Being Bad by Being Good: Owner and Captain Value-Added in the Slave Trade*

John T. Dalton† Wake Forest University

Tin Cheuk Leung‡ Wake Forest University

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Abstract

We use slave voyage data from 18th century Great Britain and France to answer two questions: 1) How important was the managerial quality of owners and captains in slave trading? and 2) What explains the substantial variation in managerial quality? Utilizing the *Trans-Atlantic Slave Trade Database*, in which we observe the performance of owners and captains in each of their voyages, we estimate the value-added of owners and captains to slave voyage output, i.e. the number of slaves arriving in the Americas. Several results emerge. First, if we replace all owners with the 90th percentile owner in the country, slave voyage output would be 16% and 21% higher than if we replaced all owners with the 10th percentile owner in Great Britain and in France. This 90/10 ratio is 1.22 for British captains. If we replace all owners with their country's 90th percentile owner, approximately 217,000 more slaves would have been exported over the course of the 18th century. Likewise, if all British captains were replaced with the 90th percentile captain, approximately 211,000 more slaves would have been exported. Second, owner value-added is negatively associated with family businesses and positively associated with the level of competition. A comparison of owner value-added before and after the unexpected outbreak of the Seven Years' War, which historians suggest decreased (increased) competition in the French (British) slave trade, suggests competition's effect on owner value-added might be causal.

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†Contact: Department of Economics, Kirby Hall, Wake Forest University, Box 7505, Winston-Salem, NC 27109. Email: daltonjt@wfu.edu

‡Contact: Department of Economics, Kirby Hall, Wake Forest University, Box 7505, Winston-Salem, NC 27109. Email: leungtc@wfu.edu

1 Introduction

Not all countries and firms were equally productive participants in the trans-Atlantic slave trade. Eltis and Richardson (1995), for example, show total factor productivity (TFP) was higher in the British than in the French slave trade industry. Dalton and Leung (2015) find large productivity variation within the slave trade industries of Great Britain, France, and Portugal. What explains the observed differences in productivity, even after controlling for technology and the level of inputs, such as capital and labor? Many economists have long thought managerial quality drives productivity differences, but data limitations regarding managers and management practices have led to a dearth of empirical findings (Syverson 2011).[1] These constraints are less severe for the historical case of the trans-Atlantic slave trade given the richness of the data available in the *Trans-Atlantic Slave Trade Database*. This paper examines one determinant of the slave trade by quantifying the contribution of managerial quality on the supply of slaves. To the best of our knowledge, we are the first to do so.

Specifically, we ask how important are the fixed effects of managerial quality? And, what explains the substantial variation in managerial quality? To answer these questions, we study the value-added of owners and captains to slave voyage output, measured as the number of slaves disembarked, during the trans-Atlantic slave trade in Great Britain and France during the 18th century.[2] In their capacities as managers, both owners and captains performed a variety of tasks influencing the outcomes of a slave voyage. From securing financing for the voyage to assembling ship and crew, especially the all-important decision about who to hire as captain, owners exerted influence over the slave trade from their positions in European ports. Once the voyage was underway, a captain's knowledge of markets in Africa and the Americas and his

[1] It is important to emphasize we are not suggesting managerial quality is the only or most important determinant of the variation observed in the slave trade. Differences in institutional efficiency are likely a main culprit, as discussed in Eltis and Richardson (1995) and explored in detail by Dalton and Leung (2015) in the context of a structural model. Dalton and Leung (2015) find eliminating market distortions would have increased TFP in the slave trade by 22% in Great Britain, 45% in Portugal, and 123% in France.

[2] We use the term *value-added* in order to be consistent with and avoid any confusion about our paper's methodology, which we adopt from the teacher value-added literature. The data we use to conduct our analysis allows us to measure the performance of an owner and captain during each slave voyage, which is similar to the data used to measure teacher performance across their different classes. McCaffrey, Lockwood, Koretz, and Hamilton (2003) provide a survey of the teacher value-added literature. We acknowledge associating the term value-added with slave traders sounds uncomfortable, but we are only using it in the technical sense derived from our methodology.

management of the vessel determined the success of the voyage and how many enslaved Africans disembarked in the New World. Stein (1979, p. 66-67) captures the historian's view as follows: "Choosing a captain was not a decision to be undertaken lightly, for no single person besides the armateur [or owner] himself had as much influence over the expedition's ultimate success as did the captain."[3]

Our analysis proceeds in three steps. First, we make use of the *Trans-Atlantic Slave Trade Database* to identify unique owners in Great Britain and France who have owned multiple slave voyages. Compared to the standard plant-level or firm-level data which document the overall performance of the plant or firm in a particular time period (say, a year), our data record the performance of an owner and captain in each task or production run, i.e. a slave voyage.

