1818 and 1830 the average frequency was three outward voyages every four years, and many ships were making an outward voyage every year.

\(^{13}\) French ships going to China between 1770 and 1790 averaged 837 tons (Dermigny, 1964), p. 206).

\(^{14}\) Unless otherwise indicated, the comparisons here and subsequently draw on the voyage lists in the works cited in note 10.

\(^{15}\) The outlier in the graph, which made two voyages every three years, was the aptly named the *Experiment*. 
Ships also came to have longer working lives. Until the 1780s the English company had limited the ships that it hired to four voyages on the principle that its high value cargoes should not be entrusted to worn-out vessels. This was hard on ship-owners because Indiamen were specialized vessels less well suited to other trades: in 1792 vessels that went to the United States and the West Indies averaged only 221 and 233 tons (Fayle, 1934, p. 223). As a result, many East Indiamen were broken up on returning from their last voyage to Asia (Dalrymple, 1786, p. 2-5; Philips, 1940, p. 80). Dutch experience shows that the EIC’s four-voyage cap may not have been very binding. Of the 101 ships built and owned by the VOC between 1750 and 1775 only 28 made more than four voyages and only three more than six voyages. The average was 3.7 voyages. In 1780, under wartime conditions, the English company temporarily suspended the four-voyage limit, but it was not until 1790 that it increased the limit to six voyages (Sutton, 1981, p. 35). In 1803 the limit was raised to eight voyages, and after 1810 the Company engaged ships for further voyages if they were judged to be in good repair (Auber, 1826, pp. 653, 660).

Table 2 shows the number of voyages made by English East India ships launched in various decades. The figures for 1765-74 make it clear that the Company adhered to its rule with few exceptions. A few ships were allowed five voyages between 1763 and 1765. Then there were no exceptions until 1780; in the next few years nine ships were allowed to make a fifth voyage, but none made a sixth. The trend towards more voyages was set, and ships launched around 1790 made about two more voyages on average than those launched around 1830, it was observed that “there is no other trade England possesses that requires ships of that class” (Journal of the House of Lords, 62, (1830), p. 602, Affairs of the East India Company: minutes of evidence, 17 June 1830, evidence of William Maxwell). Many of the Dutch company’s ships continued their working lives in intra-Asian trade, but this does not seem to have been the case for the English East India Company (Parkinson, 1937, p. 134). Dermigny puts the life of French East Indiamen at 12-14 years, or roughly six voyages, but this seems to be an ideal life rather than a calculation based on experience (Dermigny, 1964, p. 209). Only three of the 23 ships that went to China in the 1770s managed to make six voyages and the average number was 2.61 (Veyssiére, 2000, pp. 215-79).
1770, and those launched around 1810 made three more. The Company’s principal ships, indicated by the modes, went from four voyages for those built in 1765-74 to close to ten for those launched from 1805 to 1814. Four voyages, with a voyage every three years, implies a standard ship life of about 12 years; ten bi-annual voyages imply a life of about 20 years. 19

One element, but probably not the major one, in the higher frequency of voyages was faster sailing times. Table 3 summarizes the evidence on days of sailing from Europe to the first port of call in Asia. Since the distributions tend to have long tails and the occasional extremely rapid passage, both the mean and median days to each destination are given.

Before considering changes over time, it must be noted that in the 1770s Dutch and Danish ships took about two months longer to reach (and to return from) Asian destinations than their English rivals. This is a very large gap, the causes of which deserve further research. 20

The English advantage increased by another month or so in the 1780s, but from then until the 1820s the gains in speed were more modest, something on the order of 10-20 days for East India Company ships. Although non-Company ships were making more frequent voyages than Company ships in the 1820s, they do not seem to have done so by sailing faster. They generally made slower passages than did the Company ships of the 1780s.

19 Evidence on Dutch company ships suggests that without the four voyage limit English ships could have gone on for only a few more years. Of the 101 Dutch company ships built between 1760 and 1775 the lives of 51 are known and averaged 15.4 years. If the other fifty ships stopped working two years after the start of their last known voyage, then the average life would have been 12.3 years. The experience of Danish ships in the late eighteenth century was similar: on average they undertook 4.6 voyages during a life of 13 years (Gøbel, 1993, pp. 116).

20 The slowness of Dutch ships relative to the Scandinavians has been attributed to weaknesses in navigation and poor ship design (Bruijn, et al., 1987, pp. 103-06). Bruijn and Gaastra have on several occasions compared Dutch ships to French, Danish and Swedish ships, but, strangely, never to English ships, which turn out to make much faster passages than any of the others. One possible explanation for the slower Dutch voyages is that Dutch ships almost always stopped at the Cape, usually for about a month. English ships making a direct passage may also have been better placed to use the stronger westerly winds between 40 and 50 degrees south latitude (Graham, 1965, pp. 38-39).
The differences in voyage duration may help account for some substantial variations in the seasonality of voyages. Initially, East India Company departures were heavily concentrated in the first half of the year (Figure 5). In the 1780s the season started to get underway in December and end in late May or early June, but by the 1820s December departures were less common and departures in the summer more common, which may be related to the shorter voyage durations. In the 1780s Dutch (and Danish) ships departed mainly in the second half of the year, perhaps because they took two or three months longer en route.\textsuperscript{21} What is particularly interesting is that the departures of non-Company English ships in the 1820s were spread fairly evenly over the year, with a peak in May and June. (A similar pattern characterized the departures of the smaller ships employed by the Company in the same period.) Why the monsoons were not as much of a constraint for non-Company shipping remains obscure.

Ship losses fell over time. In the peacetime years between 1783 and 1792 the English East India Company lost seven ships in 249 voyages, for a loss rate of 2.8 per cent. The Dutch company had a slightly higher rate, at 3.3 per cent of 301 voyages. By the peacetime years 1818-1830 the English company’s loss rate had fallen to 1.1 per cent. In the 1820s the smaller non-Company ships may have had a somewhat higher loss rate than the Company ships. Reports of losses and wrecks in Lloyd’s List for the seasons 1822/3 to 1825/6 indicate a rate of about 3 per cent.

Crew size also fell over time. The nominal crew for EIC ships throughout the eighteenth and early nineteenth centuries was 100 men, though this could go up to 130 on larger ships. An 800-ton ship of the 1780s should thus have been operated at eight tons per

\textsuperscript{21} Dutch departures may have been spread out more over the year because Batavia could be reached throughout the year (Bruijn, Gaastra and Schöffer, Dutch-Asiatic Shipping, vol. 1, p. 97). Departures of French East Indiamen in the mid-eighteenth century were spread over the months between September and March, but all arranged to leave the Cape by the end of May (Haudrère, 1989, vol. 2, p. 650). By the end of the eighteenth century the seasonality of French departures was very similar to that for English ships (Dermigny, 1964, p. 246).
man. In 1830 William Maxwell, a captain with 25 years’ East India Company service, regarded ten tons per man as conventional (United Kingdom, Lords Journals, 62 (1830), p. 601). Direct observations on East India crews are relatively rare, but the few available observations (Table 4) are consistent with the nominal rates and show an increase from about eight to about ten tons per man. Note that in 1780s the English company’s ships already operated with more tons per man than did the continental companies’ ships.

