Slave Ship Provisioning in the long 18th Century
A Boost to West African Commercial Agriculture?

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Abstract[1]

To what extent did the 18th century intensification of the trans-Atlantic slave trade boost commercial agriculture in the coastal areas of West Africa? Exploring the provisioning strategies of 187 British, French, Dutch and Danish slave voyages conducted between 1681 and 1807, we call for a major downward adjustment of available estimates of the slave trade induced demand impulse. We show that during the 18th century, an increasing share of the foodstuffs required to feed African slaves were taken on board in Europe instead of West Africa. We also document considerable variation in provisioning strategies among slave trading nations and across main regions of slave embarkation. We explain these trends and variation in terms of the relative (seasonal) security of European versus African food supplies, the falling relative costs of European provisions and the increasing risks in the late 18th century trade, putting a premium on faster embarkation times.

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1. Introduction

The political and economic effects of the transatlantic slave trade on African societies have been intensively debated ever since the late 18th century.[2] Nobody doubts that the drain of millions of children and young adults from West and West Central Africa had a transformative societal impact, but the extent to which it has deterred long-term economic development remains a matter of dispute. Inikori (2007)), echoing the dependency views of Rodney (1972), has argued that the commodification and export of humans effectively reversed African economic prosperity after 1450, by stifling processes of internal market development and state consolidation. Manning (2010) has pointed to adverse demographic consequences. Nunn and Wantchekon (2011) have pointed to long-term distortions of societal trust. Thornton (1998), however, has argued that in areas such as the Bight of Biafra the exchange of goods with Europeans helped stimulate local industry not retard it. Johnson et al. (1990) have shown that volumes of commodity trade expanded in the wake of the slave trade, which also suggests that the strengthening of North-South trade relations supported African market development (c.f. Eltis and Jennings 1988).

More recently, historians have started to explore the potential effects of the slave trade on the development of commercial agriculture in Atlantic Africa (Law et al. 2013). The introduction of New World crops such as maize and manioc enlarged the cultivation choice-set of African farmers and became important to the organisation of the slave trade, in similar ways as African food crops (e.g. black rice) may have underpinned the organisation and expansion of New World plantation economies (Carney 2002, Carney and Rosomoff 2011, see Eltis et al. 2007 for a critical review). Large numbers of captives needed to be fed during their journey to the coast, their stay at the coast before embarkation, their stay on board before departure and during the ocean crossing. Captains taking in insufficient stocks put their cargo at higher risks of starvation and disease.[3]

The provisioning strategies of slave traders have remained understudied though. The literature generally assumes that the lion-share of food provisions required for slave voyages were produced in West Africa and sold by local farmers or middlemen to the slave ships. Based on this assumption, David Eltis has argued that the increasing intensity of the 18th century slave trade must have boosted West African food exports. In a first attempt to estimate the magnitude of the slave trade induced demand impulse he reached the provisional conclusion that food exports approached a total annual value of one million British pounds (current prices) during the late 18th century, which exceeded the total value of West Africa's commodity exports to Britain up to the mid-19th century (Eltis 2013).

Studying the Gold Coast, Klas Rönnbäck has argued that the demand for provisions by slave ships was too small to generate any direct positive linkages for commercial agricultural development. Reasoning from a set of baseline assumptions regarding the size of the urban population in the 17th and 18th centuries, and the derived demand for marketable foodstuffs

[2] See for instance the debate between early abolitionists such as Thomas Clarkson (1788) and defenders of the trade such as Norris (1789).

[3] Miller (1979, 95-102) and Newson (2007, 72, 85) argue that the poor diets of slaves from the Angolan port of Luanda, both during their stay at the coast as well as during the ocean crossing, raised mortality rates in comparison with other regions of embarkation.

from the non-farming population, he estimated that slave ships and slave forts may have added ca. 27% to urban demand at the peak of the trade, and contributed ca. 3-4% to total agricultural production in the coastal regions (Rönnbäck 2015, 166). Rönnbäck, somewhat surprisingly, qualifies this contribution as 'rather marginal' (2015, 172). More important, however is that Rönnbäck, like Eltis, doesn't bring any new data to the table in order to scrutinize his main assumptions, including the idea that slave traders bought their provisions exclusively at the Gold Coast.

This paper has two aims. First, to estimate the comparative magnitude of the demand impulse to West African commercial agriculture using primary sources on food sales from company account books from a much larger and more diverse sample of slave voyages than hitherto has been compiled. This new dataset allows for deeper insights in the 18th century development of provisioning strategies, which appear not as straightforward as many scholars have hitherto assumed. Second, to gain a deeper understanding of the commercialisation of agriculture at different parts of the African Atlantic coast by exploiting the temporal and spatial variation in slave ship provisioning.

We use primary sources on *actual provisions* taken on board in European ports of departure and along the West African coast from 187 British, Dutch, French and Danish slave journeys conducted between 1681 and 1807. Our dataset includes voyages by private merchants and chartered companies such as the British *Royal African Company* (RAC) and the Dutch *West-Indische Compagnie* (WIC). In addition, we analyse the instructions captains received for the provisioning of crews and slaves, as well as ship-logs and chartered company correspondence shedding light on the provisioning logistics. We exclude journeys undertaken from the New World (e.g. Brazil, Cuba, US) as the current dearth of primary sources on this part of the trade warrants a separate study.

This study yields two major conclusions. First, a growing proportion of the required calories and proteins for slaves were taken on board in European port cities over the course of the 18th century. We argue that this change in provisioning strategies has been driven by declining relative prices of European provisions to slave purchasing prices in combination with the increasing business risks faced by slave traders. Both the falling relative provisioning prices and the rising share of European provisions make that our revised estimates of the slave-trade induced demand-impulse are about 70 to 80% lower than Eltis' estimates. Since we find that the economic weight of late 18th century food exports was *considerably smaller*, we argue that the commercial transition from slave to commodity exports in the first half of the 19th century must have involved rather *modest losses* of food exports and cannot have deepened the rupture of Atlantic Africa's international trade much.

Second, we document substantial differences in the provisioning strategies of British as compared to continental slavers. British traders relied on African provisions to a larger extent, although they too were stocking up food in increasing quantities in Liverpool and Bristol during the 18th century. We explain the different provisioning strategies of British versus continental traders by the different positions the British held at the West African coast – especially the large range of fortified trading stations - as well as the more developed food markets in regions where British slavers conducted most of their trade, the Bight of Biafra in particular. Indeed, our evidence shows that the accessibility of African food supplies varied considerably across the major regions of embarkation along the Atlantic coast. Agricultural

commercialisation was thus a localized response to increasing slave trade induced demand for foodstuffs. On a larger plain, the 18th century expansion of the slave trade just had a modest impact on commercial agricultural development along the Atlantic African coast.

2. Did the transatlantic slave trade boost West African commercial agriculture?

The provisions that slave ships took in from European ports typically included a few staples, principally wheat (often in the form of biscuits), beans, peas, rice and barley. For crew members luxury items were added such as salted meat, stock-fish, butter, bread, cheese, suet, sweet oil, beer, wine and spirits. Provisioning of slaves and sailors on the slave ships was usually strictly segregated.[4] Moreover, throughout the 18th century special supply ships brought fairly large quantities of European provisions to the forts at the African coast, to complement or replace consumption of local foodstuffs by European staff. In Africa, captains picked up foodstuffs common to the regions where they traded; rice from the Upper Guinea and Windward coasts, maize, millet or sorghum from the Gold Coast, yams from Biafra and Gabon and manioc from the Congo and Angola. Plantains, coconuts, limes and oranges and other fresh provisions supplemented these staple foods. West African palm oil served as an important source of unsaturated fat in slave diets (Harms 2008, 112-19, Mandelblatt 2009, 411-12, Klein 2010, 94-96). Fresh water and firewood was also sourced from Africa in great quantities. As a rule, slaves were fed a kind of gruel comprised of whatever combination of the above had been bought, seasoned with salt and melegueta pepper. Small portions of salted meat, stock-fish and tobacco were occasionally handed out to slaves, but most of this was reserved for crew members.

According to David Eltis, slave provisions constituted by far the biggest export market for agricultural commodities in the coastal areas of West Africa during the long 18th century. Before 1650, sugar exports from São Tomé accounted for almost all of the cultivated crops exported, but the volumes of cash-crops traded in the 18th century paled in comparison to West Africa's 19th century export boom (Eltis 2013, 35-36, Frankema et al. 2015).[5] Eltis made a first attempt to estimate the total value of West African food exports. Even though he acknowledges that his estimates are crude and invites colleagues to improve upon them (2013, 45), his prime conclusion is nonetheless important: if annual food exports indeed rose up to one million British Pounds in the late 18th century and exceeded the average annual value of West African commodity exports to Britain during the first half of the 19th century, the

[4] For four MCC ships we found surviving accounts of the daily quantities of food used showing separate diets for sailors and captives, presumably also to emphasize social or racial hierarchy. These accounts were retrieved from the 'Consumptieboeken', which were separate to the 'Negotieboeken' which detailed purchases of food at the coast, from: Brandenburg 4e reis ZA: MCC290, Geertuda en Christina 4e reis ZA: MCC 420, Nieuwe Hoop 3e reis ZA: MCC 835, Zeemercure 1e reis ZA: MCC 835. For example, the consumption accounts of the *Nieuwe Hoop* from 1766 – 1768 report that the crew consumed bread, meat, bacon, blue & grey peas, salt fish, rice, sweet and rape oil, while slaves were given horse beans, barley, yams and African beans called *gobbegobsen*. French and Danish ships are also recorded as stocking separate food supplies for their personnel, who also ate at different times than slaves. Interestingly, our British sources do not speak to such a strict separation of slave and crew provisions, in particular regarding the consumption of staple foods.

[5] The export of non-food items also rose in the wake of the slave trade, e.g. gold, ivory, hides, dyewoods, beeswax and gum Arabic. But this did little for the development of commercial agriculture.

abolition of the slave trade must have incurred a significant loss of non-slave export revenue and may have seriously distorted food markets, after an era of rapid growth up to 1807.

Eltis' estimates are based on two core assumptions. First, that the lion-share of required provisions were sourced from Africa and that European provisions constituted a negligible share, somewhere in the order of 1 to 2%, of the purchasing price of slaves (2013, 38). Second, following Curtin's (1973, 168-9) classic study on the Senegambian slave trade, that slave maintenance costs constituted a fixed 25% of their exchange value throughout the 18th century. Both assumptions combined with an annual time-series of slave purchasing prices thus allowed him to estimate the average annual value of African-sourced provisions in the Atlantic slave trade during 1681-1807. Appendix Table 1 shows his estimates and explains his calculation procedure in greater detail.

The assumption that the lion-share of food provisions for the middle passage was produced by African farmers is repeated over and over again in the slave trade literature, but it has never been subjected to empirical verification.[6] Our analysis of surviving account books of slave trade merchants indicates that in the course of the 18th century nearly half of all calories and proteins required to keep slaves alive on board of European slave vessels – note that we exclude voyages from the New World - were sourced from European ports of departure. The slave trade may thus have stimulated commercial agriculture in the hinterland of some European port cities (e.g. Bristol, Liverpool, Nantes, Middelburg) as much as it stimulated commercial agriculture in West African regions of slave embarkation. This casts a different light on the relative magnitude of the slave trade induced demand for West African food exports and raises new questions about the provisioning strategies of slave traders.

Furthermore, it is worth noting that the 25% food share of slave purchasing prices is not the only figure one can select for this exercise. Curtin argued that the total costs of maintaining a slave was about half its market value per year. Obviously, food was a key component of those costs but also a highly variable one, depending on local harvest conditions, food prices and the time spent in captivity before embarkation.[7] Curtin argued that during extensive waiting periods slaves were often put to work to contribute to their own maintenance (1973, 170). The insecurity about average time spend 'in store', the added value of slave labour and the market prices of slave food all turn the 25% estimate into a somewhat arbitrary choice.

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[6] This assumption informed the estimates of Eltis (2013), Klein and Engerman (1979) and Rönnbäck (2015) and is also put forth in other key studies such as Carney and Rosomoff (2011, 47) and Mandelblatt (2008, 411, 421). In his study of the Danish slave trade on the Gold Coast Hernaes (1998, 337) even claimed that it was impossible to bring sufficient food supplies from Europe and that the 'millie trade' (maize) must therefore have given a major impulse to the local Gold Coast economy.

[7] Curtin (1973) estimated the costs of feeding slaves around Saint Louis in Senegambia. He showed that prices of millet (the main staple) in the 1750s varied depending on rains and other harvest circumstances, from £2.60/ton in a good year to £19.50/ton in a very severe year. Curtin settled on an average of £6.80/ton. By asking how much millet a slave might need to live he suggested a figure of £2.74 per year of millet, excluding costs for housing, clothing, guards and additional foodstuffs. As an average slave would sell for between £10 to £12, this implied that slave-owners had to pay maintenance costs between a quarter (in a very good year) to a half (in an average year) to four fifths (in a very bad year) of the eventual selling price. In Gajaaga, a kingdom on the upper Senegal, slaves could only be delivered once a year in the annual high season. This meant that slaves brought to this market had a price "*on a sliding scale, rising by 80% from a low point after the departure of the annual fleet to the high point just as the last boats prepared to sail at the end of the next high season*." (1973, 169-170).

In an essay on the French slave trade Klein and Engerman (1979) state that "*the bulk of foodstuffs consumed by Africans in the crossing were purchased on the African coast, with rice and yams serving as the staples of the diet. The costs for these foods and for the water represented less than 5% of the total costs of outfitting the vessels and therefore offered little financial restrain on adding extra food."* (p. 270). Although Klein and Engerman focus on the maintenance costs during a slave's time on board of the ship, they seem to attach a much smaller weight to food provisions in total outfitting costs.[8] It should be noted though that Klein and Engerman's estimate is based on just a single observation, a voyage of a French slaving vessel, *La Reine de France*, which we have in our dataset along with 27 other French slave voyages. Our analysis suggests that the 25% estimate appears valid for the period up to the 1740s, but is far too high for the period 1750-1808, when the trade grew to its peak.

Rönnbäck (2015) has made the valid point that any measurement of effective slave trade related demand should be assessed against the *existing size* of domestic African food markets. Without bringing in any new data, but by adopting some baseline assumptions, he estimated that the demand effect at the Gold Coast may have ranged between 3-4% of total agricultural production and 27% of total urban demand (2015, 166). However, in a sensitivity analysis of the main parameters, he reaches intervals from a 9 to 80% contribution to urban demand in the final quarter of the 18th century (2015, 178). To us, this indicates the pressing need for more precise estimates based on *new empirical evidence*. Before we proceed to offer such evidence, we ought to make a final remark though: whatever demand impulse the slave trade may have given to *commercial* agriculture in the coastal areas of West Africa, must have come at the expense of production in the raided areas. As most of the captives had been engaged in agriculture prior to capture, the Atlantic slave trade caused a relocation of food production, promoting the development of food markets in the areas of embarkation, but curbing both production and consumer demand in raided coastal or inland areas.

3. Sources and method

We compiled a sample of 187 merchant accounts of slave voyages conducted by trade companies from four European nations between 1681 and 1807. For data on British slave voyages we explored the account books of the RAC which detail the cargoes bought in England and, in the 1720s, the provisions bought in Africa.[9] For the earlier period (1680 to 1699) we used correspondence from the British forts on the West Coast of Africa compiled by Robin Law (1997). We also use records of five ships owned by a private trader, Humphrey Morice, who was involved in the trade in the 1720s.[10] These ships bought most of their slaves along the Gold Coasts and in the Bight of Benin. For the post-1740 period we use two main sources. The papers of the Liverpool merchant William Davenport who sent around 20 vessels to Africa from the 1760s to the 1780s and specialised his commercial operations in the

[8] The term 'outfitting costs' refers to the total expenses incurred to prepare a slave ship for the journey, including the exchange commodities required to purchase slaves, the provisions of crew members, ship maintenance costs and also the food rations reserved for slaves during their time on board of the vessel.
[9] The principal source is the T70 series at The National Archives, London
[10] From the M7 series at the Bank of England, London

Biafra region,[11] and the Bristol Presentments, a weekly register of shipping from the port of Bristol which begin in 1789 and record the cargoes and arrival and departure dates of 40 slaving vessels.[12] The latter concentrate on ships going to Biafra and the Cameroons, but like the Davenport papers also include ships trading in other regions. The downside to these records is that they do not record what provisions were bought in Africa, an issue we take up further below.

For data on French voyages we rely on the private trading accounts of French slave merchants based in Nantes.[13] These sources offer quantities and values of food provisions taken on board at the start of the slave journey, but do not inform us about the provisions bought elsewhere in Europe or Africa. We also use Rinchon (1964) study of the voyages of one particular slaving captain, Van Alstein, who sailed on the Bight of Benin and the West-Central African coast (Congo and Angola). This source provides full details of both food purchases in Europe and Africa and also gives some African food prices. For the Danish trade we use the work by Svalesen (2000). It provides detailed information of only two voyages conducted by one ship, but it does contain detailed instructions from the Royal Chartered Danish Guinea Company on provisioning logistics and their orders on daily slave rations (2000, 112) that applied to all the ships the company sent out.