In the second step of our analysis, we use the data on the different voyages to estimate owner and captain value-added to slave voyage output. While we are not able to quantitatively trace the management practices serving as sources of owner value-added to slave voyage outputs, we find that if we replace all owners with the 90th percentile owner in the country, slave voyage output would be 16% and 21% higher than if we replaced all owners with the 10th percentile owner in Great Britain and in France, respectively. If we replace all owners in Great Britain and France with their respective 90th percentile owner, our estimates imply nearly 217,000 more enslaved Africans would have been exported over the course of the 18th century in the combined trade. Our sample only represents 56% of the recorded slaves exported by the British and French during the 18th century, which means, if our estimates are unbiased, the number of slaves exported under the 90th percentile owner would be nearly double. These results suggest owners played a significant role in determining how many slaves arrived in the Americas during the trans-Atlantic slave trades.

Third, we test whether slave owner value-added is associated with some of the owners' characteristics and the market structure, which we find is the case in both an economically and statistically significant way. In particular, our value-added estimates are negatively associated with family businesses and positively associated with the competition level. We use the unexpected outbreak of the Seven Years' War, which historians suggest decreased (increased) the

[3]This view appears repeatedly throughout the literature on the history of the slave trades. Klein (1999, p. 83) is another example: "After the owners, the second most important participant was the captain."

market size for French (British) owners and, therefore, decreased (increased) competition in the French (British) slave trade (Holmes and Schmitz 2010), to show that competition has a causal impact on owner value-added. Insofar as the slave trade industry provides a window into the British and French economies at the time, our results suggest managerial quality, driven by competition, mattered significantly for firm outcomes.

We also use the same approach to quantify the value-added of British slave captains who have captained multiple slave voyages in our data.[4] The 90/10 ratio for British captains is 1.22. If we replace all British captains by the 90th percentile captain, our estimates imply nearly 211,000 more slaves would have been exported from Africa during the 18th century. We find captain value-added is also significantly associated with family businesses and market structure.

Since our estimation technique relies on underlying data from the *Trans-Atlantic Slave Trade Database*, including ship tonnage, which is our measure of the capital input of a voyage, we need to address the concerns raised by Solar and Duquette (2017) about this variable in the database. Solar and Duquette (2017) present a detailed discussion laying out the problems associated with these data, which, in short, revolve around inappropriate adjustments used to construct standardized tonnages. The authors show their preferred measure of British tonnage from Lloyd's Registers lies between the lower bound of unstandardized tonnage and the upper bound of standardized tonnage during the years 1763-1786. After the passage of the British Ship Registration Act of 1786, the discrepancies between the series largely go away. Solar and Duquette (2017) show the choice of tonnage matters in the case of ship crowding and slave mortality and caution researchers about the use of the tonnage data. To mitigate concerns over our tonnage variable, we conduct our analysis using both the unstandardized and standardized tonnage variables, which act as lower and upper bounds on our capital input. Given the fewer concerns with the unstandardized tonnage variable, we present those results throughout the paper and confine those using the standardized tonnage to a limited number of places where it is fruitful to make the comparison and understand how the tonnage variable affects our results.[5] Although the concern over the tonnage variable is valid, it does not change the main point of our paper, i.e. successfully quantifying and showing the important role played by owners

[4]The data prevent us from calculating estimates for French captains.

[5]Of course, all our results using the standardized tonnage are available upon request.

and captains on slave voyage outcomes, as we can always restrict our analysis to the post-1786 period.

This paper contributes to the growing literature on the study of the African slave trades, in particular on factors impacting the demand and supply dynamics of the trade. These factors include geography, such as rugged terrain (Nunn and Puga 2012); climate change and natural disaster (Boxell 2015, Fenske and Kala 2015, Hartwig 1979, Miller 1982); the "raid or be raided" arms race initiated by the gun-slave cycle (Whatley 2018); distortions in product and input markets (Dalton and Leung 2015); and political conflict among ethnic groups (Curtin 1975, Engerman, Genovese, and Adamson 1975, Thornton 1998, Klein 1999, Thomas 1997). Our paper contributes to this literature on the demand and supply dynamics of the slave trade by quantifying the role played by owner and captain value-added on the supply of slaves.

In the remainder of the paper, we develop our analysis as follows: We begin in Section 2 by describing the historical background of the slave trade with a focus on the managerial roles played by owners and captains in a typical voyage. Section 3 describes the data used in our empirical analysis. We then construct our empirical model and present the results in Section 4. Section 5 concludes.

2 Historical Background

Owners and captains filled the two most important management roles in conducting a slave voyage. In this section, we provide historical background on the tasks involved in fulfilling each of these management roles and show their importance in determining the overall success of the voyage. We argue the qualitative historical evidence suggests the managerial quality of owners and captains played a significant role in influencing the number of Africans disembarked in the Americas. Owners oversaw the organization of slave voyages in European ports from the highest level. Their primary tasks involved securing financial backing and working out the mechanics of the voyage, such as securing a ship and assembling a crew. Captains helped prepare aspects of the voyage in port, but they gained complete control once sailing began. Through their knowledge of markets in Africa and the Americas, navigation experience, role in determining ship hygiene, and maintaining order on board the ship, captains influenced the success of a

voyage and the number of slaves exported from Africa.

2.1 Owners

Organizing a slave voyage was a complex and time consuming task.[6] Owners typically brought with them years of experience in maritime commerce before engaging in the slave trade, though, and some owners were previously captains of a slave voyage themselves or the sons of captains. The variation in experience would have contributed to variation in owners' managerial quality.