No direct observations on the crews of non-Company ships in the 1820s are available, but we can approach staffing numbers in three ways. One is to infer it from the aggregate statistics of shipping to India and China by subtracting the tonnage of Company shipping from the numerator and the implied crew numbers from the denominator. This gives a figure of 14.2 tons per man. The second way is to observe labor usage on Asian routes that were largely served by non-Company shippers. Ships to Mauritius and Indonesia had rates of 17 tons per man or higher. The third way is to see what happened to staffing in the India and China trades after the Company’s China monopoly ended in 1833. Over just a few years rates rose by about six tons per man on ships bound for China and by just over three tons per man on the ships bound for either India or China. The speed with which this change took place implies that it was due to the withdrawal of the large ships from the trade. The evidence thus suggests that whilst Company ships had ten tons per man in the 1820s, non-Company ships had about 16 tons per man, a finding that accords well with the ton-man rate on French ships in the late 1820s.

Changes in shipping costs on Asian routes

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22 It should be noted that David J. Starkey (2007) has argued that the numbers of men reported in the shipping returns are probably overstated, though the biases that he points out may be less telling in the long-distance Asian trades.
What did all of these improvements mean for shipping costs? With a good number of assumptions, it is possible to make some rough calculations of costs for five stylized cases (Table 5). The first four cases correspond to contemporary experience: 1) a representative East India Company ship in the 1780s (800 tons, 100 crew, four voyages over twelve years); 2) a typical East India Company ship of the 1820s (1200 tons, 120 crew, ten voyages over twenty years); 3) a typical non-Company ship (400 tons, 25 crew, 15 voyages over 20 years); and 4) a best practice non-Company ship (400 tons, 22 crew, 20 voyages over twenty years). The fifth case is a counterfactual: an East India Company ship of the 1780s (800 tons, 100 crew, four voyages over twelve years) facing 1820s factor prices. Note that all of these calculations are for English ships. Since continental ships had longer passages, made less frequent voyages and had lower ton-man rates in the 1780s, their costs in the 1780s may well have been higher and the corresponding fall in costs over time even greater.

Fixed capital costs were calculated as the charges per voyage that over the lifetime of the ship would, when properly discounted, just cover the cost of construction. The cost of construction included not only the hull, but also sheathing, masts, rigging and guns. East Indiamen are taken to have cost £19 per ton in the 1780s and £30 per ton in the 1820s. Non-Company ships were much cheaper to build. In the 1780s costs of non-Company ships built by London yards were said to be about 40 per cent lower (Bowen, 2006, p. 283). Contemporaries put the cost in London at around £9 per ton and in the outports at about £8 per ton. Parkinson (1937, pp. 145-46) cites figures for the cost of an East Indiaman hull over several years in the 1780s and 1790s. His figures for all costs in 1802 and 1803, as well as those from similar calculations in Milburn (1813, vol. 2, p. 176), suggest that a ship with coppering, masts, sails and cordage would have cost something over 50 per cent more, or about £20 per ton. His hull cost of £12.5 in the mid-1780s (A witness before the Select Committee on Manufactures cited figures of £9 per ton in 1785 and £14 to £15 in the 1820s, both referring only to the hull (United Kingdom, 1835, pp. 339-40 (Woolcombe)). Note that coppering has been deducted from the 1780s cost. In 1788 the cost of Dutch East Indiamen was put at £15.3 to £18 per ton and the cost of hiring a smaller, less heavily manned vessel of 450 tons was reckoned at £11.8 (Gaastra and Bruijn, 1993, p. 205).
but Henley & Son were able to have ships built in the early 1790s for as low as £5 per ton.\textsuperscript{24}

In the 1830s several witnesses before the Select Committee on Manufactures put the cost of a good ship ready for sea at about £15 per ton, which is the value that will be used for non-Company ships in the 1820s.\textsuperscript{25} The discount rate used is 12.5 per cent, based on Robert Allen’s (2009) calculations of the aggregate return to capital in the British economy during this period, as well as the evidence he cites concerning realized profit rates in cotton and woolen textile enterprises.\textsuperscript{26} This rate also accords well with the average of the realized profit rates on voyages undertaken by the London firm of Michael Henley and Son., which was 13.4 per cent (Ville, 1987, pp. 174-75). Ships were not worthless at the end of their lives, so it has been assumed in the capital cost calculations that their scrap or resale value was 20 per cent of the initial cost.

Ships had to be maintained and equipment replaced. A calculation for 1804 suggests that major repairs were needed after three voyages and that these could amount to £9-10 per ton for an East Indiaman. Since prices were much higher in war years than in the 1780s or 1820s using the 1804 figure may tend to exaggerate the costs, so repair costs, for both East Indiamen and non-Company ships, will be taken as £1.3 per voyage in the 1780s and £2 per voyage in the 1820s. These costs are in line with Charles Feinstein’s (1978, p. 65) index of timber and wage costs in shipbuilding. The replacement of sails, rope and other equipment

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\item[\textsuperscript{24}] Davis, 1962, p. 361; Ville, 1987, pp. 47-48. On the costs of new ships see also Craig, 1971, pp. 142-44.
\item[\textsuperscript{25}] United Kingdom, 1835, pp. 340 (£24-£25), 420 (£14.6 per ton), 423 (£14-£15), 477 (£14 to £16). Feinstein (1978, p. 65), on the basis of an input price index, puts the price of a sailing ship at £8 in the period 1760-1790 and at £15 for the 1820s.
\item[\textsuperscript{26}] It could be argued that the appropriate discount rate for the East India Company was much lower, but the Company did not own its ships; it made long-term leasing agreements. The owners of the ships had to fund the construction costs and to face all uninsurable risks in operating the ships. But, even supposing that the discount rate for these owners was much lower, say 5 per cent, would only reduce the overall fall in shipping costs from 65 per cent to 60 per cent.
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may have cost another £2 per ton per voyage in the 1820s. The same value is used for the 1780s on the basis that the price of sailcloth was similar in the two periods.27

Labor costs were calculated in three stages. First, it was assumed that 60 per cent of the crew were ordinary sailors and that in the 1780s and in the counterfactual they were paid for 17 months and in the 1820s for 14 months on Company ships and 10 months on non-Company ships, reflecting the frequencies and duration of voyages discussed above.28 Wage costs per voyage for ordinary seamen are then simply the combination of those durations with monthly wages of £1.5 in the 1780s and £2.5 pounds in the 1820s.29 Second, the wage cost for officers was calculated on the assumption that they were paid in aggregate the same as the ordinary seamen.30 Third, the cost of feeding the officers and crew was assumed to be half the total wage cost, along the lines suggested by an East India shipowner in the 1830s (United Kingdom, 1835, p. 424 (James Aiken)). Davis (1962, pp. 355-56) cites costs for the mid-eighteenth century consistent with this ratio.