For the Dutch trade we rely mainly on the archives of the Middelburgse Commercie Companie (MCC).[14] These records detail exactly what provisions were bought in Europe, what was bought in Africa, and in many cases, where. These records provide prices of Dutch (Province of Zeeland) provisions and some scattered food price observations at the African coast. Most of the trade along the coast was conducted by barter, but the MCC converted all of the trade goods into either guilders or Flemish pounds allowing us to compare prices of individual items, which can be used for wider estimations of spending by other slave ships. Another advantage of this source is that the MCC traded regularly in all areas of Africa with the exception of the Bight of Biafra.[15] We use the appendix of Leo Balai's (2011) *Het Slavenschip Leusden* for the provisioning of three WIC ships in the 1720s, including detailed information on the instructions for ships' captains from the company.

Table 1 summarizes the 'national' coverage of our sample. We make a distinction between the era when chartered companies and private traders were both active (1681-1740) and the later era of private trade (1741-1807).[16] Our sample covers over 1% of all British, French and Dutch voyages and about 0.7% of Danish voyages in the private trade era. For 36

[11] The records are held at the Liverpool Record Office and Keele University and were accessed through www.britishonlinearchives.co.uk.

[12] From the archives of Bristol Central Library.

[13] From the Archives Départementales de Loire Atlantique.

[14] From the Zeeuws Archief Middelburg.

[15] When trade in the Biafra region reached its apogee the MCC was entering a period of crisis, suffering from rising insecurity in the Atlantic world and especially the 4th Anglo-Dutch war.

[16] Until the early 18th century, most of the slave trade was a jealously guarded government monopoly. In Great Britain, the Royal Africa Company (RAC) and in the Netherlands the West-Indische Compagnie (WIC) were the sole permitted traders. The French government experimented with a series of chartered companies. Slaves to the Spanish empire could only be handled through the *asiento* contract. These companies were unable to prevent interlopers and smugglers from carrying slaves, partly due to fact that they couldn't meet the demand of their markets, but also because they operated notoriously inefficient business models (Thomas 1999, Klein 2010, Den Heijer 1994). By the 1730s most nations, with the exception of Spain, had abandoned the concept of chartered companies and left the trade to the private sector.

of the 187 voyages we have information on the total intake of foodstuffs in both Europe and Africa (see table 2). In 129 cases the European provisions are fully specified, while the African provisions are not. In 12 cases we have full information on African provisions, but not on European provisions.

Table 1: Sample of slave ship voyages by nationality (flag), 1681-1807

	1681-1810	1681-1740			1741-1807		
	Share of total trade	Company era			Private trade era		
	%	No. of voyages	sample	%	No. of voyages	sample	%
Great Britain	47	3,840	34	0.88	7,384	84	1.14
France	14	873	1	0.12	2,557	27	1.13
Netherlands	5	544	2	0.75	705	37	5.53
Denmark	2	88	0	0	296	2	0.68
Spain/Uruguay	0	7	0	0	70	0	0
Portugal/Brazil	24	1,975	0	0	3,924	0	0
British America/US	8	185	0	0	1,781	0	0
Totals	**100**	**7,512**	**37**	**0.49**	**16,717**	**150**	**0.90**

Source: Transatlantic Slave Trade Database (TSTD); for our sample see text and Appendix Table 2a.

While our coverage of British, French and Dutch voyages is good, the absence of voyages conducted from Portugal, Spain, Brazil and British America/US is a major limitation. Portuguese and Brazilian ships sailed mainly on West Central Africa (WCA hereafter), a region that played a major role in the 18th century expansion of the trade, supplying roughly one-third of all slaves that crossed the Atlantic between 1681 and 1807. Although there is ample *qualitative* evidence that slave ships departing from Brazil were stocking up large quantities of manioc flour in home ports such as Rio de Janeiro, we failed to retrieve quantitative estimates of the proportions of home-sourced versus Africa-sourced provisions.[17] Our study excludes the southern part of present-day Angola, the focal area of the Portuguese and Brazilian ships, but it does include the Northern part of the West Central African coastline, where trade was dominated by European vessels.[18] We will consider the implications of this omission as we go along. A summary of our dataset is presented in Appendix Tables 2a and 2b.[19]

[17] See for slave provisions from Brazil, Miller (1997, 351-57); Curto (2004, 132-3) and Newson (2007, 85).

[18] da Silva and Sommerdyk (2010) have argued for separating the West Central African Coast into a Northern region, referred to as the Loango coast, including Cabinda, Congo North, Congo River, Kilongo, Loango, Malembo, Mayumba, Mpinda and Rio Zaire, and a southern region in modern-day Angola concentrated around the ports of Luanda and Benguela. The Southern area was entirely dominated by Portuguese and Brazilian traders, whereas the North was mainly visited by Northern European vessels. The trade in the North was organised by small merchant networks in contrast to the much more centralised, state-run trade in the South.

[19] Our complete dataset, including source references, will be presented in an online Appendix Table at the African Economic History Network website (www.aehnetwork.org).

Although a coverage of around 1% of the voyages made by British, French, Dutch and Danish slavers may seem small, it is the first dataset that can serve as a starting point for a more systematic empirical investigation of food provisioning strategies by European slavers. We approach the data in two steps. First, we use the sample of 36 'full data' voyages to distinguish European from African provisions and separate out provisions for crew members and fort personnel. Sailors and fort personnel were mainly fed on European provisions which were separately recorded from 'Negro Provisions' in the account books of the slave trading companies. Next, we express all foodstuffs in metric weights (kilos) and convert all food types (rice, barley, corn, yams, beans etc.) into their caloric value (Kcal) and protein content (grams), using FAO nutrition tables.[20] Appendix Table 3 lists the metric and nutritional conversion rates.

Table 2 presents preliminary results based on the sample of 36 voyages. It demonstrates that the share of European provisions is, in many cases, far too high to verify Eltis' hypothesis that these constituted a negligible share of total food provisions.[21] Only the British ships we observe operating during the company era sourced the lion-share of their provisions (96%) from West Africa. For other nations and periods the shares of provisions sourced from Africa and Europe are very different. Unfortunately, our 'full data' sample has a rather weak coverage, so we have to be careful in drawing further conclusions at this stage. Without any observations of British voyages in the 1741-1808 era, it remains unclear for instance whether the different shares carried by British and continental vessels are due to different national provisioning strategies, or because of more generic changes during the 18th century.

Table 2: Average share of provisions from Europe and Africa in 36 'full data' voyages

	1681-1740			1741-1807		
	Obs.	Company era		Obs.	Private trade era	
		% Europe	% Africa		% Europe	% Africa
Great Britain	18	4	96	0	..	..
France	1	91	9	4	68	32
Netherlands	0	..	..	11	53	47
Denmark	0	..	..	2	76	24
Totals	19			17		

Source: see Table 1 and Appendix Table 2b

Therefore, our second step is to use of the information on total caloric intake of these 36 'full data' ships, to derive a benchmark estimate of 'required' provisions per slave per day, which then allows us to deduct how much of these day-rations were covered by European or African provisions in the larger sample of 151 voyages in which we observe only one of the two areas of food provisioning. We assume a subsistence diet with 2,000 Kcal and 40 grams

[20] http://www.fao.org/docrep/w0073e/w0073e08.htm#P14552_1185427

[21] Note that Eltis suggests that non-African provisions are about 1 to 2% of slave purchasing costs. If total provisions constitute 25% of slave purchasing costs, the European share is 4 to 8% of total provisions.

of protein per slave per day. These values are in line with the 'bare-bones subsistence diet' adopted in the comparative living standards literature (Allen 2001, Allen et al. 2011, see for an application to Sub-Saharan Africa Frankema and van Waijenburg 2012) and reflect the slave feeding instructions that captains received quite well.[22] Even though 2,000 Kcal is a bare minimum compared to current WHO recommendations of around 2,500 Kcal for an adult male with a sedentary lifestyle, it suffices to keep people alive without losing muscle power.

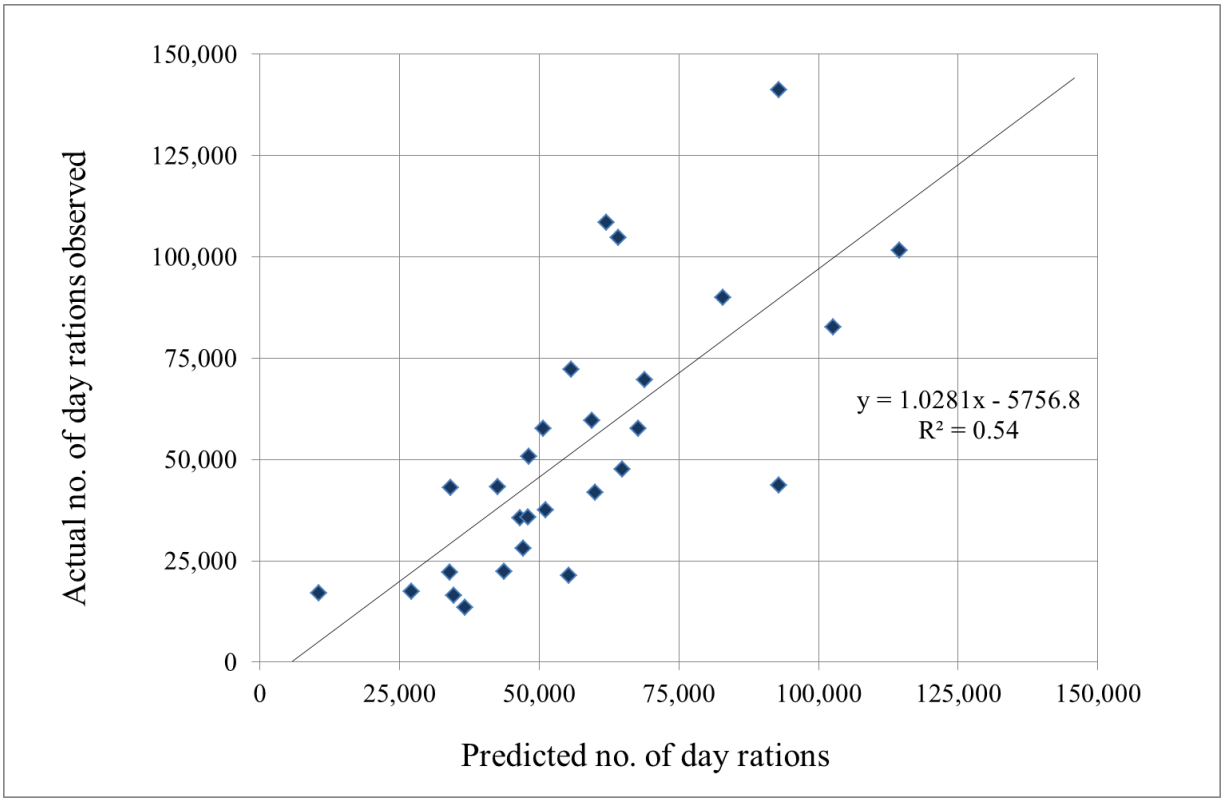
We obtain the total number of required day-rations by multiplying the number of slaves embarked from the trans-Atlantic slave trade database (TSTD hereafter) with the average number of days the median slave spent on board. We don't adjust our estimate of required day-rations for slave mortality during the voyage as captain's would probably have provisioned on the basis of a best-case scenario (i.e. negligible mortality). We also include a security margin as slave ship captains were well aware of the unpredictability of their voyages (insecure slave supplies, adverse weather conditions, diseases, food rot, privateers and so on).

We also account for region and era-specific voyage duration. Embarkation times depended on the concentration of slave supplies and the middle passage (MP) took longer from some regions than from others. Shorter *expected* voyage lengths would have translated into lower provision requirements. We assume that provisioning strategies were based on the average number of days of the MP plus one standard deviation as a security margin. We further assume a linear slave intake rate. That is, for a slave vessel taking in 300 slaves in 100 days, we add rations for three extra slaves per day. This is a conservative assumption, as slaves tended to be purchased in larger quantities towards the end of the TAC (Hogerzeil and Richardson 2007). We use 20-year interval means and standard deviations of the actual time spent at the coast (TAC) and on the MP for the seven major West African slave trading regions (Senegambia, Sierra Leone, Windward Coast, Gold Coast, Bight of Benin, Bight of Biafra and West-Central Africa). We checked the representativeness of our 'full data' sample on voyage duration and found that in 71% of our cases the observed ship remained within one standard deviation from the mean, with only one notable outlier. All the data on voyage length were taken from the TSTD and are presented in Appendix Table 4.

In Figure 1 we test the accuracy of our estimation method for the 'full data' sample. Figure 1 shows a scatter plot with the predicted number of day-rations on the x-axis and the observed number of day-rations on the y-axis. The figure confirms our expectation that ships carrying more slaves for longer periods of time carried more supplies. Moreover, our procedure does not seem to systematically under- or overestimate the required number of day-rations. The slope of our regression line ($y = 1.03x$) is close to unity and the correlation is strong ($R^2 = 0.54$). A similar test for protein requirement indicates that the far majority of ships took much more than the 40 grams per day per person that we envisioned, especially in the form of beans and peas, but this is less relevant as calories posed the main constraint to storage space.

[22] Studies on British navy sailors show they consumed around 4,500 Kcal per day, which seems a large difference, but we need to take into account that slaves were confined for most of the day (Macdonald 2006, 177).

Figure 1: Scatter plot of required day-rations predicted by our baseline model (horizontal-axis) *versus* actual observed no. of day-rations (vertical-axis)



Source: See Appendix Table 2.

Note: This sample includes English RAC, Dutch MCC, Danish and French ships as indicated in Appendix Table 2. We removed two outliers as they carried exceptional quantities of food from Europe - sufficient to make a double journey and much more than recorded for any other ship. These traders probably sold part of their stocks to West African trading forts or other slave ships before heading across the Atlantic. This supports one of our central claims, namely that European provisions played a much larger role in the logistics of the transatlantic slave trade than hitherto has been assumed.

Even though the error margins to both sides of the regression line appear to be evenly distributed, there are quite a few ships carrying much more, or far less provisions than our baseline model predicts. The likely explanation supported by our archival sources, is that 'overloaded' vessels took additional food supplies to African forts to alleviate local food scarcities.[23] Ships carrying far less than our model predicts may have taken the risk to sail off without any safety margins.[24] Serious delays at the coast or instances of food scarcity often

[23] British forts at the coast, while buying provisions locally, also relied heavily on imported foodstuffs from Europe. For example, the Company of the Royal Adventurers to England Trading with Africa, who took of the management of the forts after the dissolution of the RAC, relied on regular deliveries of bread, flour and meat delivered on ships from England: TNA T70/928 – 932. We assume that the Dutch forts also bought food from visiting vessels and speculate that this accounts for ships such as the Middelburgs Welvaren (1755) and Vliegende Faam (1757) buying respectively 372% and 263% of required total provisions (see Appendix 2).

[24] In our full data sample of ships, 4 vessels (three RAC ships and 1 private vessel from France) sailed with under 50% of the required Kcals to give their captives a sufficient daily quantity of calories. Sailing with insufficient provisions in order to free space for more captives was apparently a common strategy on Portuguese / Brazilian vessels (Miller 1997, pp351 – 355). The impact on captives was described by a British sailor in Suriname in the 1770s who described a newly arrived group of slaves as "….*such a set of scarcely animated*

forced captains to sail off and take the risk (Behrendt 2001, 190-1). The bottom-line, however, is that our estimation model appears good enough to be applied to our larger sample of voyages with incomplete information.

4. Main results

Figure 2 shows, for four consecutive periods, the percentage share of required Kcal supplied by European provisions loaded onto British, French, Dutch and Danish slave trade vessels. The figure clearly shows that the French, Dutch and Danish ships took in the major part of the required Kcal in Europe. For British slavers the picture is strikingly different. They tended to rely much more on African-sourced provisions, although they too, increased their intake of European provisions in the course of the 18th century. The shares of European provisions are too big to neglect in estimating the magnitude of West African food exports.

There was considerable variation in the quantities of European provisions taken on board. The British RAC ships in our 'full data' sample took on average only 4% of their required Kcal from England, but one ship, the Portugal, took 36% with them in 1729. While the French and Dutch almost always brought at least around 50% of their Kcal from Europe, and often far more, there were also quite a few outliers. For example, the Dutch ship "Middleburgs Welvaren" bought a huge quantity of provisions in West Africa totalling 326% of their caloric requirements, while still bringing substantial quantities of beans and barley from the Netherlands. Apparently, slave traders sometimes shipped food to or within Africa, which wasn't needed for the slaves on board. Nonetheless, despite the outliers, the overall trend is clear: over the 18th century the trade relied to a greater degree on European sourced provisions.