Market structure and the level of competition would have impacted both the level of and variation in owners' managerial quality. Since market power insulates firms from competition, entry into the slave trade and the overall managerial quality of owners could have suffered in the presence of market restrictions. Indeed, much of the period of the slave trades can be characterized by well-documented mercantilist policies imposed by various European states, a point discussed in Eltis and Richardson (1995) and Dalton and Leung (2015). In these types of economies, owners with close connections to royal families and the state would be in more advantageous positions than owners without such connections. The degree of mercantilist polices varied across Great Britain and France. For example, the Royal African Company lost its monopoly on the British slave trades at the end of the 17th century, whereas state monopolies, such as the Compagnie des Indes, only gradually lost market power in the French slave trades over the first half of the 18th century. The French slave trades were also characterized by the Acquits de Guinée, an elaborate subsidy system, and the Compagnie du Sénégal maintained monopoly rights over exporting slaves from Senegambia. Thomas (1997, p. 292) goes so far as to assert "the prime mover in the slaving business was the state."

An owner's first order of business was to secure financial backing for the voyage. The slave trade was an expensive and risky undertaking, so owners needed substantial resources at their disposal. Differential access to capital markets gave rise to variation across owners and the size of the voyages they were able to undertake. Dalton and Leung (2015) show differential access to capital markets contributed to resource misallocation, and, thus, TFP losses, in the slave trade. In the case of French owners, Stein (1979) points out the owner's relation to bankers

[6] Our discussion of owners is based largely off of Thomas (1997) for the slave trade in general and Stein (1979) and Behrendt (2007) for the French and British cases in particular.

in Paris played an important role in the owner's ability to finance voyages. Owners also often sold shares in the voyage, so they required the marketing skills necessary to lure in interested investors. The most important resource for financing voyages would have been the owner's family. Arrangements between father and son, brother and brother, and in-laws were common, not only for financing but also for organizing the voyage as a whole. Thomas (1997, p. 296) notes, "The most frequent type of association, in Liverpool as in Newport, in Nantes as in Rio, leading to a slave voyage was one of relations, the only tie which could be trusted to endure. So the slave trade seemed, to a great extent, a thing of families..." Although family businesses were clearly important for financing voyages, not having access to these networks could have formed a barrier to entry to potential owners, which then could have decreased overall owners' managerial quality in the slave trade.

Once financing was underway, owners turned their attention to the mechanical aspects of the voyage, which, as Stein (1979, p. 66) notes, included "assembling a crew, obtaining a ship and cargo, and fulfilling certain formalities [such as purchasing insurance and obtaining licences to buy and sell slaves in Africa and the Americas]." One of the owner's most important decisions was the choice of captain, the reasons for which we discuss below when detailing the role captains played on a voyage. Owners interviewed captains as part of the normal job hiring process. Postma (1990) notes the difficulties owners sometimes faced in finding competent captains for the Dutch slave trade. Likewise, Behrendt (2007) notes shortages of experienced mariners, which occurred because of high mortality, desertion, and press gangs during war, were a constant problem for British owners trying to assemble crews. This lead to competition between owners, especially when trying to hire the stars of the captain market (Behrendt 2007, p. 72):

> Shipowners competed to hire the few captain-princes whose bargaining power befitted their senior diplomatic and commercial status and role as teachers. As one merchant noted in 1789: 'The Masters of the Vessels employed in the African Slave-Trade have a Knowledge of the Wants of that Coast, and possess an Influence with the Black Traders, which no new Set of Men can at once acquire.'

Once hired, owners gave captains instructions about the voyage, such as where to buy and sell

slaves in Africa and the Americas and how many slaves to purchase. Underlying these instructions was an accumulation of knowledge on the part of owners about slave markets throughout the Atlantic. Owners maintained correspondence with a network of contacts throughout the markets in order to stay up to date on the details about current prices, shipments, and other relevant information for the success of their own slave voyage. This information, along with the captain's own expertise as we discuss below, helped inform the decision about what mix of cargo was required to trade for slaves along the African coast. Owners recognized the value of the information gathered from their correspondence and guarded these secrets carefully, going so far as to not reveal the contents of their ships, as Stein (1979, p. 176) points out in the case of France: "Members of the Nantes Consulat declared, 'We are absolutely ignorant of the objects which go out in each ship for the islands. That is the armateur's secret, and he could not divulge it without exposing himself to a ruinous competition.' "[7]

Although the decision about who to hire as captain was the most important, owners still needed to make good decisions when hiring the rest of the crew. For example, the decisions about which doctors and carpenters to hire would have an impact on the outcome of the voyage, doctors for their role in keeping crew and slaves alive and carpenters for their expertise in ship design. Owners often purchased vessels previously unconnected to the slave trade, so carpenters were needed to redesign the hulls to carry their human cargo. Carpenter expertise on the optimal hull design would have an impact on how many slaves could fit on board and what crowding conditions would be like.