During the second half of the eighteenth century the peacetime rate for marine insurance on shipping to Asia was about eight per cent (John, 1958).31 Although the observed fall in shipping losses discussed above would seem to indicate that the rate in the 1820s

27 The change is sailcloth prices is inferred from prices at Lancaster in 1785 (13.5 d per yard) and 1807 (20 d), and prices at Dundee in 1807 (16 d), 1822 (12 d) and 1828 (9 d) (Robinson, 2001, p. 36; Warden, 1864, pp. 639-44).
28 Sutton’s (1981, p. 157) table of monthly wages for officers and craftsmen shows that this group would have comprised about 40 per cent of a 100-man crew and that their total wage bill would have been roughly the same as the wage bill for ordinary seamen. On Danish ships in the 1770s officers, petty officers and trading people comprised 26 per cent of the crew; in the years 1814-1834, 25 per cent (Gøbel, 1993, p. 108).
29 The wages are gleaned from various series in Ville, 1987, pp. 209-211. A witness before the Select Committee on Manufactures put wages on long voyages at 35 s per month in 1792 and 45 s in the 1820s (United Kingdom, 1835, p. 340 (William Woolcombe)).
30 Note that no attempt has been made here to take account of the value of private trade carried on by officers and crew, with or without the authorization of the Company. If it were possible to do so, the fall in wage costs from the 1780s to the 1830s would have probably been even larger.
31 In 1783 a French ship was insured on various policies for 8-9 per cent (Dermigny, 1959, p. 167).
should have been about three per cent, several bits of evidence suggest that it was about six per cent and this latter figure has been used.32

Other shipping costs included port charges and brokerage costs. Ville (1987, pp.) puts these at about 6.5 per cent of variable costs for Henley’s fleet. For a ship of 400 tons this would come to about £200, or £0.5 per ton. Port and brokerage charges were not proportional to tonnage, and they are assumed to be £300 for an 800 ton ship in the 1820s, £400 for a 1200 ton ship in the 1820s, and £200 tons for an 800 ton ship in the 1780s (Martin, 1832, p. 104).

These calculations of total costs (Table 5) correspond surprisingly well to the relatively limited information available on freight rates between England and Asia. In 1786, after prolonged negotiation with shipowners, the East India Company agreed to rates of £24 per ton to China direct, £26 to Bombay and £27 to “Coast and Bay” (Bengal) (Auber, 1826, p. 452). These rates are somewhat higher than the calculated cost, likely because the powerful group of shipowners who were also major shareholders in the English Company earned some rents. In 1823, when conditions were more competitive, the Company hired large ships for six voyages at £21 5s, not far off the calculated cost of £20.11 (Hardy, 1835, n.p.). The Company also hired ships, usually of much smaller size, for one voyage. In the 1820s it paid an average of £11 16s per ton, a bit above the calculated cost (Hardy, 1835, n.p.). For non-Company ships contemporaries put the sum of outward and return freight rates to India at between £7 and £8 10s, but regarded these rates as “not remunerating”.33

32 United Kingdom, Lords Journals, 62, (1830), pp. 1130-36 (John Simpson); London Price Current, 1825; LMA, CLC/B/055/MS11888, Indemnity Mutual Maritime Insurance Company, day entries of ships, cargoes and valuations, 1830; LMA, CLC/B/192/M14758, London Assurance, marine department, India policies, 1834.

33 United Kingdom, 1835, pp. 190 (John Innis: £2 10s out; £4 10s to £6 return) 421 (James Aiken: £2 10s out; £4 10s to £6 return). In 1821 a witness before the House of Lords put the Company’s freight rates to and from China were at £23-25, as against rates for smaller American ships of £10-11; another witness put the Company rate at £25, as against £10 for “a very fine English ship” (United Kingdom Lords Journals 54 (11 April 1821), pp. 209, 216).
The cost calculations bring out several important features of the evolution in shipping between 1780s and 1830. The move to small ships after the Wars cut the cost of shipping in half.\textsuperscript{34} But this ignores the improvements that had been made over time in Company (and non-Company) ships. The counterfactual calculation, combining as it does 1780s techniques and conditions with 1820s prices, shows these improvements to have been almost as important in reducing costs as was the move to small ships. The cost calculations also make it possible to gauge the importance of different factors in the reduction of costs. As concerns the changes over time, falling capital costs arising from more frequent voyages over a longer ship’s lifetime accounted for 54 per cent of the reduction in costs, higher ton-man rates accounted for 39 per cent, and lower insurance costs 6 per cent. Of the change from large Company ships to smaller non-Company ships, lower capital costs due to less elaborate ships and more frequent voyages accounted for about 55 per cent of the gains, higher ton-man rates for about 37 per cent, and lower insurance costs 9 per cent. This last reduction in insurance costs arises from the lower value per ton of non-Company ships, which is closely related to their lower capital costs. The importance of savings on capital is a feature of the changes in shipping in this period that the usual concentration on labor productivity fails to detect.

\textit{Factors behind the cost reductions in shipping over time}

Capital costs fell in shipping to Asia because of the rise in the frequency of voyages and because of ships’ greater longevity. The increased longevity of ships owed most to improvements in ship construction, especially the introduction of copper sheathing as protection against worm and weed (Harris, 1966). In tropical waters ships bound for Asia faced the threat of terodo worms which could rot the ship’s hull and imperil its security. The

\textsuperscript{34} It is interesting to note that in the 1780s, when losses of its own ships in wartime led the Dutch Company to charter smaller ships, their cost was about half that of the Company’s own ships (Dillo, 1991, pp. 61, 63)
accumulation of barnacles and weed slowed ships and made them less maneuverable. In Britain the Royal Navy led the way and coppered the entire fleet between 1779 and 1781. Merchant vessels, followed soon after: the share of the English fleet coppered rose from 3.3 per cent in 1786 to 17.9 in 1816 (Rees, 1971, p. 87). The first ships to be coppered were slavers and privateers, followed quickly by Indiamen and somewhat later by ships trading to the West Indies. By 1788 22 of the 26 vessels used by the English East India Company had copper sheathing and the advantages of coppering figured in its decision in 1790 to allow ships to make six voyages (Rees, 1971, p. 91). In the 1820s both Company and non-Company ships trading to Asia were almost all coppered.

Copper sheathing was contributed to the increased frequency of voyages by reducing the need for lengthy refitting and by increasing speeds. The impact of copper sheathing on voyage times can be seen in a sort of natural experiment. The Dutch East India Company did not start sheathing its ships until the early 1790s. As Table 3 shows, there was little change in outward voyage durations for Dutch ships between the early 1770s and the 1780s, whilst the English ships gained a month or so. Copper sheathing was not a free lunch. Estimates in 1790 suggest that it cost something close to £1 per ton (Harris, 1966, p. 555). The sheathing also had to be renewed, usually after three voyages, but much of the copper could be reused, reducing the cost of maintenance. Given the savings in capital costs realized over the period, the return to coppering was high.