Why has the contribution of European provisions to the logistics of the transatlantic slave trade been overlooked for so long and by so many experts? The most likely explanation is that the literature has, repetitively, focussed on British slave ship records of the RAC, which are more complete and accessible than most other slave-trade related sources. As noted above, the RAC took almost all of its provisions from Africa. Indeed, one may easily conclude from written instructions on slave provisioning by the South Sea Company, the successor to the RAC, that food provisions were largely an African affair,

"*The following account of a proportion of provisions for 100 Negroes to be taken in at Guinea: 80 chests corn at 5 ackeys per chest is 400 ackys. 4 bushells of salt at 1 acky per bushel is 4 ackeys. 20 gallons Palm Oil at 8 tack's per gallon is 13 ackeys 4 tacks. 50 ch Malagetta at ackeys per is 4 ackeys. The above is according to the present usage of the Royal Africa company*." [25]

However, whereas in the 1680s and 1690s European provisions constituted a negligible 1 or 2% in RAC voyages, this share on ships of private British companies rose to an average of

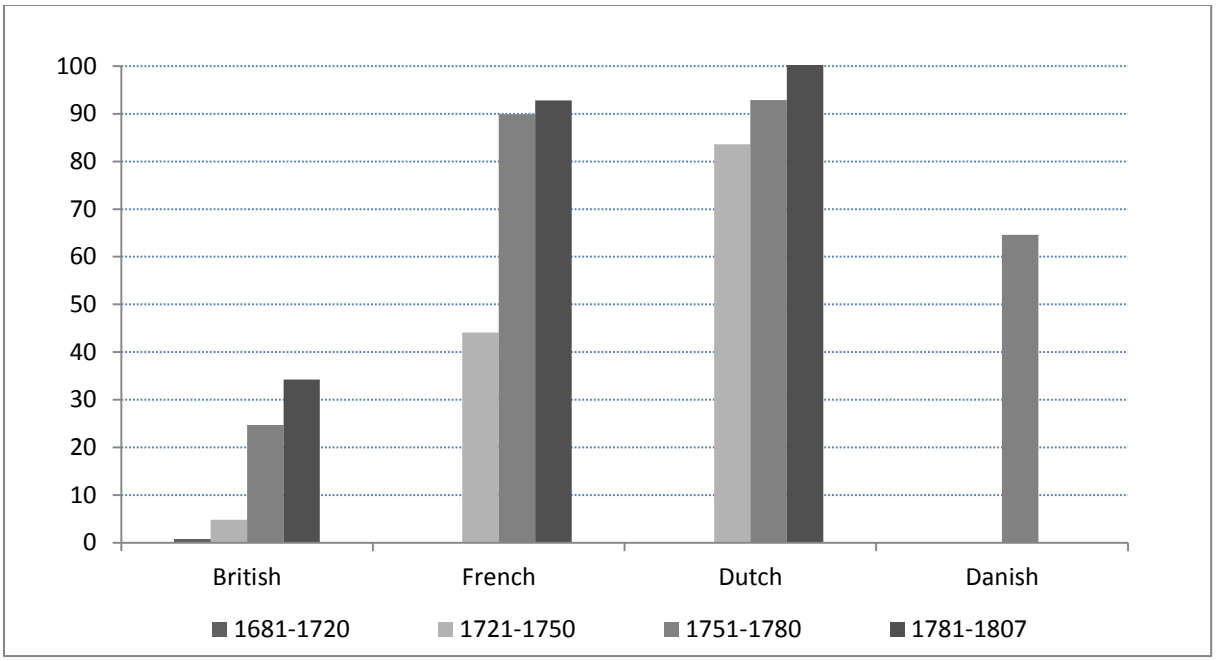
automatons, such a resurrection of skin and bones, as forcibly reminded me of the last trumpet." (Stedman 1996, p209).

[25] The South Sea Company: minutes of the Court of Directors 1713 (Donnan 1965, 157)

34% during the apogee of the trade. The literature has also largely ignored the records of the Dutch and the French traders, whose provisioning strategies were fundamentally different.

Behrendt (2001, 181-4) and Eltis (2013, 44-5) have noted that there were considerable regional differences in the type and quantity of provisions sold along different parts of the West African coast. Our data corroborates this point. Table 3 shows the average amounts of calories piled up at European ports for ships heading off to the Gold Coast, the Bight of Benin, the Bight of Biafra, and the WCA (North). The table shows that ships sailing to WCA took, on average, more than double the amount of calories from Europe. This difference cannot be explained by greater voyage length, since the average time the median slave spent on board was not that much longer than for the other regions of embarkation (see Appendix Table 4).

Figure 2: Percentage share of total required Kcal supplied by European provisions, voyages by nationality, 1681-1807



Source: See text and Appendix Table 1, available at www.aehnetwork.org

A large part of the gap is explained by the fact that British slavers were much less active at the WCA coast[26] (TSTD). It would be misleading, however, to conclude from table 3 that British slave ships would procure most of their provisions at the WCA coast (c. 87%). Slave ships did not necessarily buy their provisions at the same place they bought their slaves. The few British ships who traded at WCA probably first visited the British forts at the Gold Coast to stock up before continuing their journey further South, in a similar way as they would do when visiting the Bight of Benin.[27]

[26] During the long 18th century, British slavers took only 13% of their slaves from WCA compared to 42% for the Dutch and 46% for the French (TSTD).

[27] RAC correspondence compiled by Law (1997) shows repeated references to ships needing to 'corn' along the Gold Coast before proceeding to Benin (ref. 625, 904, 1349). The Danish ship Fredericus Quartas was required

Table 3: Average European Kcal taken to regions of embarkation (first column) and percentage shares of European Kcal of total requirements by nationality, 1681-1807

	million Kcal	British	French	Dutch	Danish
Gold Coast	30.27	14%		99%	65%
Bight of Benin	40.46	9%	64%	89%	
Bight of Biafra	48.58	29%	73%	133%	
West Central Africa (North)	111.02	13%	98%	111%	

Source: See text and Appendix Table 2

Slave captains recognised that they could not rely on local markets for provisions when trading along the Loango coast. Behrendt (2001, 184) suggests this may have been due to a more unforgiving climate which led to more frequent famines. Sommerdyk (2012, 121 and 137) agrees, but also points out that the trade in slaves involved smaller numbers and slower intake rates, with lower levels of market organization (e.g. merchant networks, credit facilities, etc.) than was common in the Gold Coast and the Bight of Biafra. As a result, the region's slave traders may have simply not been able to manage the logistics of supplying sufficient quantities of food. That French and Dutch ships took along almost all of the required provisions from Europe suggests that they were more likely to sail straight on to the WCA coast than the British. Our sub-sample of French slave ships shows that the three ships bound for WCA in the 1760s to 1780s sourced, on average, 99% of the required calories from France, while the three ships sailing to Benin in the same period took 49% from Europe.[28]

Table 3 also shows that Dutch slave ships piled up massive amounts of food when heading for the Bight of Biafra, but this must have been for a very different reason than scarcity of local food supplies, since food markets at Bonny and Old Calabar did serve the much larger British fleet. The most likely explanation, which we will further elaborate in section 7, is that Dutch ships hardly ever visited the Biafra coast, and therefore lacked the connections with local merchants that the British had established during the second half of the 18th century. Stocking up in Europe may thus be seen as a precautionary measure against insecure market access in West Africa.

to stock up on corn at Annamabo before sailing to the Bight of Benin in 1700 according to letter from the Governor Thrane of Christiansborg fort to the Directors of the West India and Guinea Company in 1700 (Justesen and Manley 2005, 95). Later in the 18th century, the MCC records show that no African provisions were ever bought by MCC ships from the Bight of Benin. Instead, food purchases were made along the Windward or Gold Coasts. In 1789 a British slave ship surgeon who was familiar with West Central Africa stated that the "*….country finds no slaves provisions - we are therefore obliged to carry provisions partly from Europe and (when to be got) partly from the Windward Coast of Africa.*" John Knox (1789) *"Minutes of Evidence taken before a committee of the whole house To whom it was referred to consider the circumstances of the slave trade"* p. 93.

[28] There is also evidence that Brazilian slavers were willing to take the risk to depart with insufficient provisions, rather than paying the inflated prices charged during regular periods of drought (Miller 1979, 102). Carney and Rosomoff (2011, 68) quote a Portuguese governor of Angola who ordered that all ships coming from Brazil should carry sufficient manioc flour to feed their slaves during the return voyage.

Whereas the Gold Coast was known as one of the slave trading regions where commercial agriculture developed in support of the trade (Shumway 2013, Savage 2014), the Bight of Benin provided no significant foodstuffs to slave ships beyond fresh provisions while ships were loading (see also Law 2004, 192). To overcome this problem, RAC ships were instructed to take on rice along the Windward coast or 'corn' at the Gold Coast, before heading to ports such as Whydah or Jakin on the 'slave coast' of Benin. This pattern continued into the private trade era, when similar provisioning strategies were adopted by the Dutch slavers of the MCC. Why farmers in Benin did not respond to growing opportunities for food sales remains puzzling. The area is attested in sources as being extremely fertile and supported complex, centralised states such as Dahomey and Oyo.[29] If environmental constraints cannot explain the lack of food available for export, the explanation may be political: did the war-economies of Dahomey and Oyo perhaps command that food surpluses be preserved for domestic security or military purposes?

5. Changing relative prices and trade risks

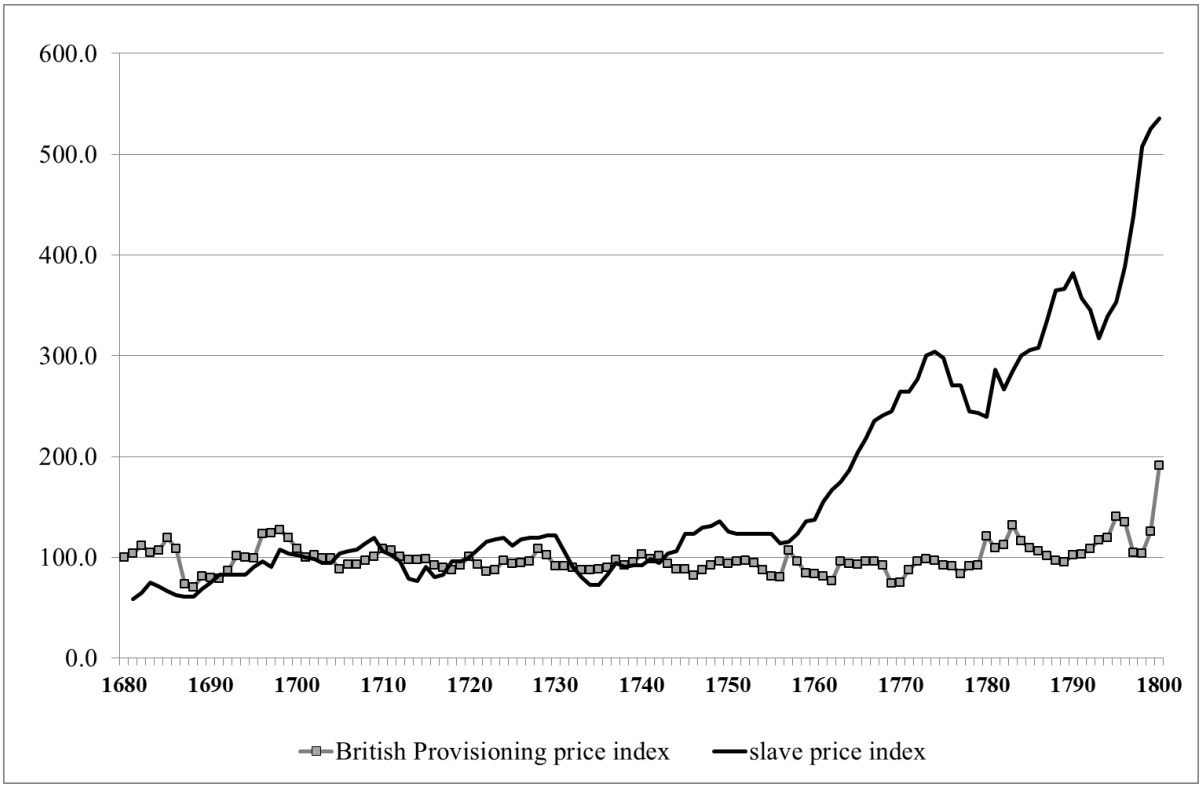
Why did European slavers purchase more provisions in Europe as time wore on? One of the explanations is that the costs of food from Europe as a share of total outfitting costs - see for our definition of the term footnote 8- were declining sharply over the course of the 18th century, mainly because slave prices rose so fast. Let's assume for the moment - we get back to this in section 7 - that European-sourced provisions were *no cheaper* than African-sourced provisions, so that the price of a day-ration consisting of 350 grams of barley, 100 grams of horse-beans, 100 grams of rice and 0,01 litre of palm oil gives us an upper benchmark estimate of slave provisioning costs.

This ration offers just over 2,000 Kcal and about 80 grams of protein. Consistent with Eltis' assumption that slaves spent on average 4.5 months waiting at or near the coast and 3 months on board of the slave ship we take 225 day-rations per slave.[30] We take annual British price-series of barley, beans and rice from Clark (2004) with a 30% mark-up. Lacking price-series for palm-oil we add a fixed average price per gallon based on scattered African price observations. To check the trend in British provisioning prices over the 18th century, we also construct a time series for barley, beans and rice on Dutch markets collected by Posthumus (1946). The Dutch price series have large gaps, but the index-trend shows that Dutch staple food prices kept pace with British food prices (see Appendix Table 5). The slave prices are taken from the same source as Eltis (2013), which consists of a series for 1681-1700 from Eltis (2000) linked to a series for 1701-1800 from Richardson (1991), all in current prices.

[29] See for example Atkins (1737, 112) or Phillips (1693, 215).

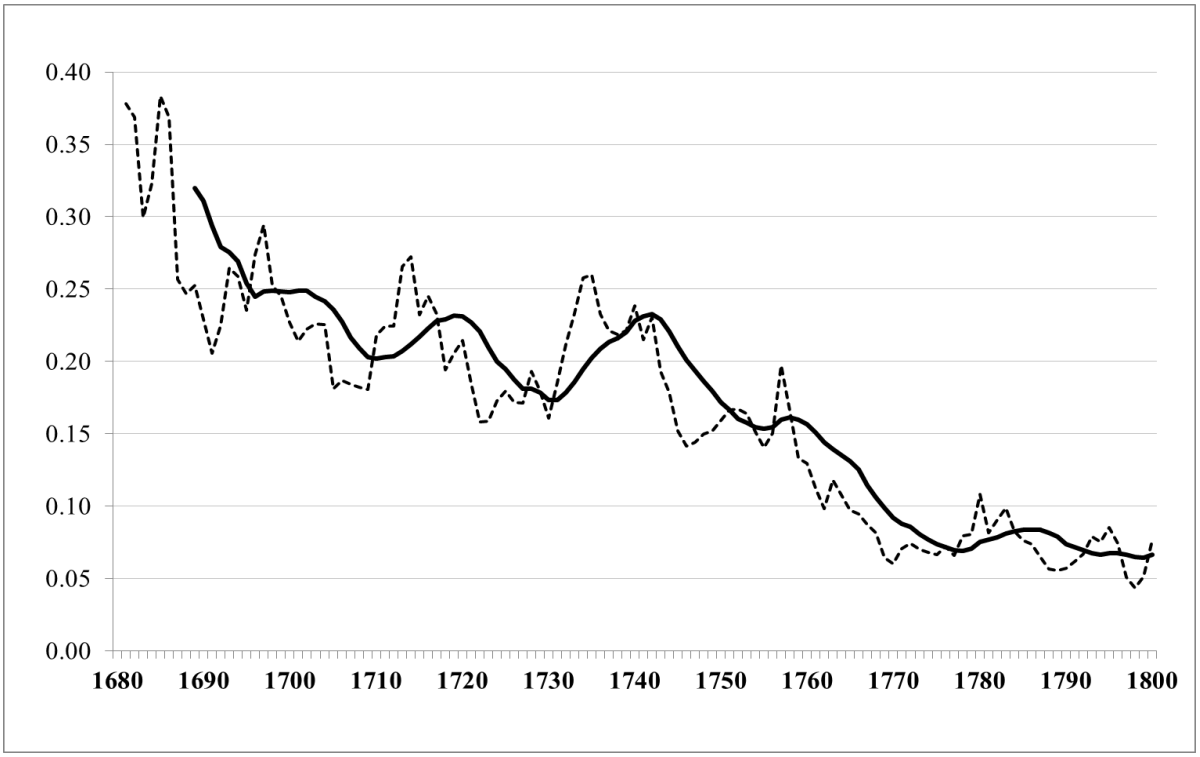
[30] In conceptual terms it seems odd to consider food provisions for slaves waiting at the coast as part of West African food exports, since pre-embarkation maintenance costs will have been factored into the purchasing price of slaves. For reasons of comparability, however, we will maintain the assumption of 225 day-rations required.