2.2 Captains

Once a slave voyage was underway, captains performed a variety of tasks as managers ((Thomas 1997, p. 307):[8]

> The captain had to be a man of parts. He was the heart and soul of the whole voyage, and had to be able, above all, to negotiate prices of slaves with African merchants or kings, strong enough to survive the West African climate and to stand storms, calms, and loss of equipment. He had to have the presence of mind to deal with

[7]The word *armateur* used here refers to the French owner of the slave voyage.

[8]Our discussion here in Section 2.2 expands on our brief discussion of captains in Dalton and Leung (2015).

> difficult crews who might jump ship, and he had to be ready to face, coolly and with courage, slave rebellions.

A captain's managerial quality, thus, influenced the outcomes of the slave voyage, like profits and the number of slaves disembarked in the Americas. Behrendt (1991) stresses the importance of captains in the slave trade relative to other trades: "More than any other trade, the slave merchants' profits depended on the captain's ability." The prominent role played by captains in the slave trade may be due to the nature of the human cargo, which required larger crews to handle.[9] Crowded ship conditions proved deadly for many enslaved Africans, slave rebellions on board were a constant threat, and interactions between crew members and slaves caused tension. Coupling these unique conditions with the normal attributes of a captain, like knowledge of navigation and expertise in trading on the African coast, the importance of a captain's managerial quality becomes clear.[10]

Captains' decisions began in the ports of Europe, as they often oversaw the preparations for a slave voyage, including the important question of what mix of cargo to load on board to exchange for slaves on the African coast (Postma 1990). In order to best answer this question, captains required detailed knowledge of the demand conditions in Africa. Such knowledge impacted voyage outcomes not only through its effect on the price paid for slaves but also because it partly determined the time required to purchase and load slaves from the African coast. The more time spent on the African coast purchasing and loading slaves, the longer some slaves would spend on the ship, which lengthened their exposure to crowding and shipborne illnesses. Hogerzeil and Richardson (2007) show that the death rates during loading are around 204 per 1,000 person-years. Likewise, as Behrendt (1991) points out, captains required knowledge of the

[9] Behrendt (2007) discusses the increased crew sizes for British slave voyages in the following passage:

> ...the peculiar trade in human cargo required outfitters to hire comparatively large crews of skilled shipmates. Whereas a typical West Indiamen that measured 250-300 tons generally mustered a captain, one or two mates, a cooper, a cook and 15-20 seamen, the same ship carrying enslaved Africans would enroll an additional 20 men as coastal traders, craftsmen or guards.

[10] Contracts between owners and captains could also make explicit the many tasks captains were expected to perform. Postma (1990) reprints the contract for captains sailing ships for the Middelburgsche Commercie Compagnie, a Dutch slave trading company. To summarize the responsibilities in the contract, captains should 1) sail to the African coast as quickly as possible, 2) purchase high quality slaves, 3) not be attacked by the slaves, 4) make sure the slaves are not mistreated by the crew, 5) make sure the slaves are treated well and taken care of by the doctor, and 6) properly brand the slaves so as not to badly injure them.

markets in the Americas where they would sell slaves.

Once a voyage departed Europe, a captain's knowledge and experience of navigation and sailing began to play a role. According to Thomas (1997), French captains were required to take exams before commanding a slave ship. Captains often carried libraries of books on maritime techniques. Better sailing expertise meant faster arrival to the Americas and less risk for slaves dying on board. Hogerzeil and Richardson (2007) show that survival rates for slaves, in particular male slaves, dropped significantly when the number of days sailing went beyond 100. Rawley (1981) notes captains needed knowledge of the African coastline and ocean currents. Prior sailing experience along the routes of the slave trade presumably made for better captains. Behrendt (1991) documents the fact that many Liverpool captains had backgrounds in the West India trade. Many future captains already had experience on slave voyages as lower ranked crew members before receiving their first command.

Captains also played an important role in determining the overall hygiene conditions on the ship (Rawley 1981), which impacted slave and crew mortality rates during the voyage. Even if a ship carried a doctor on board, captains exerted influence over hygiene by virtue of rank, i.e. they oversaw the doctor's operations and influenced the doctor's ability to provide care to both slaves and crew.[11] Rawley (1981) notes, for example, captains were responsible for the doctor receiving any needed medical supplies through their role in determining the ship's provisions. Similarly, if a captain understood the role of air ventilation in fostering cleanliness, it would lead to better practices on board, which helped slaves survive the Middle Passage. Harms (2002) notes captains were responsible for rationing food and water. Behrendt (1991) cites the importance of a captain's knowledge related to maritime and tropical diseases and their

[11]The British Parliament acknowledged the importance of the connection between captain, doctor, and the ship's hygiene with the passage of the Dolben Act of 1788, which was designed to improve mortality rates in the British slave trade. Behrendt (1991) provides a detailed discussion. The Dolben Act required every ship in the slave trade to have a surgeon on board. Moreover, the Dolben Act incentivized the promotion of surgeons to captain by requiring new captains to "...have served as chief mate or surgeon during the whole of two voyages, or either as chief or other mate, during three voyages, in purchasing and carrying slaves from the coast of Africa" (Donnan 1930). Merchants began to prefer promoted surgeons as captains for a variety of reasons. One, the slave voyage would now have two officers with medical knowledge, the promoted surgeon as the new captain and the additional required surgeon. Two, conflict between captain and surgeon regarding the ship's hygiene would likely be reduced, because both officers would have medical training. Three, the higher level of education required of surgeons was thought to be beneficial for a captain. As a result of these forces, the Dolben Act likely helped improve captains' managerial quality, especially along the dimension needed for managing health issues on board ships.

treatments. Captains' decisions regarding ship crowding could be fatal. For example, Solar and Duquette (2017) show a one standard deviation increase in crowding was associated with an increase of between 4.9 and 6.2 percentage points in slave mortality on British slave ships.