Alternative, but less plausible, explanations for the low frequency of voyages in the late eighteenth century are rationing of voyages and inadequate infrastructure. In the 1760s and 1770s there were complaints that the English company’s costs were inflated because it had too many ships on its books. In 1772 Parliament forbade the Company from chartering new ships until its total tonnage was reduced to 45,000 tons. It is possible that there was still

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35 These conclusions are based on work in progress on ships listed in Lloyd’s Registers with names beginning with the letter A.
too much tonnage in the 1780s, but the experience of the continental companies makes this unlikely. Of the ships that made only two voyages for the English Company in the years 1783-92, the average gap between departures was 2.8 years. For the Dutch company it was 3.6 years, for the Danish 3.2, and for the Swedish 3.0. For ships making three voyages the English gap of 5.6 years between first and last departure compares favorably with the Dutch one of 5.9 years and the Danish one of 6 years. Inadequate infrastructure and commercial organization, either in Asia or Europe, might have prolonged voyages, but given the average voyage duration, English vessels generally spent four to six months in Asia acquiring cargo before returning with the monsoon.

The greater frequency of voyages, taken together with the modest reduction in passage time, implies that ships were spending less time in port in the 1820s than they had in the 1780s. Beyond copper sheathing which reduced maintenance downtime, other factors may have contributed. Improvements in port infrastructure, in Europe or in Asia, may have helped speed turnaround times, but it is difficult to isolate the major changes that took place. Another possibility is changes in the composition of cargoes. Shippers may have increasingly specialized, reducing the time needed to acquire a return load. In the late 1820s there were certainly some ships that brought back only cotton, but most ships carried a mix of saltpeter, rice, indigo, sugar and spices (LMPC, 1828; GGA, 1828).

Labor costs on East India Company ships fell for two reasons. One was a modest increase in the ton-man rate, probably part and parcel of an equally modest increase in rates for English mercantile shipping as a whole (Lucassen and Unger, 2011, pp. 11, 16). Labor costs also fell because voyage length shrank. Faster sailing times and changes in departure dates meant that the voyage lasted on average 14 months instead of 17 months. Some of this reduction in costs resulted from coppering and other improvements in ship construction, but part was also probably due to improvements in navigation. Longitude measurement
improved, charts became more accurate, and the prevailing winds became better understood (Kirkaldy, 1914, pp. 307-09; Fayle, 1934, pp. 210-12). C. Northcote Parkinson (1937, pp. 106, 161) notes that a route saving a thousand miles from the journey was unknown until 1811, though he argues elsewhere that passage times improved after 1815 only because of competition.

The fall in insurance costs is also to be attributed to improved ship construction and better navigation. Philippe Haudrère (1991, p. 17) judges that most French ship losses in the eighteenth century were the result of erroneous or incomplete charts. There was also a fall in piracy after the wars, but this made little difference to well manned and armed East Indiamen. In the peacetime years between 1783 and 1792 no East India Company ships had been taken; they had only been lost, burnt, blown up or never heard of (Hardy, 1811).

Factors behind the cost reductions due to smaller ships

When the trade shifted from large East India Company ships to smaller non-Company ships capital costs fell again for two reasons. Smaller ships with their much reduced armament simplified design and fabrication (Unger, 2011, p. 257). Less timber was required and hulls were easier to mould, reducing construction costs (Glete, 1993, pp. 52-53). Smaller ships also reduced loading and unloading time, permitting a higher frequency of voyages.36

Abandoning heavy armament reduced labor costs directly and indirectly. There was no longer any need for a large crew to man the guns. Fewer guns and men also made more space available for cargo. The effects of doing so can be seen from 1828 when the English Company’s began hiring “dismantled ships”, vessels which had been stripped of their

36 Analysis of the cargoes entering London and Liverpool in the first half of 1828 shows that several ships carrying cotton and little else (LMPC, 1828; GGA, 1828). In the eighteenth century the Dutch had used fluyts with smaller crews to transport masts to Batavia and sugar from Asia to Europe. (Gaastra and Bruijn, 1993, p. 185). They were considerably slower than the regular East Indiamen (Bruijn, et al., 1987, p. 55).
armament. The freights paid were much lower than for the regular Company ships, though still well above the rates that the Company paid to hire smaller vessels.

The lower cost of smaller ships raises the key question: why did the English East India Company, or the continental companies for that matter, not use them earlier? Richard Unger (2011, p. 250) has argued that “by the eighteenth century shipbuilders and shippers had, through trial and error and because of the rising volume of trade, discovered the optimum size for sailing ships at somewhere around 400 tons”. Indeed, in 1786-7 a French census of European shipping (Britain excepted) showed only 282 ships of 600 tons or more (Romano, 1962). These large ships, many of which would have been involved in Asian trade, accounted for only 3.6 per cent of all European ships over 100 tons. To some extent the companies did use smaller ships. From the 1790s the English East India Company occasionally hired what were called “extra ships” for a single voyage. These extra ships were generally smaller than the regular company ships, but were still relatively large, in the 500-700 ton range. The Dutch company also sometimes sent out ships of this size, and even smaller, in the 1780s. But the main business of the companies continued to be done in heavily manned and armed ships, and the reason was clearly security. The importance of large ships was still being defended in the early 1830s. As Peter Auber (United Kingdom, 1831-2, p. 146), secretary to the English company, argued before the parliamentary committee on the Company’s affairs:

I doubt very much, upon the out-turn of the whole concern in the long run, whether it will be found, that when the services they have performed, the cargoes they bring, and the security and safety altogether of that class of ships are considered, they much exceed the cost of the private traders. It is an important point to bear in mind, that from the opening of the trade to the present time peace has existed; but I should confidently predict, that if we were to be at war again with any naval power, the India trade (and supposing the China trade to be thrown
open it would be still worse, for the Indian Archipelago presents the means of resort for privateers, and rendezvous for an enemy,) the loss to the commercial interests of this country would be very great, for anything like a sufficient convoy or security to that commerce could not possibly be afforded.

Auber identifies two sorts of threats, from other powers and from privateers. But he was not taking account of a world that had changed fundamentally during the Revolutionary and Napoleonic wars.

In the eighteenth century power in Asia was multipolar. On land, and occasionally at sea, native rulers were still important (Marshall, 1980). At sea the English, French, and Dutch were more or less on a par in Asian trade (Table 6). There are no figures for these powers’ naval strength in Asia, but in total numbers of frigates and small ships, the sorts of vessels usually deployed there, the English navy had slightly more ships than the French and Dutch navies taken together (Glete, 1993, Appendix 2). It is a commonplace that wars were frequent in the eighteenth century, and these wars had implications for Asian trade. The European powers sought to capture each others’ trading ports and ships, both naval and mercantile. The chartered company fleets were at first the principal actors in this struggle (Bowen, 2006, pp. 44-50; Lavery, 1996, pp. 31-39). Only from the early 1740s did the European powers start to send naval squadrons to the Indian Ocean (Graham, 1965, p. 44).