Figure 3a: Index-series of slave purchasing prices (African coast) and slave provisioning prices (British staples), 1680-1800 (1701 = 100)



Source: Food price index based on Clark (2004); Slave price index based on Eltis (2000) and Richardson (1991).

Figure 3b: Slave provisioning price (225 day-rations) as percentage share of average slave purchasing price, 1680-1800 (10-year moving average in bold)



Source: see figure 3a.

Figure 3a shows the index-series of slave purchasing prices and slave provisioning prices (1701 = 100) and Figure 3b shows the slave provisioning prices (i.e. 225 day rations) as percentage share of slave purchasing prices. Together, these graphs help us understand why European slave traders may have increased their reliance on European provisions. In the mid-1750s slave purchasing prices started to rise from an index level of 114 in 1756, to a mere 535 in 1800. Slave prices experienced a temporary drop in the 1770s and 1790s, but never fell back to pre-1750 levels. Provisioning prices remained much more stable. Although there was a sizeable surge from 1770 to 1800, most of this was a price shock associated with the Napoleonic wars in the 1790s, when the index shut up from 103 in 1798 to 191 in 1800.

The implication of these diverging price developments is that the relative costs of food provisions fell over the course of the 18th century, from about 20%-25% of total outfitting costs in the early decades to about 5-10% in the closing decades of the 18th century. Hence, if relative food prices had played a role in merchant's deciding where to buy provisions (Europe or West Africa), the impact of this choice on the overall profit margin of slave trading companies decreased enormously. Since we have no accurate information on the long-term price trends of African food staples, it is impossible to assess the long-term trend in European and African food price gaps – this is an important topic for future research -, but scattered price observations of African rice, corn and yams presented in section 7 suggest that these gaps were not that large.

Given the declining relative cost of provisions, stocking up on food before departure became increasingly attractive as a means to reduce voyage time and related business risk. The trans-Atlantic slave trade, while potentially lucrative, was a highly insecure enterprise (Behrendt 2001, Morgan 2007, Haggerty 2009, McDade 2011) and the most successful merchants were those who best managed its risks. Moreover, as the 18th century progressed the risks increased due to rising competition among slavers, difficulties in finding the right cargoes to suit rapidly changing African consumer tastes and the need to protect increasingly valuable cargoes of slaves against disease, slave revolts and piracy (Haggerty 2009, 819-822). Radburn's (2015) study of the role of credit in slave ventures shows that the financial instruments used were more fragile than has previously been thought. The credit crises in the 1770s and 1790s brought on by intensified Atlantic warfare put huge strains on investors (665, 685-86). These conflicts also made the voyage more dangerous, with the British seeing a 47% increase in the number of ships captured or destroyed in the period from 1760 to 1808 as compared to the previous 40 years.[31] In section 7 we will further elaborate this argument.

6. Revised estimates of West African food exports, 1681-1807

It is first time to revise Eltis' estimates. We take the total number of slaves embarked in the period 1681-1807 according to nationality of the slaver (flag) and insert our estimates of the share of European provisions in total provisioning requirements. For British slavers we assume 5% for 1680-1740 and a linear increase to 40% during 1740-1807. For Dutch slavers we assume 80% for the WIC era up to 1740 and 90% for the MCC traders after 1740. For

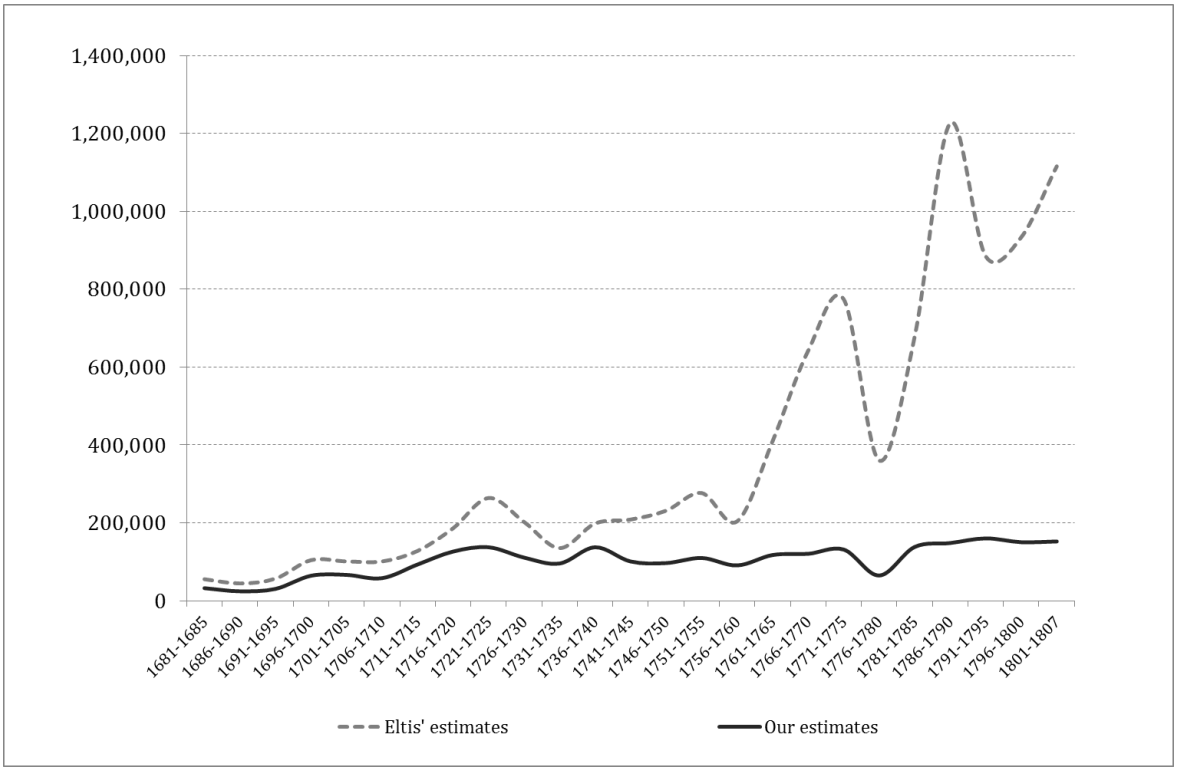
[31] Data from TSTD.

French vessels we assume 50% up to 1740 and 75% thereafter, and for Danish ships we assume 50% before 1740 and 66% thereafter. Lacking any estimates for the Luso-Brazilian trade we assume that ships departing from the New World source only 20% of food for the MP from their home ports, putting our revised estimates at the very safe side.

Then we refine Eltis' assumption of provisioning costs being a fixed 25% share of slave purchasing prices, using the shares reported in Figure 3b. In so far African provisions continued to offer a cheaper alternative, these shares represent an upper-estimate of the relative provisioning prices. We maintain Eltis' assumptions for converting the value of exchange commodities f.o.b. to c.i.f. (multiplying f.o.b. series by 2) and also maintain the mark-up of 3% for the consumption of African provisions by slave ship crews.

Figure 4 compares our five year-interval estimates of the overall slave-trade induced demand impulse on West African commercial agriculture to the estimates offered by Eltis. The difference is vast. We estimate the slave trade induced demand had a monetary value of around £60,000 in the first decades of the 18th century, to increase to c. £110,000 per year in the middle decades and c. £150,000 during the heydays of the trade in the 1780s to 1800s. For the latter period, our estimates are about 70 to 80% lower than Eltis' estimates. This difference has two causes. First, the non-African share in slave provisions were too significant to assume away. Second, Eltis' estimates were hugely inflated by assuming a fixed 25% of rapidly rising slave purchasing prices after the mid-1750s. Yet, in the more likely scenario that provisioning prices remained stable, or rose much less, food provisions must have constituted a rapidly shrinking proportion of the total outfitting costs.

Figure 4: Our estimates of the average annual value of African-sourced provisions compared to Eltis estimates, 1681-1807, in constant British £ of 1700



Sources: Eltis 2013; for our own estimates see text and Appendix table 6.

All this does not mean that in some areas the slave trade induced demand for food provisions may have been big enough to stimulate agricultural commercialization. In the Bight of Biafra the exchange of provisions produced by Igbo farmers in the interior for coastal produce such as salt had been observed since the 16th century.[32] By the end of the 18th century, when British traders had shifted their focus to this region, these farmers provided huge quantities of food to slave trading vessels and therefore it would be here that we would expect that the transatlantic slave trade might have had an impact on commercial agriculture.[33] Out of a total regional population of around 1 to 1,5 million,[34] about 14,000 slaves were exported each year in the peak period of 1781-1800 (TSTD). Assuming that this trade required 225 day-rations per slave and that 80% of this was sourced from domestic crops, this would have commanded around 7,000 year-rations of food. In view of the size of the total population, this only required a supply rise of 0.5% to 0.7%. Yet, if just 10% of all staples were produced for the market, slave trade induced demand may have contributed some 5 to 7% to market exchange of foodstuffs, which seems neither very impressive, nor entirely negligible.

7. Why did British provisioning strategies differ?

The question that remains is why British slave traders adopted different provisioning strategies than continental slave traders? In this final section we review four possible explanations which are all in some way connected to the management of business risk: 1) differential access to West African food markets; 2) different price bids of African and European staple foods; 3) different sensitivity to slaves' dietary preferences; and 4) differential techniques to preserve food for ocean-bound journeys.

Let's start with the last two factors. It is generally acknowledged that techniques to prepare and conserve food improved during the 18th century, and fitted into a pattern of ongoing 'professionalization' of the slave trade (Leuftink 1991, Behrendt 2001), resulting amongst others in declining mortality rates on board of slave ships (Klein et al. 2001, 100). It is highly implausible, however, that the Dutch and French traders had a structural knowledge advantage of food conservation techniques over the British that could explain their greater reliance on European provisions.

The argument on dietary preferences of African slaves has a similar problem. Many sources indicate that European slavers were well aware of the advantages of feeding their captives with African staple foods. Instructions to, and observations by, ship's captains of all nations advised to prepare food with some local ingredients, even if it was just a condiment

[32] This was noted by the explorer Duarte Pacheco Pereira at the beginning of the 16th century (Fage 1980, 71) and the Dutch physician and explorer Olfert Dapper in the later 17th century (Dapper 1676, 136-7).

[33] Behrendt (2001, 182) and Behrendt et al. (2010, 90) suggest ships were taking between 10,000 and 50,000 yams per voyage. Taking these figures as high and low estimates and multiplying them with the number of British ships visiting the region, the Bight of Biafra may have exported around 1 to 2.5 million yams a year.

[34] Ballpark figures for the early 19th century derived from backward extrapolations of the 1952 census, see Inikori and Daget (1988); Nwokeji (2000).

such as palm-oil or melegueta pepper.[35] Traders believed that it reduced sickness and mortality and that it helped to get Africans slowly used to European food. It cannot entirely be ruled out that British slavers were, on the whole, more sensitive to the dietary preferences of slaves than Dutch or French slavers, but the many documented cases of British slavers using force to feed slaves who refused their food makes this an unlikely interpretation (Rediker 2007, 263-4 and 284-8).[36]

It is far more likely that the Dutch and French had other reasons to rely on European provisions. Were food price differentials sufficiently large to influence provisioning choices? And if so, were these consistent with the different strategies pursued? Figures 5a and 5b present the food price observations we were able to collect from the RAC accounts for the years 1680-1730[37], complemented by yam prices in Biafra in the 1780s derived from Behrendt et al. (2010), and rice and yam prices from the MCC records.[38] Figure 5a compares West African rice prices with British domestic prices of rice and wheatflour. Figure 5b compares British barley and bean prices with West African corn and yam prices.[39] All prices have been standardized in pence per 2,000 Kcal using the metrics listed in Appendix Table 3.

Figure 5a indicates that West African rice prices were considerably lower than European rice prices. Part of this difference may be explained by differences in quality, but with a price gap of 300% the Windward coast obviously offered more value for money. That said, large price differences between Sherbo and Cape Coast Castle show that it also mattered where or when slavers bought foodstuffs in West Africa. It is possible that the price of rice sold to slavers at Cape Castle followed British market prices, and perhaps the rice was even first imported from Europe in order to supply British forts and then partly resold to British slave ships.

[35] In their instructions to captains, the directors of the West India Company recommended that all beans be flavoured with "….een weinig sap" and "…wat oly de palm" (quoted in Balai 2011, 250). Likewise the Royal Africa company stated that its ships were to purchase a proportion of corn, palm oil and melegueta pepper (Donan II, 164). Later ships of the Middelburgse Commercie Companie regularly stocked up on palm oil and pepper, regardless of other provisions they bought. A recipe for soup served aboard French slaving vessels included locally bought corn, pepper and palm oil as well as beans or rice (Mandelblatt 2008, 412).

[36] There is also evidence that African slave raiders used food as a strategy to dislocate their captives from their home environment, by feeding them staples they were not used to. Smallwood (2008) and Byrd (2010) argue that as soon as people were kidnapped, captured or sold a process began to separate them from the social context which had previously defined them as members of a community and reduced them to commodities (Byrd 2010, 29). Smallwood (2008, 43-44) argues that the food given to slaves was an important part of this process.

[37] For the forts the data comes from Sherbo (Sierra Leone) and Cape Coast Castle (Gold Coast) for 1686, 1687 and 1688. These primarily show purchases of African products in local currencies which are converted into pound sterling. For ships we have taken information from ship accounts in the invoice books of the RAC which show both quantities and prices of European foodstuffs.

[38] Information to derive prices for yams can be found in Behrendt et al. 2010, pp. 90-91, 102, 108, 135, 140 and 170; Behrendt 2001, 182; Thomas 1999, 418.

[39] The British annual price series are farm-gate prices from Clark (2004) to which we added a 30% mark-up to adjust for transportation and transaction costs incurred in getting foods from the countryside to the belly of slave vessels in the harbours of Bristol and Liverpool. This 30% mark-up closes the gap between the farm-gate prices and the unit prices reported in the slave ship trading accounts we have studied.

Figure 5a: British prices of rice and wheatflour *versus* West African rice prices, pence per 2,000 kcal

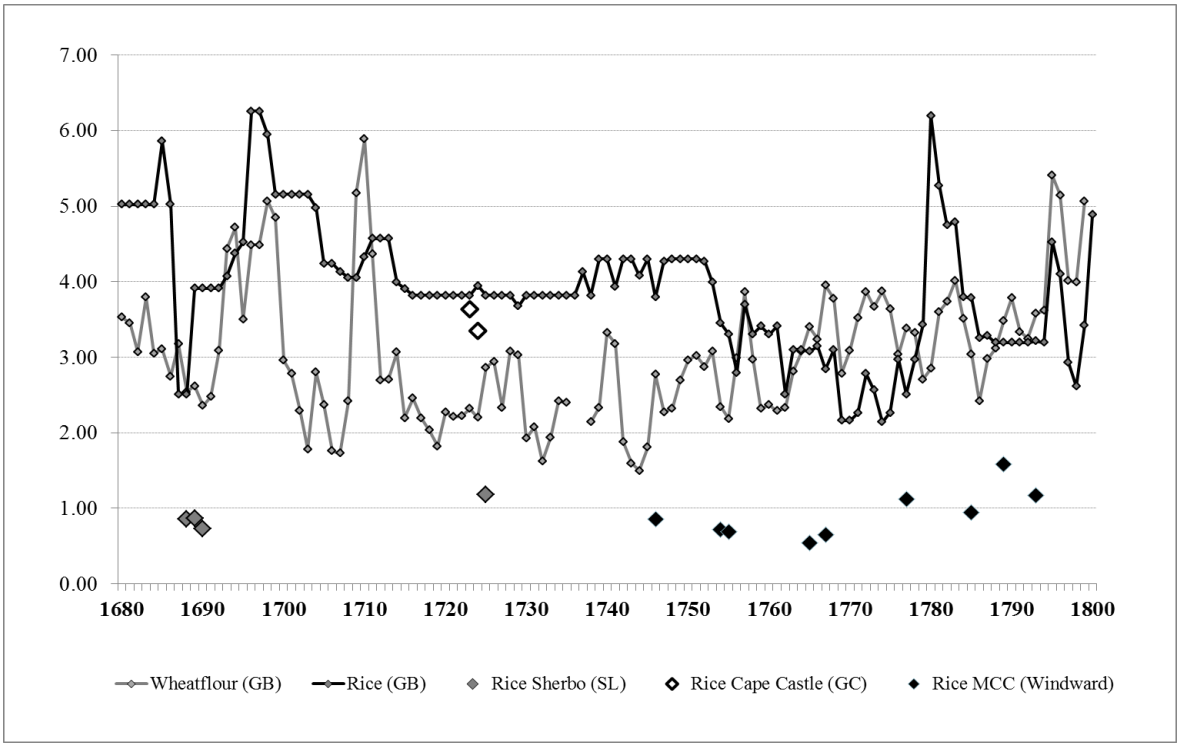
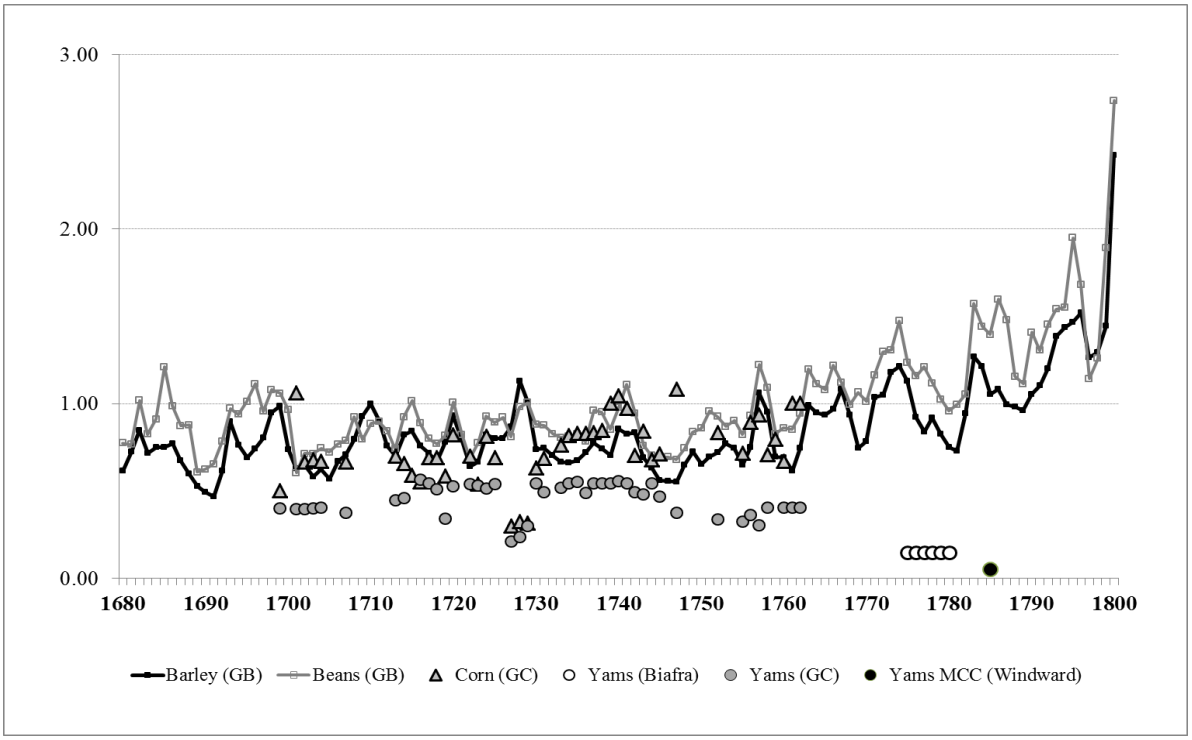