Maintaining crew discipline and obedience from the slaves provided additional obstacles for the captain's management of a slave voyage (Harms 2002). Behrendt (1991, p. 103) cites the memoirs of Hugh Crow, a captain in the British slave trade, as evidence for why some captains might not maintain their command on subsequent voyages. Speaking of a Captain Gilbert Rigby, Crow writes Rigby "had neither the firmness nor the tact to keep others in subjection" and that his crew became insubordinate. Slave rebellion was always a possibility, but better captains had knowledge of which slaves, or mix of slaves, were more prone to violence and rebellion and could adjust the ship's security accordingly. Rawley (1981, p. 298), reporting on a Captain James Fraser, notes this skill: "...he seldom confined Angola slaves, 'being very peaceable,' took off the handcuffs of Windward and Gold Coast slaves as soon as the ship was out of sight of land, and soon after that the leg irons, but Bonny slaves, whom he thought vicious, were kept under stricter confinement."

3 Data

Our data on slave ship owners come from the *Trans-Atlantic Slave Trade Database*, which resides online at `http://www.slavevoyages.org`. The data consist of information on 34,948 voyages between the years 1514 and 1866 and are widely used by historians and economics historians in their study of the African slave trades. Eltis and Richardson (2010) provides a useful visual summary in the form of an atlas. We only consider those voyages for Great Britain and France during the 1700s, because these voyages have the best coverage in the data. We drop those observations with only the owner's last name. Different owners may still have the same first and last names. There is no perfect way to completely solve this problem. One potential problem is that different owners with the same first and last name appear in years that are very far apart. In our final sample, only 6% (2%) and 5% (1%) of the owners in Great Britain and France have first and last appearances in the data that are 30 (40) years apart.

We exploit the richness of the *Trans-Atlantic Slave Trade Database* to construct the variables

in our data. The variable *tonnage* measures the ship's tonnage, or size. This is the unstandardized tonnage alluded to during our discussion of Solar and Duquette (2017) in the introduction to the paper. We use *crew1* for the crew size. Number of slaves disembarked, *slamimp*, is our measure of voyage-level output. The variable *ownera* records the full name of the first owner, which we use to identify the main owner of a voyage.[12] The variables *yeardep* and *datedepb* identify the year and month of the departure. *natinimp* identifies the country. *ptdepimp* identifies the port of departure.

We also construct variables about owners' characteristics. We construct a dummy variable *Company* to identify if the main owner of the voyage is a company. *Family Business* is a dummy variable that is equal to one if either family relationship (such as father-son partnership) is listed in the owner's name or the two largest owners (*ownera* and *ownerb* in the dataset) share the same last name. *Family Captain* is a dummy variable that is equal to one if the captain's last name is the same to either one of the three largest owners of the voyage. The *Trans-Atlantic Slave Trade Database* also records at most 16 different owners (variables *ownera* to *ownerp*), which we use to construct a variable to record the number of owners of each voyage.