Not only did navies attack merchant vessels, states licensed privateers to prey on enemy shipping. Henning Hillman and Christina Gathman (2011, p. 731) have shown that privateering in the eighteenth century was highly profitable, though becoming less so over time. They argue that it was “a strategy that both opened up promising business opportunities during wars and contributed to the economic and political power of states at little additional

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37 Table 6 covers the major shippers to Asia, but small numbers of Portuguese, Imperial (Trieste and Ostende), Prussian, Russian and Italian ships also ventured into the Indian Ocean (see the lists of ships stopping in Mauritius in Toussaint, 1967, pp. 277-95, 303-07, 321-27).
cost to their governments.” Even in peacetime, when privateering was not a threat, shipping in Asia was risky. Pirates from the Persian Gulf preyed on shipping along the west coast of India, and piracy was also common in the Moluccan straits. But the threat from pirates should not be overstated. In 1821 a witness told the House of Lords that ships of 250 or 350 tons would be considered secure against the pirates in the seas near Penang (United Kingdom, Lords Journals, 54 (11 April 1821), pp. 215, 223).

In a world of war, privateering and piracy, the use of large, armed ships by the chartered companies made sense and, as these vessels also made excellent privateers, their use by all the European companies can be thought of as the outcome of an arms race. Indeed, over time these vessels tended to become larger (De Vries, 2003, p. 50). One of the lessons drawn by the East India Company from the wars between 1776 and 1783 was that their ships were not equal to those of the Dutch, and as a result they started to commission larger vessels (Parkinson, 1937, p. 165).

Since large, armed ships were expensive to build and operate and difficult to deploy in other trades their construction required a long-term commitment. The VOC built its own ships while the EIC signed long-term contracts with private shipowners. Both chartered companies’ monopoly on trade prevented private shippers--using smaller, cheaper vessels--from cherry-picking in periods of peace. In the context of this arms race, the chartered monopoly was thus an effective way of organizing trade.

The French case is particularly interesting for this interpretation. In the 1760s the French Company’s ships averaged 784 tons, considerably larger those of the EIC. After its financial failure and abolition in 1769, French ships trading to Asia became much smaller, averaging 482 tons in 1771-7 and 388 tons in 1783-92 (Haudrère, 1989, vol; 4, pp. 1215, 1227). These smaller ships had to take care to avoid being captured. One French shipowner instructed his captain to “employerés toutes les précautions imaginables pour n’être pas
approché d’aucun navire de quelque pavillon qu’il vous parraise et vous fuirés tous les parages dangereux” (Dermigny, 1959, p. 45). The perils of relying on small ships became apparent when France went to war against Britain in 1778. The aggregate tonnage of French shipping to Asia during the wars was only 43 per cent of that in peacetime years of the 1770s and only 30 per cent of that in the peacetime years of the 1780s. The founding of a new French Company in the mid-1780s had a good deal to do with widely expressed dissatisfaction with the results of free trade, but its difficulty in raising capital, as well as some financial shenanigans, meant that the average size of French Indiamen was only beginning to grow before the Company’s demise in 1790 (Nussbaum, 1933).

The Danish experience also departs from the European norm (Feldbæk, 1978). The Danes had a chartered company, but its monopoly from 1772 was limited to the China trade. The Danish company did send ships to India, but so, too, did other private shippers, often English merchants operating under the Danish flag. In the China trade the Danes used large ships, of 1068 tons on average in 1783-92, but smaller ships prevailed in the trade to India. The Danish company’s India ships averaged 576 tons and non-company ships 447 tons. The Danes may have been able to get away with using smaller ships because they remained neutral throughout the eighteenth century. Indeed, in wartime periods some ships from other countries arranged to sail under the Danish flag, though it meant that they were obliged to land their cargoes in Copenhagen. But if neutrality protected Danish shipping from the depredations of the major powers, it remains puzzling why the Danes continued to employ such large ships in the China trade.

38 In 1785-6 six ships, averaging 733 tons, were built at Lorient (Le Bouëdec, 1996, p. 140 n. 1).
The other country that used its neutrality to run smaller ships to India and China was the United States. The small ships that Americans used in the China trade were particularly notable. In the 1790s and 1800s the East India Company was repeatedly frustrated in its efforts to rein in American ships carrying goods both within Asia and from Asia to Europe (Furber, 1938).

French, Danish and American experience shows that private shippers preferred smaller ships if it was safe to use them. The rise of British hegemony in Asian waters not only made the seas safer, but also by making the chartered monopolies no longer necessary as proxy navies, gave private shippers the leeway to use whatever sized ships they wanted. After 1815, the Royal Navy ruled the seas and Britain dominated trade with Asia (Graham, 1967). Of frigates, the sort of ships most suited to Asian service, Britain’s share had risen to 58 per cent in 1820, twice as many as its European rivals taken together (Glete, Navies, Appendix 2). Table 6 shows that Britain’s share of the mercantile tonnage cleared to Asia had doubled to 62 per cent in the 1820s. Evidence on European and American shipping at Indian ports and at Canton confirms this dominance. The British also began to take concerted action against pirates. In 1809 and 1810 naval and East India Company forces destroyed three pirate bases and over 80 pirate vessels in the Persian Gulf (Gardiner, 2002, pp. 88-91). In 1819 another naval expedition was sent to subdue pirates based in the Strait of Hormuz. In the 1810s and early 1820s the British, with intermittent Dutch help, tried to eradicate piracy in the Moluccan

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39 American ships trading to China averaged about 300 tons (Richards, 1994). American ships clearing Calcutta between 1795 and 1813 averaged 277 tons, as against 621 tons for British ships (United Kingdom, 1831-2, vol. 3, appendix, pp. 773-840).
40 Much of the extensive testimony to a House of Lords committee in 1820-1 was taken up with the issue of American competition in China and southeast Asia (United Kingdom, Lords Journals, 54 (11 April 1821), pp. 192-320).
41 British ships accounted for 86 per cent of clearances to the western hemisphere from India ports in the 1820s, with French ships accounting for 7 per cent and American ships for 5 per cent (United Kingdom, 1831-2, vol 3, app, pp. 773-840). Britain’s share of shipping at Canton was 71 per cent, as against 29 per cent for America (BPP 1833 (001), Tables of the Revenue, Part 1, pp. 318-19).
straits (Graham, 1965, pp. 52-54; Tarling, 1963, pp. 69-70, 82-89). With peace and the reduction in privateering and piracy, shippers from all countries went over to lightly manned ships of 300-400 tons, with the attendant reduction in costs.\textsuperscript{42} The trade to East Asia was thus able to reap gains to safer seas that had been attained much earlier in the Atlantic (Menard, 1991, pp. 274-75).