Figure 5b: British prices of barley and beans *versus* West African prices of corn and yams, pence per 2,000 kcal



Sources: GB Data: Clark (2004), MCC Data: Zeuus Archiefen, MCC Inventaris, Reizen 1730 – 1790, Yams Biafra: Behrendt et al. 2010, Yams, Palm Oil, Corn (Gold Coast): Ronnback 2014, Rice Sherbo (SL): TNA T70/880, Rice Cape Castle (GC): TNA T70/763; Notes: GB is Great Britain, GC is Gold Coast, SL is Sierra Leone, MCC is Middelburgse Commercie Compagnie.

Figure 5b indicates though that a West African rice diet was not necessarily cheaper than a diet of European barley and beans. The costs of corn from the Gold Coast were also in the same range. In fact, there seems to have been only one major bargain available in West Africa, namely yams from Biafra, which were much cheaper than any other staple sourced from either Britain or West Africa. Yams were harvested only once a year, which increased pressures on captains to time their voyages accurately, but once obtained, yams can be stored for long periods of time (Behrendt 2001, 183). Moreover, the densely populated regions around the major slaving ports of Bonny and Old Calabar with their highly efficient trading networks based on coastal and inland Aro merchants, were able to significantly increase production (Behrendt et al. 2010, 102, Northrup 1978, 174). Large supplies of yams at low prices may thus have reduced the time spent on the coast, lowering the risk of slave rebellions, diseases or naval attacks and, more generally, raising cost efficiency.

Lovejoy and Richardson (2004) have argued that faster loading times and superior credit arrangements, were the main reasons why British slave traders began to favour what was originally considered a 'horrid hole' with less desirable slaves and higher rates of mortality for both captives and crew (378–80).[40] Ready and cheap access to yams in Biafra may have been another factor supporting this shift. Yet, Biafra only became of central importance to the British trade after the 1750s which Nwokeji (2010, pp 49 – 53) has argued had much to do with the opening up of new markets for slaves in the densely populated central region. Cheap yams may thus explain why British slave ships kept relying on African provisions to a larger extent than the French or the Dutch - who traded much less in this area - but they cannot explain the already existing differences in provisioning strategies.

Behrendt (2001) has argued that "During peak periods of the slave trade, English food supplies could not meet the requirements of all Guineamen. Merchants thus relied on African provisions, particularly during late summer and fall…." (p. 181). There is no doubt that the slave trade at its peak required huge amounts of food. If one were to count the crew and slaves aboard ships out of Liverpool as additional mouths to be fed, then they would have added some 5% to 7% to the total population of Lancashire in an era when the city was itself growing rapidly.[41] Yet, even if British slavers departing from Liverpool and Bristol had difficulties in sourcing food from their immediate hinterlands, it would still have been an option to call in at London, the largest commercial and naval hub of Western Europe, or other European ports for that matter, as was common practice in the purchase of exchange commodities, such as textiles, guns, alcohol, tobacco, iron and copper rods.[42] French slavers

[40] Slaves from Biafra were lower valued by buyers in the New World as they were regarded as more disease prone. This is also borne out by analyses of mortality rates during the middle passage with slaves from the Biafra region dying at nearly twice the rate as those from other areas (Klein 2010, Thomas 1999).

[41] Population estimates from Wrigley (2007).

[42] Records from the accounts of forts along the coast of Africa show that they were importing trade goods from around the world, including Swedish iron, Indian textiles, Danish guns, Brazilian tobacco and Caribbean rum. TNA T70/928 – 930.

leaving from the port of Nantes sometimes first sailed northwards to the Dutch port of Rotterdam to take in provisions.[43]

The most likely explanation for the differences in provisioning strategy, therefore, cannot be found in the availability of foodstuffs in Europe, but rather in the differential access to West African food markets. British ships could pile up food at various fortified coastal stations in Sierra Leone and the Gold Coast, before taking a leap to the Bight of Benin, where food access was problematic. The Dutch had fewer forts along this part of the coast and with the critical exception of Elmina, these were also playing a less significant role in the slave trade itself. With less dependable supplies along the coast it made sense to stock up in Europe, even if this may not have given the best value for money. MCC ship logs reveal that there were very few places along the coast where they could obtain reliable supplies.[44] This is not to say that French, Danish or Dutch ships didn't buy any West African commodities at all, but they did buy much less of the main staples.

French ships had even fewer permanent establishments along the coast to stop over. Writing in the 1764, the Nantais merchant Joseph Mosneron, stated that the captain of his ship decided to set sail for the Carribbean, despite not having his full complement of slaves because: "*Les provisions de France étaient en grande partie consummées…."* (Pétré-Grenouilleau 1995, p. 75). Other captains, like Van Alstein, had to sail to the islands of Fernando Po and São Tomé: "*II n'en est pas de meme de la Cote d'Or ou de Juda; quand on manque de vivres, on peut aller relacher a l'Isle des Princes ou a celles de Saint-Thome et d'Annobon qui n 'en sont pas eloignees."* (Rinchon 1964, p264). Since the majority of French merchants were, unlike the British and Dutch, not specialised in the slave trade but undertook it as a side activity to bilateral commodity trade with the Caribbean (Michon 2007), they had lower incentives to invest in reliable African coastal stations anyway[45].

The idea that Dutch and French slave traders may have had more diversified portfolio's is important in another respect as well. Recent research by Gerhard de Kok reveals that landowning elites in the Dutch province of Zealand invested heavily in the MCC trade.[46] They outfitted ships with supplies from local farms, some of which they owned themselves. Differences in European investor-supplier networks may thus offer an additional explanation as to why Dutch slavers piled up the bulk of their provisions in home ports such as Middelburg. Future research will have to make clear whether such links were weaker in Bristol and Liverpool and whether path-dependencies in the commercial organization of the slave trade can account for different logistic approaches.

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[43] Based on personal correspondence with Gerhard de Kok. We thank him for sharing this insight with us. Mandelblatt (2008) notes that while the majority of provisions on French ships were bought in France, they also purchased rice in London and Salt Beef from Ireland (p. 417).

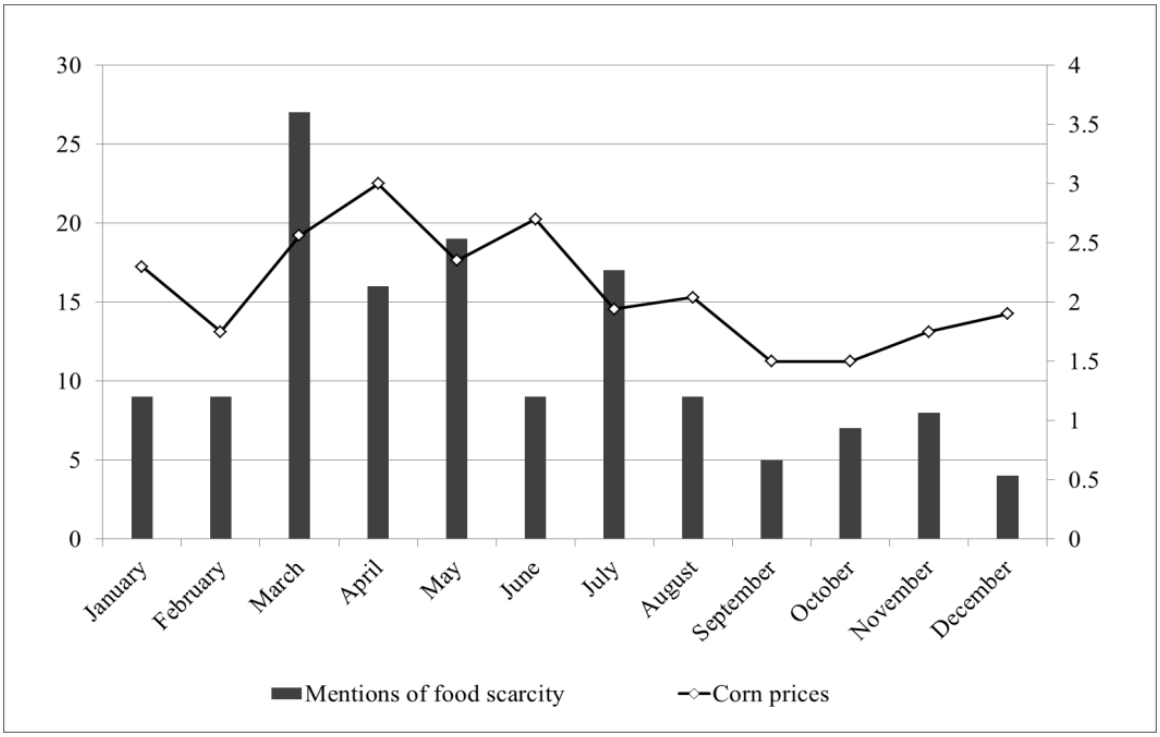
[44] Our database of MCC ships provides 75 observations of specific locations used by ships to purchase provisions. Of these, 27 come from the short stretch of coast from Axim to Elmina on the western side of the Gold Coast and 34 from the equally small area between Grande Mesurado and Sestra Kru on the Windward Coast. The prominence of the latter area may be due to the fact that it saw less competition from more established traders on other parts of the coast (Vos 2009, 32).

[45] An analysis of the Chaurand papers in the Nantes archives from 1777 to 1787 (101 J 26, 27, 28) shows that they sent out 27 West India ships to only 11 slave ships. These slave voyages were all concentrated between 1783 and 1787, a period of rapid growth in West Africa and that after 1787 they withdrew from the slave trade to again concentrate on the bilateral trade with St Domingue. A further study of the comparative impacts of specialisation in the British as opposed to the French slave trade would merit further study.

[46] Based on personal communication with Gerhard de Kok.

But even the British, with the advantage of having a string forts along the West African coast, faced considerable problems with West African supplies at a time the trade was just a fraction of its 18th century peak. Correspondence from and to RAC officials stationed in the forts along the Gold and Slave Coast in the 1680s and 1690s reveals that especially in the months of March to July there were frequent mentions of food 'scarcity' causing trouble to traders (see Figure 6). In 1686, Captain Woodfine stated that he was unable to move on to Whydah until he had sufficient corn and that there was none to be had except at inflated prices[47]. Likewise Captain Jefferies, in 1692, mentioned he was unable to move on to the Bight of Benin for want of sufficient corn.[48] Local forts, which were often suppliers of slaves as well as provisions, were equally affected by insecure food supplies. In 1681 the factor at Accra stated that he was unable to buy more slaves as there was no corn to be had.[49] Figure 6 shows that the average monthly prices of corn coincided with numerous mentions of scarcity. The reasons for failing supplies were not only related to the seasonality of harvests. Local wars and disputes as experienced by the Egya fort, near modern day Cape Coast in Ghana[50], could put a complete ban on food supplies reaching the coastal forts. Such problems were not confined to the Gold Coast or the Bight of Benin. In Senegambia food shortages caused by warfare or drought were also the 'biggest bottleneck' in the slave purchasing chain (Searing 2003, 81).

Figure 6: Monthly mentions of provisioning problems in RAC correspondence (left-hand axis) and monthly corn prices in gold ackies (right-hand axis), 1680 - 1699



Source: Own calculations based on the letters between British forts and slave ships compiled by Law (1997).
Note: Gold ackies were an African coastal currency unit worth c. 1 British shilling (12 pence).

[47] Law (1997) Book 2, May 16 1686 Ref 904
[48] Law (1997) Book 3, November 13 Ref 10
[49] Law (1997) Book 1, October 25 1681 Ref 417
[50] Law (1997) Book 2, March 8 1687 Ref 647

If the possibility of faster embarkation was the main reason for the British to shift their trade to the Bight of Biafra, this indicates that they, too, were sensitive to provisioning-induced risks of delay. There is tentative evidence that the demand for African foodstuffs was stretching supplies in the main regions of embarkation. For instance, during the severe contraction of the slave trade in the late 1770s to the early 1780s, caused by the American War of Independence, slave captains from Britain going to the Gold Coast and the Bight of Biafra took far fewer European provisions with them. When the slave trade resurged after the conflict had ended the quantity of European provisions resurged.[51] Apart from structural shortages, supplies may have become less predictable as slave raids undermined agricultural production and disrupted local trade routes.

The effects of internal wars must have been more severe in some regions than in others. In this respect it is interesting to see that British slave vessels sailing off to the Windward Coast and the Gold Coast took about 62% of total provisions from their home ports, while vessels sailing to Biafra brought about 34% in the 1790s and 1800s. Although this requires much more research, the difference seems consistent with Nwokeji (2010), who has argued that the demographic impact of slave raiding in Biafra was mild compared to the region around the Bight of Benin, which suffered a serious decline in population (Manning 1982, 30-34). In Biafra fewer slaves were obtained through violent slave raiding and instead far more through the use of judicial punishment (Nwokeji 2010, 68, 76, 130, 179, Martin 1992, 27, Lovejoy 2011, 82). According to Nwokeji (2001, 626) a more balanced sex ratio and the willingness of people to accept and incorporate outsiders meant that "….Igboland retained a high population density not because it escaped heavy slaving…..but in spite of it."

In sum, British access to African provisions was more secure because of a string of forts that could mediate the risk of local food shortages, but also because it shifted its trade to the region where local merchant networks were geared towards a quick, abundant and secure supply of foodstuffs to slave traders eager to minimize their embarkation times.

8. Conclusion

In this paper we have asked the question to what extent the increasing demand for food provisions by European slave ships may have boosted West African commercial agriculture in the long 18th century. Exploring the provisioning strategies of British, French, Dutch and Danish slave ships, we have shown that a considerable share of the calories and proteins required to maintain African slaves were supplied from Europe. We have also shown that the relative costs of European-sourced slave provisions remained fairly stable, while slave

[51] During the period of the American civil war, ships belonging the Liverpool merchant William Davenport were taking as little as 3% of their provisions from Liverpool. However by the 1790s ships were taking on average of 30%. This figure did vary according to region and ship captain. The log of the slave ship Ranger (STD ID: 83272, LRO: 387 MD 55), one of the few to itemise the food given to slaves, shows that they were fed around 3700 kcals / day with European beans and rice and around 2000 kcals of corn from the Gold Coast. To put this into perspective, sailors on British ships who were far more physically active were fed around 4800 kcals / day in total (MacDonald 2004 p177).

purchasing prices quintupled between 1755 and 1807. Hence, the Atlantic slave trade played a smaller role in the development of West African commercial agriculture than previous studies have suggested and was definitely much smaller than the aggregate value of West African commodity exports to Britain during the mid-19th century. The loss of food export demand caused by the abolition was more than offset by expanding commodity exports of the 'commercial transition'.