Figure 1: Distribution of Owners' Appearances in the Data

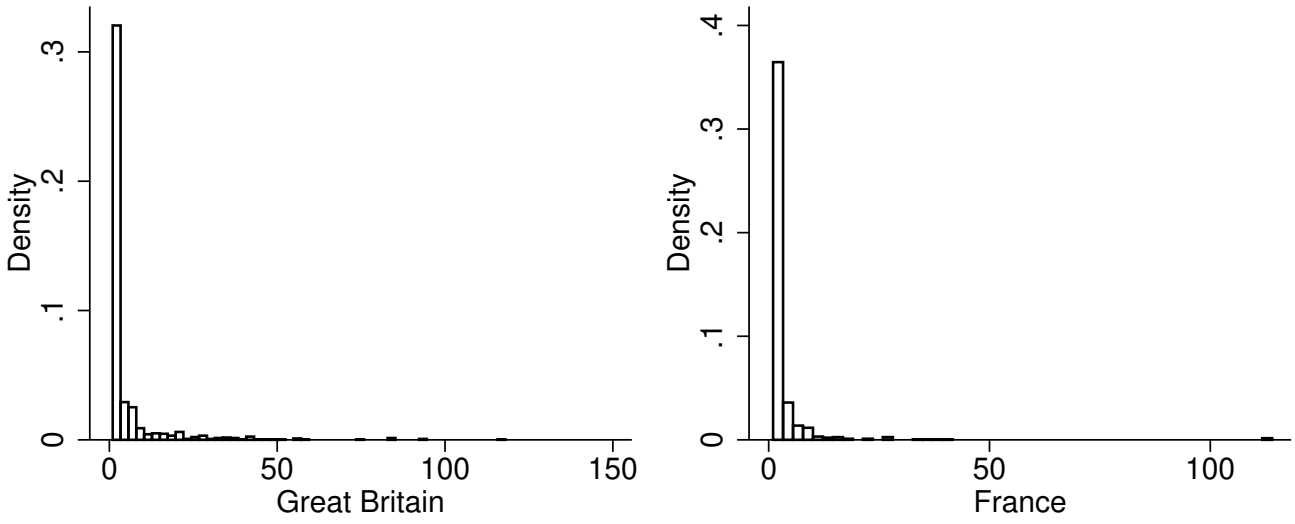


Figure 1 shows the distribution of the number of appearances of owners in our data. A

[12] We follow the suggestion in the documentation available at `http://www.slavevoyages.org` in deciding to use the first listed owner as the main owner.

significant portion of owners appear only once in the data. We see multiple appearances of owners more often in Great Britain than in France, with the average number of appearance being 4.90 (with a standard deviation of 17.65) in the former and 2.97 (with a standard deviation of 8.06) in the latter. As we show in the following section, we use within-owner variation to identify the capital and labor share in the production function, so we only include those voyages with owners that appear in the data at least three times. The average number of appearances in the resulting sample is 12.22 (with a standard deviation of 15.67) in Great Britain and 8.35 (with a standard deviation of 14.35) in France.

Table 1: Data Selection

	Great Britain	France
Voyages in 1700s	7453	3194
Drop Missing Tonnage	6770	3112
Drop Missing Crew Size	5066	2188
Drop Missing Slaves Disembarked	4871	2132
Drop Owners that Appear less than Three Times	3918	1381
Unique Owners	351	196

Table 1 shows how we select our sample. Initially there are 7453 British voyages and 3194 French voyages in the 1700s. We then drop those observations in which information on either tonnage (our measure of capital), crew size (our measure of labor), or slaves disembarked (our measure of slave voyage output) is missing. This leaves us with 4871 and 2132 voyages in Great Britain and France. Finally, we keep only those voyages in which owners appear in our data at least three times. The final sample includes 3918 voyages and 1381 voyages in Great Britain and in France, respectively. These voyages are owned by 351 and 196 unique owners in Great Britain and France.

Table 2 compares the summary statistics of the data in different cuts. The first three columns of the table report the summary statistics of British voyages, and the last three columns report the summary statistics of French voyages. The first column for each country reports the statistics of voyages with missing information on either tonnage, crew size, or slaves disembarked. The second column for each country reports the statistics for voyages whose owners appear less than three times in the data. The third column for each country reports the statistics of the final sample used in our main analysis.

Table 2: Voyage-level Summary Statistics[a]

	Great Britain			*France*		
	Missing Info	Owner App < 3	Final Sample	Missing Info	Owner App < 3	Final Sample
Production Variables						
Ship Tonnage	124.41	122.52	136.58	220.15	209.26	228.80
	(80.97)	(73.52)	(80.09)	(187.56)	(172.87)	(165.49)
Crew Size	28.86	26.59	30.25	32.45	37.09	41.38
	(17.93)	(11.51)	(11.46)	(26.09)	(20.68)	(17.55)
Slaves	208.46	223.57	256.65	259.81	261.44	310.05
Disembarked	(100.23)	(110.73)	(109.26)	(126.52)	(133.07)	(132.45)
Owners' Characteristics						
Company	0.29	0.31	0.31	0.18	0.27	0.25
	(0.45)	(0.46)	(0.46)	(0.39)	(0.45)	(0.43)
Family Business	0.05	0.06	0.08	0.01	0.01	0.02
	(0.21)	(0.24)	(0.27)	(0.10)	(0.10)	(0.12)
Family Captain	0.06	0.15	0.05	0.05	0.02	0.01
	(0.25)	(0.36)	(0.22)	(0.21)	(0.15)	(0.09)
Number of Owners	2.35	2.72	3.21	1.29	1.37	1.38
of the Voyage	(1.93)	(2.29)	(2.47)	(0.56)	(0.61)	(0.59)
Port						
Liverpool	0.30	0.47	0.64			
	(0.45)	(0.50)	(0.48)			
Bristol	0.18	0.21	0.28			
	(0.39)	(0.41)	(0.45)			
London	0.35	0.28	0.08			
	(0.41)	(0.33)	(0.24)			
Nantes				0.15	0.58	0.60
				(0.36)	(0.49)	(0.49)
Saint-Malo				0.04	0.11	0.06
				(0.20)	(0.31)	(0.23)
Lorient				0.01	0.01	0.11
				(0.12)	(0.21)	(0.28)

[a] The numbers reported are the mean with std. dev. in parentheses.