Greater security for shipping between Europe and Asia probably meant that shipping within Asia was also safer. Kaori Sugihara (2009) has argued for a resurgence of intra-Asian trade in the first half of the nineteenth century. He attributes this to a “regime change from mercantilism to forced free trade,” though he acknowledges the role played by improved ports and ships. In the eighteenth century the Dutch company sent a regular surplus of large East Indiamen to Batavia, ships which were then used in intra-Asian trade. In the 1750s these averaged 819 tons. The English company played a lesser role in trade from Indian ports, but private English shippers based in India also operated large ships, most of which were built in India.\textsuperscript{43} These “English” ships were said to have been favored by Asian merchants, who were willing to pay higher freight rates for the security that they offered (Marshall, 1987, p.283). Safer seas may well have permitted a similar move to smaller, more lightly manned ships and promoted the increase in “country trade”.

\textit{Impact of the cost reductions on price differentials}

\textsuperscript{42} After the French wars the Company continued to use large ships in the China trade, perhaps under the influence of the shipping interest, and some new Indianmen were constructed during this period. But with the end the China monopoly in 1833 many of these ships seem to have gone out of service. The average life of East Indiamen constructed in the 1810s was close to 21 years; those conructed in the 1820s had lives of about 14 years (\textit{Lloyd’s Register}).

\textsuperscript{43} In 1811 the merchant shipping fleet of Calcutta comprised 116 vessels, of which 20 were of 500 tons or more. Six of these ships had 800 tons or more, and in Madras there were another four ships of similar size. In Bombay 27 vessels were listed with an average tonnage of 652 tons; five were of 800 tons or more (Milburn, 1813, vol. 2, p. 67, 173; vol. 1, p. 237).
Table 7 reports estimates of the potential impact that these improvements in shipping could have had on price differentials. The calculations start from the overall gross margins of the chartered companies, which ranged from 1.8 to 2.5 in the mid- to late eighteenth century. De Vries put imports of Asian products by the British, French and Dutch at 52.8 million guilders in the 1770s. His total is increased to 60 million guilders to take account of the Danes, Swedes and others. These products were brought to Europe by 46,000 tons of shipping, leading to a value of imports per ton of £117.44 Given the range of margins, the cost of the goods in Asia was between £47 and £65 per ton and the difference between prime cost and sale price was between £52 and £70 per ton. Certain costs can be estimated, notably freight (from the calculations above); insurance on merchandise in peacetime; the wartime insurance premium (on the basis conflict rages in half of our years); and working capital costs (based on an interest rate of 12.5 per cent). The residual includes all other costs of acquiring and selling the goods, general administrative overheads and any monopoly rents.

The reductions in costs arose from lower shipping costs, from safer seas, and from shorter voyage times. These have been partitioned into changes due to technical progress in shipping, which includes half of the fall in shipping costs and the entire fall in the peacetime insurance rate, and changes due to safer seas and the consequent ability of smaller ships to make return voyages within the year. This second effect, attributed to British naval hegemony, is about twice as large as that due to improved ships and better navigation. Together they produce a 20-23 per cent reduction in the European price of Asian goods. This fall is much larger than what could be expected from the elimination of monopoly profits. Indeed these are bounded above by the residual of the calculation which also includes

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44 The figures for margins, imports and shipping tonnage come from De Vries (2010, pp. 716, 723, 729). Conversion from guilders to pounds was at the par rate of 11.11 guilders per pound.
administrative and other costs. Whatever monopoly profits remained after administrative and
other costs would have been fallen to the company or to its shipowners and ship captains.45

The observed reduction in price differentials came suddenly in the aftermath of the
French wars because much of the gain was driven by the move to small ships. That moved
was hastened both by the end of the India monopoly in 1813 and by peace of Vienna in 1815.
The reduction in costs due to technical changes was more gradual, but its impact on freight
rates and price differentials would have been offset, at least in part, by wartime increases in
insurance rates and the use of convoys during, which tended to increase voyage durations.
Round trip durations were actually a month or two longer in the early 1810s than they had
been in the 1780s (Hardy, 1811, 1835).

Yet there must have been some fall in monopoly profits since the fall in shipping costs
was too small to explain fully the very large fall in price differentials for exotic goods such as
cloves, pepper and coffee. Or perhaps it is better to say monopsony and monopoly profits.
The Dutch company did have fairly tight control over Asian supplies of these commodities
and was able to keep supply prices very low. The price of cloves in southeast Asia was fixed
by the Dutch in 1656 and remained constant until the 1770s. Similarly, the price paid for
pepper by the Dutch in their colonial domain remained the same from 1680 to 1789 (Bulbeck
et al., 1998, pp. 26-31, 58-59, 82-84, 167-69). However, by the late eighteenth century these
commodities represented less than 15 per cent of the value of Dutch company shipments to
Europe and an even smaller share of English shipments (Jacobs, 2006, pp. 354-55; Chaudhuri,
1983, pp. 818-19, 842). Given the special nature of supply conditions for these items and their
small and decreasing importance in trade, one should not, like O’Rourke and Williamson,
take the margins on these goods as representative of trade between Asia and Europe.

45 On potential rents to English shipbuilders, shipowners and ship captains, see Parkinson,
The fall in shipping costs had, of course, a larger impact than simply a fall in prices. It expanded the range of goods that could be profitably traded between Europe and Asia. As noted above, by the 1820s India came to supply about a tenth of Britain’s cotton supplies. In addition to the fall in shipping costs, the large drop in the price differential for raw cotton owed a great deal to the increased capability of compressing this bulky item into denser bales. Davis cites a court case in the early eighteenth century in which it appears that a ton of cotton took three to four times as much space as a ton of sugar or water (Davis, 1962, p. 178).

Powerful baling presses were being imported into India from the 1790s, though it is hard to quantify their impact on Indian freight rates for cotton.46 The American experience suggests that it could have accounted for a halving or more of rates (Harley, 1988, p. 857; French, 1987).

**Conclusion**

The end of English East India Company monopoly mattered, but not primarily because the Company had been acting like a classic monopolist, as has been suggested by O’Rourke and Williamson and Jones and Ville. The English company and the other European chartered companies had been effective institutions for organizing trade in a multipolar world in which war was as common as peace and in a region where governments had not yet assumed what Frederic Lane (1966, chs. 22-25) termed the costs of protection. As Britain came to control the seas and increasingly the land in Asia, the chartered company had outlived its usefulness and made way for the sort of ordinary trade carried on by smaller, lightly manned ships that had long characterized the Atlantic world. There was for European consumers a peace dividend in the form of lower prices for Asian goods, though they or the Europeans’ Asian subjects may have had to pay somewhat higher taxes to sustain an

46 BL, IOR, H/374, 21 May 1794, 18 October 1797.
increased imperial presence in Asia. These changes in the composition of shipping, as well as improvements in ship construction and navigation, were key to reducing shipping costs between Europe and Asia.