Apart from assessing orders of magnitude, our analysis has revealed two interesting patterns of variation in slave ship provisioning strategies. British slavers relied to a much larger extent on African food markets than continental slavers. We have hypothesized that the main reason for this difference is that British slavers had more secure access to provisions, especially because a string of trading forts on the West African coast reduced the risk of failing supplies. We have also observed notable differences in the size of food exports across various regions of slave embarkation. While some structural differences may have been caused by different ecological conditions for the production of food surpluses, it is also possible that political or institutional constraints have held back the development of coastal food markets, especially in the case of Benin. Further exploration of these patterns of variation will aid a deeper understanding of the economic impact of the slave trade as well as the long-term effects it had on the commercial transition of the 19th century.

Our estimates shed a different light on the role of the African commodity export boom of the 19th century. Compared to West African exports of staple foods the 'commercial transition' did imply a substantial expansion of African international trade. Expanding food exports in West Africa were confined to a few key areas. In areas such as Senegambia, Sierra Leone, the Gold Coast and in Biafra, where the slave trade stimulated the development of coastal food markets to varying degrees, it placed a stepping stone for the 19th century commercial transition. In those areas where markets for food provisions remained underdeveloped, i.e. WCA and Benin, the commercial transition either failed to gain steam or developed much later. The connections between both types of commercial development offer an intriguing subject for further investigation.

Appendix Table 1: Eltis' estimates of the five-year average annual value of African-sourced provisions in the Atlantic slave trade, 1681-1807 (all estimates in constant British Pound sterling of 1700)

	Average annual value of slaves purchased (fob Europe/Americas)	Average annual value of African-sourced provisions (fob Europe/Americas)	Average annual value of African-sourced provisions (cif Africa)	Average annual value of African-sourced provisions for slave ship crews	Average annual value of African-sourced provisions (total)
	1	**2**	**3**	**4**	**5**
1681-1685	107,587	26,897	53,794	1,614	55,407
1686-1690	86,610	21,653	43,305	1,299	44,604
1691-1695	110,731	27,683	55,366	1,661	57,026
1696-1700	202,723	50,681	101,362	3,041	104,402
1701-1705	196,478	49,120	98,239	2,947	101,186
1706-1710	196,241	49,060	98,121	2,944	101,064
1711-1715	248,689	62,172	124,345	3,730	128,075
1716-1720	361,423	90,356	180,712	5,421	186,133
1721-1725	512,750	128,188	256,375	7,691	264,066
1726-1730	392,838	98,210	196,419	5,893	202,312
1731-1735	262,800	65,700	131,400	3,942	135,342
1736-1740	385,436	96,359	192,718	5,782	198,500
1741-1745	405,049	101,262	202,525	6,076	208,600
1746-1750	449,280	112,320	224,640	6,739	231,379
1751-1755	537,147	134,287	268,574	8,057	276,631
1756-1760	396,019	99,005	198,010	5,940	203,950
1761-1765	796,786	199,197	398,393	11,952	410,345
1766-1770	1,246,728	311,682	623,364	18,701	642,065
1771-1775	1,503,464	375,866	751,732	22,552	774,284
1776-1780	698,969	174,742	349,485	10,485	359,969
1781-1785	1,317,247	329,312	658,624	19,759	678,382
1786-1790	2,381,871	595,468	1,190,936	35,728	1,226,664
1791-1795	1,717,428	429,357	858,714	25,761	884,475
1796-1800	1,812,184	453,046	906,092	27,183	933,275
1801-1807	2,165,957	541,489	1,082,979	32,489	1,115,468
1681-1807	**762,158**	**186,494**	**372,989**	**11,190**	**384,179**

Source: Eltis (2013) Table 1.2, p. 39; Column 1 is taken from Table 1.1, p. 33.

Note: By taking 25% of slave purchasing prices for 1681-1807 and multiplying these with slave export volumes (column 1) from the Trans-Atlantic Slave Trade Database (Eltis and Richardson 2010), Eltis expressed the average annual value of West African food exports in European exchange goods f.o.b. (column 2)[52]. These were then multiplied by two to account for the costs of freight and insurance (c.i.f.) in the transportation of European exchange commodities to the regions of slave purchase (column 3). Adding a share of 3% to account for African-sourced provisions for slave ship crews (column 4), his final estimates (column 5) indeed suggest a total annual average demand impulse of close to one million British Pounds[53].

[52] Slave prices series for 1681-1699 were derived from Eltis (2000, 296) and for 1700-1807 from Richardson (1991, 52-56).

[53] West Africa was exporting a number of important commodities in addition to slaves throughout the period of transatlantic slavery, the most important of which for most of 18th century were gold and ivory. Other products included dyewoods, wax, gum and palm oil. Increasing demand from an industrialising Europe combined with the slow decline of export slavery in the 19th century saw such commodity exports increasing rapidly from the 1820s (Law 2002, Frankema et al. 2015)

Appendix Table 2a: Summary statistics of the sample of 187 voyages

No	voyage no. TSTD	Name Vessel	Year Arrive	Nation	No. of slaves embarked	Main provisions	Total kcal taken on board in Europe (millions)	Main African provisions	Total kcal taken on board in Africa (millions)	Major Region of Slave Embarkation	Average no. of days on board at African Coast (TAC)	Average no. of days on board during Middle Passage (MP) + 1 st. dev.	No. daily rations required	% share European provisions of total required (kcal)
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	35161	Cron Printz Christian	1755	DK	125	Beans, Stockfish	27.14	Millet, Palm Oil	7.72	Gold Coast	134	150	27,125	50.0
2	35181	Fredensborg	1768	DK	265	Beans, Barley	76.29	Millet, Palm Oil	25.25	Gold Coast	130	117	48,230	79.1
3	33330	Diligent	1732	FR	256	Beans	50.80	Corn, Cassava	5.25	Bight of Benin	113	128	47,232	53.8
4	30484	Reine de France	1744	FR	404	Beans, Rice	63.91	Corn, Yams, Cassava	23.37	Bight of Benin	152	154	92,920	34.4
5	30754	Thélémaque	1764	FR	365	Beans, Rice	76.67	Corn, Yams, Cassava	7.23	West Central Africa North	163	83	60,043	63.8
6	30911	Pompée	1770	FR	390	Beans, Rice	148.01	Corn, Palm Oil, Yams, Cassava	61.63	West Central Africa North	163	83	64,155	115.4
7	32283	Duc de Laval	1775	FR	393	Beans, Rice	152.42	N/D	N/D	West Central Africa North	163	83	64,649	117.9
8	31639	Pactole	1784	FR	428	Beans, Rice	63.91	Corn, Rice, Palm Oil, Yams, Cassava, Plantains	75.29	Bight of Benin	130	96	68,908	46.4

9	30808	Jeune Reine	1765	FR	169	Beans	40.64	N/D	N/D	Senegambia	90	53	16,562	122.7
10	30864	Saint François	1768	FR	534	Biscuits, Beans	140.56	N/D	N/D	West Central Africa North	328	109	145,782	48.2
11	30874	Saint Jacques	1769	FR	528	Beans	106.67	N/D	N/D	Bight of Biafra	365	36	115,368	46.2
12	30875	Mars	1768	FR	373	Beans	45.64	N/D	N/D	Other Africa	216	140	92,504	24.7
13	30882	Saint Laurent	1769	FR	473	Biscuits, Beans, Rice	140.56	N/D	N/D	West Central Africa North	137	70	65,511	107.3
14	30893	Prince Grasse	1769	FR	415	Beans, Rice	115.41	N/D	N/D	West Central Africa North	208	61	68,475	84.3
15	30926	Saint François	1770	FR	520	Biscuits, Beans	147.94	N/D	N/D	West Central Africa North	164	60	73,840	100.2
16	30927	Saint Jacques	1770	FR	582	Biscuits, Beans	174.81	N/D	N/D	West Central Africa North	163	58	81,189	107.7
17	30948	Saint Jean Baptiste	1772	FR	571	Beans, Rice	121.35	N/D	N/D	West Central Africa North	139	50	68,235	88.9
18	30967	Glaneuse	1772	FR	172	Beans, Rice	36.91	N/D	N/D	West Central Africa North	60	62	15,824	116.6
19	30970	Nymphe	1772	FR	336	Beans, Rice	50.70	N/D	N/D	Bight of Biafra	137	56	41,832	60.6
20	31000	Saint Jean Baptiste	1774	FR	462	Beans, Rice	124.76	N/D	N/D	West Central Africa North	93	47	43,197	144.4
21	31009	Nymphe	1775	FR	460	Biscuits, Beans, Rice	154.05	N/D	N/D	West Central Africa North	267	57	87,630	87.9

22	31026	Saint Jean Baptiste	1776	FR	435	Beans, Rice	121.26	N/D	N/D	West Central Africa North	87	59	44,588	136.0
23	31180	Madame	1787	FR	643	Beans, Rice	210.03	N/D	N/D	Southeast Africa and Indian Ocean islands	134	102	108,667	96.6
24	31184	Fine	1787	FR	198	Beans, Rice	51.13	N/D	N/D	West Central Africa North	207	59	32,175	79.5
25	31188	Bailli de Suffren	1787	FR	569	Beans, Rice	107.72	N/D	N/D	West Central Africa North	174	53	79,660	67.6
26	31189	Passepartout	1787	FR	14	Beans, Rice	4.21	N/D	N/D	West Central Africa North	139	58	1,785	117.8
27	31209	Jeanne Thérèse	1788	FR	258	Beans, Rice	80.25	N/D	N/D	Bight of Benin	164	198	72,240	55.5
28	31220	Aimable Aline	1787	FR	516	Biscuits, Beans, Rice	121.20	N/D	N/D	Bight of Biafra	97	57	54,438	111.3
29	31224	Louis	1788	FR	274	Beans, Rice	107.49	N/D	N/D	Bight of Benin	126	88	41,374	129.9
30	31279	Bailli de Suffren	1790	FR	440	Beans, Rice	115.25	N/D	N/D	West Central Africa North	199	56	68,420	84.2
31	9917	Charles	1681	GB	288		N/D	Corn	113.08	Bight of Benin	73	117	44,208	N/D
32	9870	Merchant Bonadventure	1683	GB	448		N/D	Corn	160.83	Bight of Benin	73	117	68,768	N/D
33	15074	Mary	1683	GB	507	Beans	0.61	Corn	179.49	Gold Coast	107	110	82,895	0.4
34	20112	Saint George	1683	GB	550		N/D	Corn	251.29	Bight of Benin	73	117	84,425	N/D

35	9669	Jefferie	1685	GB	310	Beans	0.33	Corn	114.88	Gold Coast	107	110	50,685	0.3
36	9668	Good Hope	1685	GB	376	Beans	0.58	Corn	118.47	West Central Africa North	78	119	59,408	0.5
37	9684	Sarah Bonadventure	1686	GB	404		N/D	Corn	179.85	Bight of Benin	73	117	62,014	N/D
38	9702	Kendall	1694	GB	600		N/D	Corn	187.39	Bight of Benin	73	117	92,100	N/D
39	9714	Hannibal	1694	GB	700	Beans	2.90	Corn	200.32	Gold Coast	107	110	114,450	1.3
40	9701	Katherine	1694	GB	600		N/D	Corn	252.37	Bight of Benin	73	117	92,100	N/D
41	9726	Fauconberg (a) Falconberg	1696	GB	605	Beans	2.54	Corn	280.01	Bight of Benin	73	117	92,868	1.4
42	75599	Hanibal	1721	GB	273		N/D	Rice	2.56	Gold Coast	117	112	46,547	N/D
43	76371	Sherborough Gally	1721	GB	231		N/D	Rice, Palm Oil	22.57	Sierra Leone	137	75	33,149	N/D
44	75956	Otter	1721	GB	209	Beans	0.73	Corn	32.31	Senegambia	132	100	34,694	1.0
45	75330	Dispatch	1721	GB	110		N/D	Corn, Palm Oil	49.55	Gold Coast	117	112	18,755	N/D
46	76147	Sarah Gally	1721	GB	250	Beans	1.45	Corn, Rice, Palm Oil	85.09	Gold Coast	117	112	42,625	1.7
47	76399	Henry	1722	GB	367	Beans	1.86	Corn, Rice, Palm Oil	113.27	Bight of Benin	113	128	67,712	1.4

48	76405	Judith	1722	GB	107	Beans	0.51	N/D		Senegambia	132	100	17,762	1.4
49	76960	King Solomon	1722	GB	300	Beans	2.18	Corn, Rice, Palm Oil	N/D	Gold Coast	117	112	51,150	2.1
50	76435	Sarah Gally	1723	GB	273	Beans	0.91	Corn, Palm Oil, Yams	70.01	Gold Coast	117	112	46,547	1.0
51	75181	Bladen Frigate	1723	GB	250	Beans	3.39	N/D	N/D	Bight of Benin	113	128	46,125	3.7
52	76192	Squirrell	1723	GB	121	Beans	3.81	N/D	N/D	Bight of Benin	113	128	22,325	8.5
53	76693	Lady Rachel	1723	GB	221	Beans	2.18	Corn, Rice	24.92	Senegambia	132	100	36,686	3.0
54	75286	Clarendon	1723	GB	69	Beans	0.63	Corn, Rice	33.56	West Central Africa North	139	83	10,523	3.0
55	76542	Diligence	1723	GB	200		N/D	Corn, Palm Oil	58.37	Gold Coast	117	112	34,100	N/D
56	76176	Sloper	1723	GB	282	Beans	2.54	Corn, Palm Oil	69.05	Gold Coast	117	112	48,081	2.6
57	75181	Bladen Frigate	1723	GB	250		N/D	Corn	179.49	Bight of Benin	113	128	46,125	N/D
58	76965	Dove	1723	GB	237	Beans	0.85	Corn, Rice	43.96	Bight of Benin	113	128	43,727	1.0
59	76348	Whidah Frigate	1724	GB	300	Beans	6.77	Corn	35.90	Bight of Benin	113	128	55,350	6.1
60	76695	Cape Coast Frigate	1724	GB	205	Beans	2.12	Corn	42.36	Senegambia	132	100	34,030	3.1

61	75258	Chandos	1724	GB	556	Beans	3.63	Corn, Palm Oil	161.73	Bight of Benin	113	128	102,582	1.8
62	76095	Royal African Packet	1724	GB	645		N/D	Corn, Palm Oil	184.20	Gold Coast	117	112	109,973	N/D
63	76617	Portugal	1729	GB	327	Beans	40.64	Corn, Rice, Palm Oil, Yams	103.72	Gold Coast	117	112	55,754	36.4
64	90937	Plumper	1763	GB	304	Beans, Stockfish	8.70	N/D	N/D	Windward Coast	232	103	66,576	6.5
65	91213	William	1765	GB	77	Beans, Rice	19.89	N/D	N/D	Senegambia	90	94	10,703	92.9
66	92315	Sisters	1766	GB	280	Beans, Pease	20.33	N/D	N/D	Bight of Benin	155	103	50,540	20.1
67	91219	Dalrymple	1767	GB	383	Beans, Rice	24.36	N/D	N/D	Bight of Biafra	155	103	69,132	17.6
68	91427	Neptune	1768	GB	169	Beans, Rice	9.91	N/D	N/D	Bight of Biafra	155	103	30,505	16.2
69	91577	Little Brittain	1769	GB	148	Beans, Rice	14.54	N/D	N/D	Windward Coast	232	103	32,412	22.4
70	91428	Plumper	1769	GB	326	Beans, Barley, Rice	33.50	N/D	N/D	Bight of Benin	155	103	58,843	28.5
71	91553	Fox	1769	GB	180		N/D	Yams	3669.87	Bight of Biafra	155	103	32,490	N/D
72	91594	Andromache	1770	GB	162	Rice, Beans, Stockfish	8.49	N/D	N/D	Bight of Biafra	155	103	29,241	14.5
73	91221	Dalrymple	1770	GB	342	Rice, Beans, Stockfish	33.60	N/D	N/D	Bight of Biafra	155	103	61,731	27.2