Overall, the voyages in the final sample are very similar to the dropped voyages in terms of sizes and owners' characteristics. In both countries, the capital and labor inputs (ship tonnage and crew size) are close in magnitude between the final sample and the dropped samples. The outputs, however, are slightly higher in the final sample, indicating that the productivity of voyages in the final sample are slightly higher than voyages with missing information or whose owners appear less than three times in the data. These patterns are the same if instead we use the variable *tonmod* for ship tonnage, which is the standardized tonnage alluded to in our discussion of Solar and Duquette (2017) in the introduction of the paper. In this case, the mean

of the tonnage increases in the final sample in Great Britain from 136.58 to 190.09. Likewise, the mean of the tonnage increases from 228.80 to 259.10 for France. This is why we say the unstandardized and standardized tonnages act as lower and upper bounds to our measure of the capital input. We return to this point in Sections 4.1 and 4.2 when discussing how the capital input affects our estimates of owner value-added.

The owners' characteristics are also very similar between the final sample and the dropped samples. Approximately 30% and 25% of the voyages were owned by a company in Great Britain and in France, respectively. Family businesses had a bigger influence in the British slave trade than in the French. Approximately 8% of voyages were owned by families in Great Britain, and only 2% of them in France. British owners hired family member as captains 5% of the time in our final sample, while only 1% of the French voyages hired family captains. There were, on average, more owners per voyage in Great Britain (3.2 owners per voyage) than in France (1.4).

Owners in some ports tend to appear more times than owners in other ports. A significant portion of London owners appeared only once in the data and were dropped in the final sample. Owners in Liverpool and Bristol, thus, represent a larger portion in the final sample than in the original sample. Also, most French owners in ports other than the three main slaving ports (Lorient, Nantes, and Saint-Malo) are also dropped because of missing information or limited appearance in the data. Owners in the three main French ports represent the majority share (77%) of all voyages in the final sample.

4 Empirical Model and Results

4.1 Owner Value-Added to Voyage Output

In order to measure the owner's contribution to slave voyage output, we follow Dalton and Leung (2015) to adopt a Lucas span-of-control approach (Lucas 1978) by assuming the following production function for each voyage i financed by owner j at time t:

$$\begin{aligned} Y^*_{ijt} &= (A_{it}\Phi_j)K^{\alpha}_{it}L^{\beta}_{it} \\ &= (A_{it}\Phi_j)(\eta\hat{K}_{it})^{\alpha}L^{\beta}_{it} \\ &= \hat{A_{ijt}}\hat{K_{it}}^{\alpha}L^{\beta}_{it}, \end{aligned} \tag{1}$$

where Y^*_{ijt} is the number of slaves disembarked in the Americas, Φ_j is the owner's managerial input or value-added (assumed constant over time), K_{it} is capital, and L_{it} is the number of crew, all for voyage i.[13] α and β, with $0 < \alpha + \beta < 1$, represent the shares of capital and labor in production, which we will assume constant across voyages due to data constraints. A_{it} is unadjusted TFP. We only observe a voyage's ship tonnage $\hat{K}_{it}$ in the data, which is a proxy for the voyage's total capital K_{it}. As in Dalton and Leung (2015), the manipulations in (1) show how we adjust ship tonnage by the factor η and incorporate the owner's effect to arrive at our final production function for disembarked slaves in terms of ship tonnage, number of crew, and TFP, $\hat{A}_{ijt}$.

The whole point of our approach will be to use the structure provided by the production function in equation (1) to estimate the owner's value-added, Φ_j. Using equation (1), we can already see how the choice of the unstandardized versus standardized tonnage variable should affect the results. A lower capital input (unstandardized tonnage in this case) will increase TFP, which means owner value-added is likely to increase as well. This is precisely what we find in Section 4.2.

Returning to our procedure, we first use the information on the names of owners to identify a unique owner. We can then take log and rewrite equation (1) as

$$\ln Y^*_{ijt} = \alpha \ln \hat{K}_{it} + \beta \ln L_{it} + \delta_t + \mu_{ijt}, \text{ where } \mu_{ijt} = \Phi_j + \epsilon_{ijt}, \tag{2}$$

where we now include δ_t as a time dummy. The residual (μ_{ijt}) is assumed to be composed of the owner's value-added (Φ_j) and an idiosyncratic voyage effect that varies across voyages and over time (ϵ_{ijt}).[14]

[13] We assume that slaves disembarked are homogeneous goods. In general, this is, of course, not true. For instance, both male and female slaves were exported. But, in our data, the average proportion of male slaves exported is approximately 0.63 for the two countries studied, with a standard deviation of below 0.1.

[14] Similar to equation (2) in which α and β are estimated separately, we also use a second method that makes use of historical estimates on labor and capital shares in the slave trade to estimate the production function, which is similar to the approach adopted in Dalton and Leung (2015):

$$\ln Y^*_{ijt} = \gamma \left[\bar{\alpha} \ln \hat{K}_{it} + (1-\bar{\alpha})\beta \ln L_{it}\right] + \delta_t + \mu_{ijt} = \gamma \ln Z_i + \delta_t + \Phi_j + \epsilon_{ijt}, \tag{3}$$

where $\bar{\alpha}$ and $1-\bar{\alpha}$ represent historical estimates on capital and labor shares and γ is the so called span-of-control parameter governing the returns to scale. The historical estimates of capital and labor shares are taken from Eltis and Richardson (1995). The main results are very similar and, thus, are not reported here. Interested readers can contact the authors for this set of results.