The changes during this period are a mix of the pre-modern and the modern. Menard (1991, pp. 274-75), drawing on a literature pioneered by Davis and James Shepherd and Gary Walton, has argued that before the nineteenth century “productivity gains rooted in better techniques played only a minor role in the growth of trade. Broad political and commercial developments fostered the safe shipment of large quantities across great distances by turning the oceans of the world into a vast inland sea dominated by Europe’s major metropolitan capitals.” As he shows in the cases of the wine trade within Europe and of the rise of the Atlantic economy, safe seas could lead to significant reductions in freight rates. The effects of British hegemony on trade between Europe and Asia can be seen as the last act in this early modern story. Yet the introduction of copper sheathing heralds the changes in technology, notably application of iron and steam power to shipping, that would lead to the further falls in freight rates during the second half of the nineteenth century, changes that have been so clearly explicated by Harley (1988).

The changes that took place in shipping between Europe and Asia between the 1770s and the 1820s were a marked discontinuity in the global economy. Ton-man rates on Dutch East Indiamen had remained more or less constant since the early seventeenth century, as had real freight rates on Dutch and English ships (Menard, 1991). The large reduction in the costs of shipping after the French wars helps account for the narrowing of price differentials between Europe and Asia. As such, it contributed, along with the mechanization of industry in Europe, to the scissors movement in prices that in the nineteenth century turned India and

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Note that van Tilhof and van Zanden (2011) find that real freight rates on Dutch shipping within Europe were also more or less constant during the seventeenth and eighteenth centuries. They interpret the rise in ton-man rates in Europe as a substitution of capital for labour rather than as a gain in efficiency.
China from manufacturers to suppliers of raw materials in the global division of labor

(Chaudhuri, 1983, pp. 807, 842-43).
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Van Lottum, Jelle, Jan Lucassen and Lex Heerma Van Voss. “Sailors, National and International Labour Markets and National Identity, 1600-1850.” In *Shipping and...*


### Table 1
**Shipping from Europe to Asia by Size of Ship**
(number of ships, excluding packets)

<table>
<thead>
<tr>
<th>Tonnage classes</th>
<th>1783-1792</th>
<th>1818-1830</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>EIC</td>
<td>EIC</td>
</tr>
<tr>
<td>&lt;300</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>300-599</td>
<td>58</td>
<td>8</td>
</tr>
<tr>
<td>600-899</td>
<td>106</td>
<td>195</td>
</tr>
<tr>
<td>900-1199</td>
<td>112</td>
<td>28</td>
</tr>
<tr>
<td>1200+</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>277</td>
<td>444</td>
</tr>
<tr>
<td>Mean (tons)</td>
<td>867</td>
<td>820</td>
</tr>
</tbody>
</table>

**Notes and Sources:** VOC: Bruijn, et al., 1979; EIC, 1783-1792: Farrington, 1999; EIC and Non-EIC, 1818-1830: *Lloyd’s Register*.

### Table 2
**Voyages per ship: English East Indian Company ships**

<table>
<thead>
<tr>
<th>Voyages</th>
<th>Ships making their first voyage in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1765-1774 1775-1784 1785-1794 1795-1804 1805-1814</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>38</td>
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<td>5</td>
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</tr>
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<td>6</td>
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<td>7</td>
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<td>8</td>
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<td>13</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
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<tr>
<td>Total</td>
<td>63</td>
</tr>
<tr>
<td>Mean (exc 1 voyage)</td>
<td>4.0</td>
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<tr>
<td>Median</td>
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**Sources and notes:** Farrington, 1999. The means are calculated without ships making one voyage since the Company occasionally hired unspecialized vessels for one voyage only.
<table>
<thead>
<tr>
<th>Destination</th>
<th>Ceylon</th>
<th>Bombay</th>
<th>Madras</th>
<th>Bengal</th>
<th>India</th>
<th>Batavia</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean days</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median days</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td><strong>(number of observations)</strong></td>
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<tr>
<td>English EIC, 1770-1775</td>
<td>159</td>
<td>168</td>
<td>197</td>
<td>-</td>
<td>173</td>
<td>211</td>
<td></td>
</tr>
<tr>
<td></td>
<td>151</td>
<td>159</td>
<td>177</td>
<td>-</td>
<td>160</td>
<td>203</td>
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<tr>
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<td>(24)</td>
<td>(68)</td>
<td>(5)</td>
<td>(20)</td>
<td>(5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dutch, 1770-1775</td>
<td>211</td>
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<td>-</td>
<td>233</td>
<td>-</td>
<td>253</td>
<td>-</td>
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<tr>
<td></td>
<td>207</td>
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<td>221</td>
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<td>(12)</td>
<td>(6)</td>
<td>(156)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>English EIC, 1783-1792</td>
<td>137</td>
<td>133</td>
<td>136</td>
<td>-</td>
<td>179</td>
<td>169</td>
<td></td>
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<td></td>
<td>127</td>
<td>130</td>
<td>132</td>
<td>-</td>
<td>173</td>
<td>154</td>
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<td></td>
<td>(47)</td>
<td>(118)</td>
<td>(32)</td>
<td>(10)</td>
<td>(85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>French, 1783-1792</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>189</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(8)</td>
</tr>
<tr>
<td>Dutch, 1783-1792</td>
<td>239</td>
<td>-</td>
<td>-</td>
<td>227</td>
<td>-</td>
<td>238</td>
<td>-</td>
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<tr>
<td></td>
<td>208</td>
<td>-</td>
<td>-</td>
<td>248</td>
<td>-</td>
<td>231</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(22)</td>
<td>(3)</td>
<td>(238)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Danish, 1783-1792</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>296</td>
<td>238</td>
<td>-</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>241</td>
<td>231</td>
<td>-</td>
<td>247</td>
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<td></td>
<td>(3)</td>
<td>(14)</td>
<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English, EIC, 1820-1828</td>
<td>119</td>
<td>110</td>
<td>125</td>
<td>-</td>
<td>-</td>
<td>163</td>
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<tr>
<td></td>
<td>117</td>
<td>108</td>
<td>121</td>
<td>-</td>
<td>-</td>
<td>158</td>
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<td>(57)</td>
<td>(63)</td>
<td>(103)</td>
<td></td>
<td></td>
<td></td>
<td>(64)</td>
</tr>
<tr>
<td>English, non-EIC, 1823-1826</td>
<td>129</td>
<td>143</td>
<td>135</td>
<td>153</td>
<td>-</td>
<td>139</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>121</td>
<td>140</td>
<td>130</td>
<td>145</td>
<td>-</td>
<td>136</td>
<td>-</td>
</tr>
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<td></td>
<td>(13)</td>
<td>(75)</td>
<td>(71)</td>
<td>(145)</td>
<td>(28)</td>
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</table>

### Table 4

**Ton-man Rates**

(tons per crew member)