74	91573	Hector	1770	GB	260	Rice, Beans, Stockfish	30.48	N/D	N/D	Bight of Biafra	155	103	46,930	32.5
75	91409	King of Prussia	1770	GB	164	Rice, Peas, Beans, Stockfish	16.68	N/D	N/D	Bight of Biafra	155	103	29,602	28.2
76	91653	Swift	1770	GB	167	Beans, Rice, Stockfish, Pease	22.02	N/D	N/D	Bight of Biafra	155	103	30,144	36.5
77	91545	Dobson	1770	GB	355		N/D	Yams	3669.87	Bight of Biafra	155	103	64,078	N/D
78	91595	Andromache	1771	GB	190	Rice, Beans, Stockfish	11.98	N/D	N/D	Bight of Biafra	155	103	34,295	17.5
79	91743	May	1771	GB	176	Rice	15.78	N/D	N/D	Bight of Biafra	155	103	31,768	24.8
80	91430	Plumper	1771	GB	348	Beans, Barley, Stockfish	20.50	N/D	N/D	Bight of Biafra	155	103	62,814	16.3
81	91643	True Blue	1771	GB	365	Beans, Barley, Rice	19.69	N/D	N/D	Bight of Benin	155	103	65,883	14.9
82	91752	Dalrymple	1772	GB	243	Rice, Beans, Stockfish	28.82	N/D	N/D	Bight of Biafra	155	103	43,862	32.8
83	91574	Hector	1772	GB	250	Rice, Beans, Stockfish	26.78	N/D	N/D	Bight of Biafra	155	103	45,125	29.7
84	91410	King of Prussia	1772	GB	239	Rice, Peas, Beans, Stockfish	18.49	N/D	N/D	Bight of Biafra	155	103	43,140	21.4
85	91979	Andromache	1774	GB	210	Rice, Beans, Stockfish	16.05	N/D	N/D	Bight of Biafra	155	103	37,905	21.2
86	91813	Badger	1774	GB	243	Rice, Peas	15.24	N/D	N/D	Bight of Biafra	155	103	43,862	17.4

87	91814	Badger	1775	GB	238	Peas, Beans, Rice	19.14	N/D	N/D	Bight of Biafra	155	103	42,959	22.3
88	91575	Hector	1775	GB	141	Rice, Beans, Stockfish	27.49	N/D	N/D	Bight of Biafra	155	103	25,451	54.0
89	92536	Badger	1777	GB	421	Peas, Beans, Stockfish	25.69	N/D	N/D	Bight of Biafra	155	103	75,991	16.9
90	91576	Hector	1777	GB	236	Rice, Sotckfish, Peas	20.22	N/D	N/D	Bight of Biafra	155	103	42,598	23.7
91	91794	Swift	1777	GB	211	Beans, Stockfish, Pease	7.01	N/D	N/D	Bight of Biafra	155	103	38,086	9.2
92	83174	Preston	1780	GB	210	Stockfish, Pease	1.72	N/D	N/D	Bight of Biafra	155	103	37,905	2.3
93	83175	Preston	1782	GB	221	Beans, Pease	0.81	N/D	N/D	Bight of Biafra	103	98	33,040	1.2
94	83176	Preston	1784	GB	302	Barley, Rice, Pease	1.80	N/D	N/D	Bight of Biafra	103	98	45,149	2.0
95	17983	Alert	1789	GB	276	Beans, Rice	12.28	N/D	N/D	Gold Coast	147	95	46,506	13.2
96	80687	Brothers	1789	GB	455		N/D	Yams	146.03	Bight of Biafra	103	98	68,023	N/D
97	18057	Thomas	1790	GB	359	Beans	10.16	N/D	N/D	Bight of Biafra	103	98	53,671	9.5
98	18068	Eliza	1790	GB	291	Beans	16.93	N/D	N/D	Bight of Biafra	103	98	43,505	19.5
99	18080	Prince	1790	GB	396	Beans, Rice	14.68	N/D	N/D	Bight of Biafra	103	98	59,202	12.4

100	18088	Wasp	1790	GB	249	Beans, Rice	19.70	N/D	N/D	Bight of Biafra	103	98	37,226	26.5
101	18071	Hector	1791	GB	764	Beans	33.86	N/D	N/D	Bight of Biafra	103	98	114,218	14.8
102	18112	Pilgrim	1791	GB	381	Beans, Rice	25.74	N/D	N/D	Bight of Biafra	103	98	56,960	22.6
103	18077	Mermaid	1791	GB	140	Beans, Rice	35.68	N/D	N/D	Gold Coast	147	95	23,590	75.6
104	18082	Royal Charlotte	1791	GB	140	Beans	14.90	N/D	N/D	Bight of Biafra	103	98	20,930	35.6
105	18060	Albion	1791	GB	262	Beans	2.12	N/D	N/D	Sierra Leone	192	57	40,086	2.6
106	18092	Brothers	1791	GB	279	Beans, Rice	78.76	N/D	N/D	Bight of Biafra	103	98	41,711	94.4
107	18083	Royal Charlotte	1791	GB	336	Rice	8.81	N/D	N/D	Bight of Biafra	103	98	50,232	8.8
108	18062	Alfred	1791	GB	316	Beans, Rice	16.49	N/D	N/D	Bight of Biafra	103	98	47,242	17.5
109	18103	James	1791	GB	176	Beans, Rice	25.57	N/D	N/D	Windward Coast	211	68	30,536	41.9
110	18075	King George	1791	GB	369	Beans, Rice	10.93	N/D	N/D	Bight of Biafra	103	98	55,166	9.9
111	18097	Eliza	1791	GB	291	Beans, Rice	57.47	N/D	N/D	Bight of Biafra	103	98	43,505	66.0
112	18096	Daniel	1791	GB	146	Beans, Rice	8.47	N/D	N/D	Bight of Biafra	103	98	21,827	19.4

113	18117	Rodney	1791	GB	371	Beans, Rice	34.51	N/D	N/D	Bight of Biafra	103	98	55,465	31.1
114	18120	Sarah	1791	GB	231	Beans, Rice	24.96	N/D	N/D	Bight of Biafra	103	98	34,535	36.1
115	18078	Pearl	1791	GB	372	Beans, Rice	N/D	N/D	N/D	Bight of Biafra	103	98	55,614	N/D
116	18115	Recovery	1791	GB	304	Beans, Rice	49.10	N/D	N/D	Bight of Biafra	103	98	45,448	54.0
117	18158	Pilgrim	1792	GB	412	Beans, Rice	19.70	N/D	N/D	Bight of Biafra	103	98	61,594	16.0
118	18142	General Orde	1792	GB	240	Beans	135.46	N/D	N/D	Bight of Biafra	103	98	35,880	188.8
119	18101	Hester	1792	GB	243	Beans, Rice	33.31	N/D	N/D	Bight of Biafra	103	98	36,329	45.8
120	18104	Lion	1792	GB	328	Beans	1.27	N/D	N/D	Bight of Biafra	103	98	49,036	1.3
121	18131	Alfred	1792	GB	326	Beans, Rice	23.95	N/D	N/D	Bight of Biafra	103	98	48,737	24.6
122	18113	Prince	1792	GB	359	Rice	17.62	N/D	N/D	Bight of Biafra	103	98	53,671	16.4
123	18152	Mermaid	1792	GB	159	Beans, Rice	10.08	N/D	N/D	Senegambia	79	71	17,570	28.7
124	18153	Morning Star	1792	GB	56	Beans, Rice	9.62	N/D	N/D	Sierra Leone	192	57	8,568	56.1
125	18122	Swift	1792	GB	380	Beans, Rice	1.06	N/D	N/D	Bight of Biafra	103	98	56,810	0.9

126	18138	Fame	1792	GB	200	Beans, Rice	79.99	N/D	N/D	Bight of Biafra	103	98	29,900	133.8
127	18124	Trelawney	1792	GB	333	Beans, Rice	6.60	N/D	N/D	Bight of Biafra	103	98	49,784	6.6
128	18113	Prince	1792	GB	359	Beans, Rice	18.63	N/D	N/D	Bight of Biafra	103	98	53,671	17.4
129	18126	Wasp	1792	GB	235	Beans, Rice	16.93	N/D	N/D	Bight of Biafra	103	98	35,133	24.1
130	18144	Hector	1793	GB	596	Beans	50.80	N/D	N/D	Bight of Biafra	103	98	89,102	28.5
131	18140	Favourite	1793	GB	156	Beans, Rice	26.48	N/D	N/D	Bight of Biafra	103	98	23,322	56.8
132	18182	Langrishe	1793	GB	416	Beans, Rice	21.51	N/D	N/D	Bight of Biafra	103	98	62,192	17.3
133	18186	Royal Charlotte	1793	GB	210		74.50	N/D	N/D	Windward Coast	211	68	36,435	102.2
134	18130	Albion	1793	GB	239	Beans	1.18	N/D	N/D	Sierra Leone	192	57	36,567	1.6
135	18177	Catherine	1793	GB	345	Beans, Rice	41.21	N/D	N/D	Bight of Biafra	103	98	51,578	39.9
136	18156	Nassau	1793	GB	190	Beans, Rice	17.54	N/D	N/D	Sierra Leone	192	57	29,070	30.2
137	18163	Roman Emperor	1793	GB	382	Rice	34.51	N/D	N/D	Bight of Biafra	103	98	57,109	30.2
138	18146	Jupiter	1793	GB	400	Beans, Rice	27.95	N/D	N/D	Bight of Biafra	103	98	59,800	23.4

139	18157	Pearl	1793	GB	400	Beans, Rice	34.51	N/D	N/D	Bight of Biafra	103	98	59,800	28.9
140	18159	Prince	1793	GB	311	Beans, Rice	37.32	N/D	N/D	Bight of Biafra	103	98	46,495	40.1
141	18214	Pilgrim	1796	GB	404	Beans	16.93	N/D	N/D	Sierra Leone	192	57	61,812	13.7
142	18259	Swift	1803	GB	389	Beans	37.25	N/D	N/D	Gold Coast	147	95	65,547	28.4
143	18267	Alert	1806	GB	277	Beans, Rice	27.72	N/D	N/D	Sierra Leone	192	57	42,381	32.7
144	82379	Lottery	1798	GB	460	Beans, Rice	48.40	N/D	N/D	Bight of Biafra	103	157	95,910	25.2
145	82382	Lottery	1802	GB	305	Beans, Rice	32.39	N/D	N/D	Bight of Biafra	103	193	74,573	21.7
146	81302	Enterprize	1804	GB	412	Beans, Rice	44.96	N/D	N/D	Bight of Biafra	103	173	92,494	24.3
147	81497	Fortune	1805	GB	343	Beans, Rice	75.95	N/D	N/D	West Central Africa North	139	240	106,159	35.8
148	10212	Leusden	1721	NL	446	Beans, Barley	196.86	N/D	N/D	West Central Africa North	139	83	68,015	144.7
149	10213	Leusden	1722	NL	461	Beans, Barley	150.90	N/D	N/D	Bight of Benin	113	128	85,055	88.7
150	?	Francis	1723	GB	200	Beans	2.54	Corn, Palm Oil	83.71	Gold Coast	117	112	34,100	3.7
151	10976	Raadhuis van Middelburg	1742	NL	272	Beans, Barley	61.47	N/D	N/D	Windward + Ivory + Gold + **Benin**	152	154	62,560	49.1

152	10626	Groot Prooijen	1748	NL	328	Beans, Barley	78.68	N/D	N/D	West Central Africa North	179	65	50,676	77.6
153	10620	Granadier	1749	NL	270	Beans, Barley	114.74	N/D	N/D	West Central Africa North	179	65	41,715	137.5
154	10957	Prins Willem de Vijfde	1754	NL	232	Beans, Barley	87.75	N/D	N/D	Gold Coast	134	150	50,344	87.2
155	10869	Middelburgs Welvaren	1754	NL	270	Beans, Barley	90.95	Corn, Rice	126.20	Windward + Ivory + Gold + **Benin**	152	154	62,100	73.2
156	10870	Middelburgs Welvaren	1755	NL	289	Beans, Barley	48.25	Corn, Rice, Palm Oil, Yam	337.61	Windward Coast	172	93	51,731	46.6
157	10527	Drie Gezusters	1756	NL	234	Beans, Barley	91.95	N/D	N/D	Gold Coast	134	150	50,778	90.5
158	10958	Prins Willem de Vijfde	1756	NL	348	Beans, Barley	123.76	N/D	N/D	West Central Africa North	179	65	53,766	115.1
159	11114	Vrouw Johanna Cores	1757	NL	282	Beans, Barley	89.95	Rice	5.07	Windward + Ivory + Gold + **Benin**	152	154	64,860	69.3
160	11088	Vliegende Faam	1757	NL	281	Beans, Barley	67.37	Corn, Millet	273.81	Windward + Ivory + Gold + **Benin**	152	154	64,630	52.1
161	10528	Drie Gezusters	1758	NL	405	Beans, Barley	97.12	N/D	N/D	West Central Africa North	179	65	62,573	77.6
162	10959	Prins Willem de Vijfde	1758	NL	465	Beans, Barley	98.35	N/D	N/D	West Central Africa North	179	65	71,843	68.4
163	10965	Prins Willem de Vijfde	1758	NL	377	Beans, Barley	123.76	N/D	N/D	West Central Africa North	179	65	58,247	106.2
164	11116	Vrouw Johanna Cores	1761	NL	381	Beans, Barley	81.96	N/D	N/D	West Central Africa North	168	83	63,627	64.4

165	10906	Nieuwe Hoop	1765	NL	351	Beans, Barley	115.56	N/D	N/D	West Central Africa North	168	83	58,617	98.6
166	10963	Prins Willem de Vijfde	1766	NL	238	Beans, Barley	84.78	Corn	3.59	Gold Coast	130	117	43,316	97.9
167	10907	Nieuwe Hoop	1767	NL	329	Beans, Barley	100.70	Rice, Palm Oil	5.82	Gold Coast	130	117	59,878	84.1
168	10544	Enigheid	1767	NL	315	Beans, Barley	111.47	N/D	N/D	West Central Africa North	168	83	52,605	105.9
169	11119	Vrouw Johanna Cores	1768	NL	249	Beans, Barley	102.50	N/D	N/D	Windward + Ivory + Gold + **Benin**	191	132	56,648	90.5
170	11178	Zanggodin	1770	NL	67	Beans, Barley	36.31	N/D	N/D	Bight of Biafra	155	103	12,094	150.1
171	11125	Watergeus	1774	NL	375	Beans, Barley	179.90	N/D	N/D	West Central Africa North	168	83	62,625	143.6
172	11134	Welmenende	1774	NL	203	Beans, Barley	59.27	N/D	N/D	Windward + Ivory + Gold + **Benin**	191	132	46,183	64.2
173	10787	Jonge Willem	1775	NL	163	Beans, Barley	71.66	N/D	N/D	Bight of Biafra	155	103	29,422	121.8
174	11085	Vis	1775	NL	238	Beans, Barley	103.40	N/D	N/D	Windward + Ivory + Gold + **Benin**	191	132	54,145	95.5
175	10590	Geertruida en Christina	1775	NL	335	Beans, Barley	109.10	Millet	40.04	Windward + Ivory + Gold + **Benin**	191	132	76,213	71.6
176	11180	Zanggodin	1775	NL	127	Beans, Barley	58.61	N/D	N/D	Bight of Biafra	155	103	22,924	127.8
177	10591	Geertruida en Christina	1777	NL	303	Beans, Barley	103.90	N/D	N/D	Gold Coast	130	117	55,146	94.2

178	11126	Watergeus	1777	NL	325	Beans, Barley	179.90	N/D	N/D	West Central Africa North	168	83	54,275	165.7
179	11210	Zorg	1778	NL	246	Beans, Barley	76.86	Rice	5.07	Gold Coast	130	117	44,772	85.8
180	10666	Haast U Langzaam	1780	NL	373	Beans, Barley	101.30	Corn, Rice, Palm Oil	31.71	Windward + Ivory + Gold + **Benin**	191	132	84,858	59.7
181	10913	Nieuwe Hoop	1785	NL	215	Beans, Barley	101.30	N/D	N/D	Gold Coast	147	95	36,228	139.8
182	11056	Vergenoegen	1787	NL	386	Beans, Barley	108.75	Corn, Rice	18.64	Gold Coast	147	95	65,041	83.6
183	11182	Zeemercuur	1789	NL	270	Beans, Barley	118.54	Rice, Palm Oil, Yams	33.30	Gold Coast	147	95	45,495	130.3
184	11057	Vergenoegen	1790	NL	266	Beans, Barley	131.14	N/D	N/D	West Central Africa North	168	83	44,422	147.6
185	10463	Brandenburg	1792	NL	226	Beans, Barley	110.34	N/D	N/D	Windward + Ivory + Gold + **Benin**	130	96	36,386	151.6
186	11183	Zeemercuur	1793	NL	174	Beans, Barley	119.80	Corn, Rice, Palm Oil, Yams	17.80	Windward + Ivory + Gold + **Benin**	130	96	28,014	213.8
187	11058	Vergenoegen	1795	NL	367	Beans, Barley	131.14	N/D	N/D	West Central Africa North	168	83	61,289	107.0