<table>
<thead>
<tr>
<th>Period</th>
<th>Company</th>
<th>Observations</th>
<th>Ton-man rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1770-1778</td>
<td>Danish Company</td>
<td>18</td>
<td>5.7</td>
</tr>
<tr>
<td>1770-1778</td>
<td>France</td>
<td>31</td>
<td>6.3</td>
</tr>
<tr>
<td>1783-1792</td>
<td>English Company</td>
<td>4</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>French Company</td>
<td>11</td>
<td>7.2</td>
</tr>
<tr>
<td></td>
<td>Dutch Company</td>
<td>75</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>Swedish Company</td>
<td>11</td>
<td>5.8</td>
</tr>
<tr>
<td>1793-1805</td>
<td>Danish Company</td>
<td>17</td>
<td>7.5</td>
</tr>
<tr>
<td>1818-1830</td>
<td>English Company</td>
<td>8</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>All ships China</td>
<td>258</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>All ships India &amp; China</td>
<td>1819</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>Implied non-Company India &amp; China</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All ships Java &amp; Sumatra</td>
<td>54</td>
<td>17.0</td>
</tr>
<tr>
<td></td>
<td>All ships Mauritius</td>
<td>168</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>France (1825-9)</td>
<td>169</td>
<td>16.2</td>
</tr>
</tbody>
</table>

Table 5
Costs of English Shipping to Asia
(£ per ton)

<table>
<thead>
<tr>
<th>Owner</th>
<th>Observed</th>
<th>Counterfactual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EIC 1780s</td>
<td>EIC 1820s</td>
</tr>
<tr>
<td>Date</td>
<td>1780s</td>
<td>1820s</td>
</tr>
<tr>
<td>Tonnage</td>
<td>800</td>
<td>1200</td>
</tr>
<tr>
<td>Crew size</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>Voyages per year</td>
<td>0.33</td>
<td>0.50</td>
</tr>
<tr>
<td>Capital cost of ship</td>
<td>8.00</td>
<td>7.68</td>
</tr>
<tr>
<td>Repairs</td>
<td>1.30</td>
<td>2.00</td>
</tr>
<tr>
<td>Stores</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Labour—seamen</td>
<td>1.91</td>
<td>2.10</td>
</tr>
<tr>
<td>Labour—officers</td>
<td>1.91</td>
<td>2.10</td>
</tr>
<tr>
<td>Labour—food</td>
<td>1.91</td>
<td>2.10</td>
</tr>
<tr>
<td>Insurance</td>
<td>1.60</td>
<td>1.80</td>
</tr>
<tr>
<td>Port charges and Brokerage</td>
<td>0.25</td>
<td>0.33</td>
</tr>
<tr>
<td>Total costs</td>
<td>18.89</td>
<td>20.11</td>
</tr>
</tbody>
</table>

Notes and sources: see text.
Table 6
European and American Shipping to Asia
(average annual)

<table>
<thead>
<tr>
<th></th>
<th>Tons per year</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1783-1792</td>
<td>1820-1829</td>
</tr>
<tr>
<td>Britain</td>
<td>23992</td>
<td>85909</td>
</tr>
<tr>
<td>France</td>
<td>17410</td>
<td>16818</td>
</tr>
<tr>
<td>Netherlands</td>
<td>27540</td>
<td>17800</td>
</tr>
<tr>
<td>Denmark</td>
<td>6095</td>
<td>2277</td>
</tr>
<tr>
<td>Sweden</td>
<td>1448</td>
<td>673</td>
</tr>
<tr>
<td>United States</td>
<td>1000</td>
<td>19754</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>77485</strong></td>
<td><strong>143231</strong></td>
</tr>
</tbody>
</table>

Notes and sources:
Britain: 1783-1792: Farrington, 1999; 1820-1829: United Kingdom, annual returns of trade and navigation.
Netherlands: Bruijn, et al., 1979; 1820-1829: Horlings, 1995, p. 391. The numbers of Dutch ships cleared for Asia in the 1820s comes from Horlings, who also gives figures for the tonnages cleared, derived by applying an estimated average tonnage of about 1050 tons. Returns for the numbers and tonnage of ships entering ports in Java and Madura show that a correct factor should be more like 480 tons, which is is used here (Dagblad van 's Gravenhage, 28 May 1830). Horlings’ figures are also not consistent with the estimated fall of about two-thirds in employment in East Indian shipping between 1780 and 1827 (Van Lottum, et al., 2011, p. 319).
Denmark: 1783-1792: Feldbæk, 1978; 1820-1829: Møller, 1974, p. 110, estimated according to the number of ships with China and East India destinations in 1820-1829 relative to 1783-1792.
United States: 1783-1792: assumed on the basis that the tonnage entered from Asia was 1000 tons in 1791 and 1760 in 1792; United States, American State Papers, Commerce and Navigation, vol. 1, pp. 217, 252; 1820-1829: United States, Reports on Commerce and Navigation, 1820-1829.
Table 7
Potential Impact on Price Differentials, 1770s

<table>
<thead>
<tr>
<th></th>
<th>1.8</th>
<th>2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assumed gross margin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>European value of goods (£)</td>
<td>117.0</td>
<td>117.0</td>
</tr>
<tr>
<td>Implied Asian cost of goods (£)</td>
<td>65.0</td>
<td>47.0</td>
</tr>
<tr>
<td>Implied company costs and profits (£)</td>
<td>52.0</td>
<td>70.0</td>
</tr>
<tr>
<td>Of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Insurance—peacetime (8%)</td>
<td>5.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Insurance—wartime premium (3.875%)</td>
<td>2.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Working capital (12.5%; 17 months)</td>
<td>16.4</td>
<td>12.8</td>
</tr>
<tr>
<td>Residual costs and monopoly profit</td>
<td>7.9</td>
<td>31.8</td>
</tr>
<tr>
<td>Changes in costs (£)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight</td>
<td>-13.3</td>
<td>-13.3</td>
</tr>
<tr>
<td>Insurance—peacetime</td>
<td>-1.3</td>
<td>-0.9</td>
</tr>
<tr>
<td>Insurance—wartime premium</td>
<td>-2.5</td>
<td>-1.8</td>
</tr>
<tr>
<td>Working capital</td>
<td>-8.6</td>
<td>-7.0</td>
</tr>
<tr>
<td>Percentage fall in price due to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical changes in shipping</td>
<td>-6.8</td>
<td>-6.5</td>
</tr>
<tr>
<td>Peace dividend from British hegemony</td>
<td>-15.2</td>
<td>-13.2</td>
</tr>
<tr>
<td>Elimination of monopoly profits (maximum)</td>
<td>-6.7</td>
<td>-27.2</td>
</tr>
</tbody>
</table>

Notes and sources: see text.
Figure 1
English East India Company stock prices, 1807-1820


Figure 2
British Shipping to Asia, 1780-1838: numbers of ships

Sources: see text.
Figure 3
British Shipping to Asia, 1780-1838: log tonnage

Sources: see text.

Figure 4
Voyages per year: English East India Company ships
(at least four voyages; excluding “extra ships”)

Source: Farrington, 1999.
Figure 5
European Shipping to Asia: Seasonality of Departures