Appendix Table 2b: Summary statistics of 36 'full data' voyages

No	voyage no. TSTD	Name Vessel	Year Arrive	Nation	No. of slaves embarked	Main European provisions	Total kcal taken on board in Europe (millions)	Main African provisions	Total kcal taken on board in Africa (millions)	Major Region of Slave Embarkation	% total provisions from Europe	% total provisions from Africa
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	35161	Cron Printz Christian	1755	DK	125	Beans, Stockfish	27.14	Millet, Palm Oil	7.72	Gold Coast	77.9	22.1
2	35181	Fredensborg	1768	DK	265	Beans, Barley	76.29	Millet, Palm Oil	25.25	Gold Coast	75.1	24.9
3	33330	Diligent	1732	FR	256	Beans	50.8	Corn, Cassava	5.25	Bight of Benin	90.6	9.4
4	30484	Reine de France	1744	FR	404	Beans, Rice	63.91	Corn, Yams, Cassava	23.37	Bight of Benin	73.2	26.8
5	30754	Thélémaque	1764	FR	365	Beans, Rice	76.67	Corn, Yams, Cassava	7.23	West Central Africa North	91.4	8.6
6	30911	Pompée	1770	FR	390	Beans, Rice	148.01	Corn, Palm Oil, Yams, Cassava	61.63	West Central Africa North	70.6	29.4
8	31639	Pactole	1784	FR	428	Beans, Rice	63.91	Corn, Rice, Palm Oil, Yams, Cassava, Plantains	75.29	Bight of Benin	45.9	54.1
34	15074	Mary	1683	GB	507	Beans	0.61	Corn	179.49	Gold Coast	0.3	99.7
36	9669	Jefferie	1685	GB	310	Beans	0.33	Corn	114.88	Gold Coast	0.3	99.7

37	9668	Good Hope	1685	GB	376	Beans	0.58	Corn	118.47	West Central Africa North	0.5	99.5
40	9714	Hannibal	1694	GB	700	Beans	2.9	Corn	200.32	Gold Coast	1.4	98.6
42	9726	Fauconberg (a) Falconberg	1696	GB	605	Beans	2.54	Corn	280.01	Bight of Benin	0.9	99.1
45	75956	Otter	1721	GB	209	Beans	0.73	Corn	32.31	Senegambia	2.2	97.8
47	76147	Sarah Gally	1721	GB	250	Beans	1.45	Corn, Rice, Palm Oil	85.09	Gold Coast	1.7	98.3
48	76399	Henry	1722	GB	367	Beans	1.86	Corn, Rice, Palm Oil	113.27	Bight of Benin	1.6	98.4
51	76435	Sarah Gally	1723	GB	273	Beans	0.91	Corn, Palm Oil, Yams	70.01	Gold Coast	1.3	98.7
54	76693	Lady Rachel	1723	GB	221	Beans	2.18	Corn, Rice	24.92	Senegambia	8.0	92.0
55	75286	Clarendon	1723	GB	69	Beans	0.63	Corn, Rice	33.56	West Central Africa North	1.8	98.2
57	76176	Sloper	1723	GB	282	Beans	2.54	Corn, Palm Oil	69.05	Gold Coast	3.5	96.5
59	76965	Dove	1723	GB	237	Beans	0.85	Corn, Rice	43.96	Bight of Benin	1.9	98.1
60	76348	Whidah Frigate	1724	GB	300	Beans	6.77	Corn	35.9	Bight of Benin	15.9	84.1
61	76695	Cape Coast Frigate	1724	GB	205	Beans	2.12	Corn	42.36	Senegambia	4.8	95.2

62	75258	Chandos	1724	GB	556	Beans	3.63	Corn, Palm Oil	161.73	Bight of Benin	2.2	97.8
64	76617	Portugal	1729	GB	327	Beans	40.64	Corn, Rice, Palm Oil, Yams	103.72	Gold Coast	28.2	71.8
149	?	Francis	1723	GB	200	Beans	2.54	Corn, Palm Oil	83.71	Gold Coast	2.9	97.1
157	10869	Middelburgs Welvaren	1754	NL	270	Beans, Barley	90.95	Corn, Rice	126.2	Windward + Ivory + Gold + Benin	41.9	58.1
158	10870	Middelburgs Welvaren	1755	NL	289	Beans, Barley	48.25	Corn, Rice, Palm Oil, Yam	337.61	Windward Coast	12.5	87.5
161	11114	Vrouw Johanna Cores	1757	NL	282	Beans, Barley	89.95	Rice	5.07	Windward + Ivory + Gold + Benin	94.7	5.3
162	11088	Vliegende Faam	1757	NL	281	Beans, Barley	67.37	Corn, Millet	273.81	Windward + Ivory + Gold + Benin	19.7	80.3
168	10963	Prins Willem de Vijfde	1766	NL	238	Beans, Barley	84.78	Corn	3.59	Gold Coast	95.9	4.1
169	10907	Nieuwe Hoop	1767	NL	329	Beans, Barley	100.7	Rice, Palm Oil	5.82	Gold Coast	94.5	5.5
177	10590	Geertruida en Christina	1775	NL	335	Beans, Barley	109.1	Millet	40.04	Windward + Ivory + Gold + Benin	73.2	26.8
181	11210	Zorg	1778	NL	246	Beans, Barley	76.86	Rice	5.07	Gold Coast	93.8	6.2
182	10666	Haast U Langzaam	1780	NL	373	Beans, Barley	101.3	Corn, Rice, Palm Oil	31.71	Windward + Ivory + Gold + Benin	76.2	23.8
184	11056	Vergenoegen	1787	NL	386	Beans, Barley	108.75	Corn, Rice	18.64	Gold Coast	85.4	14.6

185	11182	Zeemercuur	1789	NL	270	Beans, Barley	118.54	Rice, Palm Oil, Yams	33.3	Gold Coast	78.1	21.9

Appendix Table 3: Weights, measures and nutritional contents used in our study

Food type	Quantity Measure	Kg	Kcal / kg	Protein / kg
Barley	Lb (Br)	0.45	3500	82
Barly	Lb (Middleberg)	0.47	3500	82
Barley	Sack	60.00	3500	82
Barley	Litre	6.20	3500	82
Barley	Last (Muddle,Schepel)	2000.00	3500	82
Beef flesh	Hogshead (Hhd)	228.82	1150	220
Bread White	Hundred Weight (cwt)	50.85	3410	77
Cassava flour	Bushel	0.00	3440	16
Cassava flour	Alquiers	14.00	3440	16
Corn Ears/Cobs	Piece	0.00	2450	20
Fish, dried, salted	Lbs (Br)	0.45	2250	470
Kidney beans, dry	Quarter	12.71	3330	236
Kidney beans, dry	Bushel	0.00	3330	236
Kidney beans, dry	Ton	1016.96	3330	236
Kidney beans, dry	Sack	60.00	3330	236
Kidney beans, dry	Last (Muddle,Schepel)	2133.80	3330	236
Maize flour, whole	Lb (Br)	0.45	3530	93
Maize flour, whole	English Chest	101.70	3530	93
Maize flour, whole	Dutch Chest	104.83	3530	93
Maize flour, whole	Stekan	1.77	3530	93
Millet, bulrush	Stekan	1.77	3410	104
Millet, bulrush	Chest	104.83	3410	104
Palm oil	Litres	1.00	8840	0
Palm Oil	Gallon	3.50	8840	0
Palm Oil	Aume	0.00	8840	0
Palm Oil	Anker	0.00	8850	10
Pigeon peas, dry	Lb (Br)	0.45	3430	217
Rice Polished	Lb (Br)	0.45	3610	65
Rice Polished	Lb (Middleberg)	0.47	3610	65
Rice Polished	Alquiers	14.00	3610	65
Rice Polished	Barrels	81.72	3620	75
Wheat, whole	Hundred Weight (cwt)	50.85	3230	126
Wheat, whole	Hundred Weight (cwt)	50.85	3230	126
Yam	Piece	7.50	1180	15
Plantain	Piece	0.30	1350	12

Appendix Table 4: Average time spend on board of a slave vessel per region of embarkation, 1681-1807, 20-year time intervals

	Senegambia TAC				Senegambia MP				Senegambia Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*Sd*	*N*	*TAC + MP*
1680 - 1700	**91**	80	41	13	**42**	36	19	31	**133**
1701 - 1720	**60**	61	24	12	**47**	43	15	28	**106**
1721 - 1740	**132**	104	83	69	**52**	42	48	70	**184**
1741 - 1760	**116**	83	85	80	**47**	43	20	65	**163**
1761 - 1780	**90**	62	81	58	**53**	42	41	71	**143**
1781 - 1800	**79**	63	55	91	**45**	38	26	117	**124**
	Sierra Leone TAC				Sierra Leone MP				Sierra Leone Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*Sd*	*N*	*TAC + MP*
1680 - 1799	**160**	155	65	4	**56**	48	21	10	**216**
1701 - 1720	**49**	49	33	2	**65**	56	26	4	**114**
1721 - 1740	**137**	117	30	3	**56**	56	19	5	**193**
1741 - 1760	**186**	141	133	17	**60**	52	24	15	**246**
1760 - 1780	**244**	227	168	15	**55**	54	18	25	**298**
1781 - 1800	**192**	168	116	54	**44**	43	13	76	**235**
	Windward Coast TAC				Windward Coast MP				Windward Coast Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*S.D*	*N*	*TAC + MP*
1680 - 1700	**ND**	ND	ND	ND	**ND**	ND	ND	ND	**ND**
1701 - 1720	**29**	29	23	2	**60**	59	17	4	**88**
1721 - 1740	**55**	55	8	2	**80**	80	34	2	**135**
1741 - 1760	**172**	173	55	23	**70**	61	23	22	**242**
1761 - 1780	**232**	204	95	20	**74**	62	29	21	**306**
1781 - 1800	**211**	161	142	38	**52**	50	16	46	**263**

	Gold Coast TAC				Gold Coast MP				Gold Coast Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*S.D*	*N*	*TAC + MP*
1680 - 1700	**107**	95	76	8	**78**	73	22	15	**184**
1701 - 1720	**133**	87	154	63	**68**	63	20	119	**201**
1721 - 1740	**117**	105	85	110	**82**	75	30	90	**199**
1741 - 1760	**134**	120	91	86	**94**	85	56	104	**229**
1761 - 1780	**130**	111	76	156	**84**	77	33	151	**214**
1781 - 1800	**147**	124	109	204	**68**	63	27	240	**215**
	Bight of Benin TAC				Bight of Benin MP				Bight of Benin Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*S.D*	*N*	*TAC + MP*
1680 - 1700	**73**	53	61	41	**91**	87	26	70	**164**
1701 - 1720	**96**	85	85	137	**85**	76	39	175	**182**
1721 - 1740	**113**	99	58	184	**97**	94	31	196	**210**
1741 - 1760	**152**	137	74	120	**117**	112	37	126	**269**
1761 - 1780	**191**	177	88	168	**100**	99	32	149	**291**
1781 - 1800	**130**	117	72	96	**64**	52	32	244	**194**
	Bight of Biafra TAC				Bight of Biafra MP				Bight of Biafra Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*S.D*	*N*	*TAC + MP*
1680 - 1700	**ND**	ND	ND	ND	**93**	85	28	16	**ND**
1701 - 1720	**ND**	ND	ND	ND	**91**	83	32	23	**ND**
1721 - 1740	**72**	72	0	1	**127**	94	80	3	**199**
1741 - 1760	**118**	128	63	17	**86**	82	24	19	**203**
1761 - 1780	**155**	127	114	42	**78**	78	25	57	**234**
1781 - 1800	**103**	91	76	195	**66**	60	32	243	**169**

	West Central Africa TAC				West Central Africa MP				West Central Africa Total Mean
Decades	*Mean*	*Median*	*S.D*	*N*	*Mean*	*Median*	*S.D*	*N*	*TAC + MP*
1680 - 1700	**78**	56	58	5	**84**	83	35	6	**162**
1701 - 1720	**115**	137	55	17	**58**	59	17	17	**174**
1721 - 1740	**139**	131	82	103	**58**	51	25	81	**197**
1741 - 1760	**179**	152	109	240	**49**	49	16	85	**228**
1761 - 1780	**163**	156	90	401	**58**	56	25	259	**222**
1781 -1800	**139**	133	71	361	**53**	50	17	488	**192**

Appendix Table 5: Price index of staple food basket (barley, beans, rice) on English and Dutch markets, 1681-1800 (1701 = 100)

year	Britain	NL	year	Britain	NL	year	Britain	NL
1681	103.9		1721	93.1		1761	81.2	
1682	111.5		1722	85.4	75.2	1762	76.6	
1683	104.2		1723	87.4		1763	96.1	
1684	106.6		1724	96.7		1764	93.6	
1685	119.5		1725	93.9		1765	92.4	
1686	108.2	86.4	1726	94.3		1766	96.1	
1687	73.0		1727	95.8		1767	96.1	
1688	70.1	86.2	1728	108.1	85.1	1768	91.9	
1689	81.1	94.9	1729	101.9		1769	73.7	
1690	79.8		1730	91.3		1770	74.7	
1691	79.1		1731	91.6	73.0	1771	87.6	
1692	86.5	112.0	1732	89.4		1772	95.8	
1693	101.7		1733	87.6		1773	98.6	
1694	99.6		1734	87.5		1774	96.7	
1695	99.2		1735	88.1		1775	92.3	
1696	122.9		1736	89.5		1776	91.5	112.4
1697	123.9		1737	97.4		1777	83.1	104.0
1698	127.2		1738	92.1	83.2	1778	91.0	111.6
1699	119.1		1739	95.4	82.9	1779	91.8	133.0
1700	108.2		1740	102.8		1780	120.9	129.6
1701	100.0	100.0	1741	98.5		1781	109.5	137.8
1702	101.9		1742	101.5		1782	112.5	124.8
1703	99.3		1743	93.8		1783	131.6	
1704	99.1		1744	88.4		1784	116.0	139.2
1705	87.9	103.5	1745	87.9		1785	109.0	119.5
1706	92.5		1746	81.8		1786	105.9	
1707	92.9		1747	87.2		1787	101.4	122.3
1708	96.9		1748	92.1		1788	96.5	116.3
1709	100.9		1749	96.1		1789	95.3	114.8
1710	108.0		1750	93.3		1790	102.1	
1711	107.0		1751	96.2		1791	103.1	
1712	100.8		1752	96.4		1792	108.5	
1713	97.3		1753	94.6		1793	117.0	
1714	97.3		1754	87.5		1794	119.1	
1715	98.0		1755	81.0		1795	140.3	
1716	92.2		1756	80.0		1796	134.6	
1717	89.5		1757	106.6		1797	104.7	
1718	87.2	100.2	1758	96.0		1798	103.4	
1719	92.4		1759	84.1		1799	125.7	
1720	100.3		1760	83.1	104.1	1800	191.3	

Appendix Table 6: Our estimates of the five-year average annual value of African-sourced provisions in the Atlantic slave trade, 1681-1807 (all estimates in constant British Pound sterling of 1700)

New world provisions at 20%

	Average annual value of slaves purchased (fob Europe/Americas)	Average annual value of slave provisions (fob Europe/Americas)	Average annual value of African-sourced slave provisions (fob Europe/Americas)	Average annual value of African-sourced provisions (c.i.f) (OUR ESTIMATES)	Average annual value of African-sourced provisions (ELTIS)
	1	**2**	**3**	**4**	**5**
1681-1685	107,587	21,517	16,000	**32,480**	55,407
1686-1690	86,610	17,322	12,043	**24,447**	44,604
1691-1695	110,731	22,146	15,097	**30,647**	57,026
1696-1700	202,723	40,545	31,710	**64,371**	104,402
1701-1705	196,478	41,986	32,789	**66,562**	101,186
1706-1710	196,241	37,383	28,665	**58,191**	101,064
1711-1715	248,689	59,579	45,936	**93,250**	128,075
1716-1720	361,423	78,978	62,297	**126,464**	186,133
1721-1725	512,750	87,627	67,742	**137,516**	264,066
1726-1730	392,838	68,864	54,658	**110,955**	202,312
1731-1735	262,800	60,350	47,170	**95,754**	135,342
1736-1740	385,436	87,318	67,764	**137,561**	198,500
1741-1745	405,049	78,565	49,726	**100,943**	208,600
1746-1750	449,280	67,117	47,714	**96,859**	231,379
1751-1755	537,147	84,801	54,153	**109,930**	276,631
1756-1760	396,019	61,509	44,798	**90,940**	203,950
1761-1765	796,786	84,934	57,943	**117,624**	410,345
1766-1770	1,246,728	96,768	59,459	**120,702**	642,065
1771-1775	1,503,464	105,134	64,839	**131,622**	774,284
1776-1780	698,969	56,824	31,983	**64,926**	359,969
1781-1785	1,317,247	113,308	68,133	**138,310**	678,382
1786-1790	2,381,871	146,573	73,085	**148,363**	1,226,664
1791-1795	1,717,428	126,445	78,975	**160,319**	884,475
1796-1800	1,812,184	107,428	74,118	**150,459**	933,275
1801-1807	2,165,957	108,298	75,091	**152,435**	1,115,468
1681-1807	**762,158**	**76,318**	**51,832**	**105,220**	**421,430**

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