The data allows us to observe the performance of an owner in each of his voyages. We follow previous literature (Chetty, Friedman, and Rockoff 2014, Kane and Staiger 2008) to construct an unbiased estimator of Φ_j. The controls ($\ln \hat{K}_{it}$ and $\ln L_{it}$) and ϵ_{ijt} may be correlated with Φ_j. We, therefore, construct the estimator in three steps. We first regress log slave voyage output on the observables and, then, compute the output residuals adjusting for observables. Next, we construct the best linear predictor of mean output residuals in year t based on mean output residuals in prior years. Finally, we use the coefficients of the best linear predictor to predict each owner's value-added at time t. We now describe these steps formally.

First, we regress $\ln Y^*_{ijt}$ on $\ln \hat{K}_{it}$ and $\ln L_{it}$, with owner fixed effects and time fixed effects, to compute the log output residuals adjusting for observables. In particular, we estimate α and β using an OLS regression of the form

$$\ln Y^*_{ijt} = \tau_j + \alpha \ln \hat{K}_{it} + \beta \ln L_{it} + \delta_t + \varepsilon_{ijt}, \tag{4}$$

where τ_j is an owner fixed effect. The residuals of slave voyage output, after adjusting for observables, are

$$\ln Y_{ijt} = \ln Y^*_{ijt} - \alpha \ln \hat{K}_{it} - \beta \ln L_{it} - \delta_t = \mu_{ijt} = \Phi_j + \epsilon_{ijt}. \tag{5}$$

We only include observations in which the owner appears in our data at least three times to allow for enough within-owner observation.[15] We, thus, estimate α and β using within owner variation. Because it is natural to think that owner value-added is correlated with $\ln \hat{K}_{it}$ and $\ln L_{it}$, estimates of α and β in a specification without owner fixed effects would overstate the importance of the controls. As table 3 shows, the estimates are somewhat different between specifications with and without owner fixed effects.

Second, we follow Raudenbush and Bryk (2002)'s approach to construct the empirical Bayes estimate of owner value-added. Indeed, our estimator is also similar to the one in Kane, Rockoff, and Staiger (2008) and Kane and Staiger (2008) and the special case in Chetty, Friedman, and Rockoff (2014), in which value-added is constant over time.[16] The empirical Bayes estimate is a

[15] We vary this minimum appearance restriction from two to four times. Results are similar.

[16] The major difference is that they assume the value-added has a zero mean, while we do not pose such restriction.

Table 3: OLS Regression of Slave Outputs[a]

	Britain			*France*		
	(1)	(2)	(3)	(4)	(5)	(6)
Capital Share	0.343***	0.370***	0.410***	0.261***	0.126***	0.189***
(α)	(0.013)	(0.017)	(0.020)	(0.029)	(0.041)	(0.047)
Labor Share	0.477***	0.458***	0.373***	0.518***	0.730***	0.740***
(β)	(0.018)	(0.020)	(0.023)	(0.043)	(0.056)	(0.064)
Time Dummy	No	Yes	Yes	No	Yes	Yes
Owners Fixed Effects	No	No	Yes	No	No	Yes
Adj. R^2	0.508	0.514	0.509	0.380	0.442	0.425
N	3917	3917	3917	1380	1380	1380

[a] Standard errors are reported in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

best linear predictor of the random owner effect in equation (2). The intuition of the approach is to form a weighted average using a noisy estimate of owner value-added (such as the mean of the residual outputs over owner j's career, $\ln \bar{Y}_j = \frac{\sum_{i,t} \ln Y_{ijt}}{n_j}$, where n_j is the total number of voyages financed by owner j) and the mean of the residual outputs of all owners in the country ($\ln \bar{Y} = \frac{\sum_{i,j,t} \ln Y_{ijt}}{\sum_j n_j}$), with the weight on the former being its "reliability" (which is the ratio of signal variance to signal variance plus noise variance) and the weight on the latter being 1 minus the reliability. With fewer observations per owner, the noise variance would increase, and, thus, the reliability estimate would shrink back toward $\ln \bar{Y}$.

We construct our estimator in the following steps:

1. We estimate the variance of the owner (Φ_j) and voyage (ϵ_{ijt}) components of the residual (μ_{ijt}) from equation (2). The within-owner-5-year-period variance in μ_{ijt} was used as an estimate of the variance of the voyage component:

$$\hat{\sigma}^2_\epsilon = Var(\mu_{ijt} - \bar{\mu}_{jt}), \tag{6}$$

   where $\bar{\mu}_{jt}$ is the owner's mean residual. The variance of the owner component is the difference between the total variance of $\ln Y_{it}$ ($Var(\ln Y_{it})$) and the estimate of the voyage component:

$$\hat{\sigma}^2_\Phi = Var(\ln Y_{it}) - \hat{\sigma}^2_\epsilon. \tag{7}$$

2. We construct an empirical Bayes estimator of each owner's value-added by multiplying

the mean residual outputs over owner j's career ($\ln \bar{Y}_j = \frac{\sum_{i,t} \ln Y_{ijt}}{n_j}$) by an estimate of its reliability:

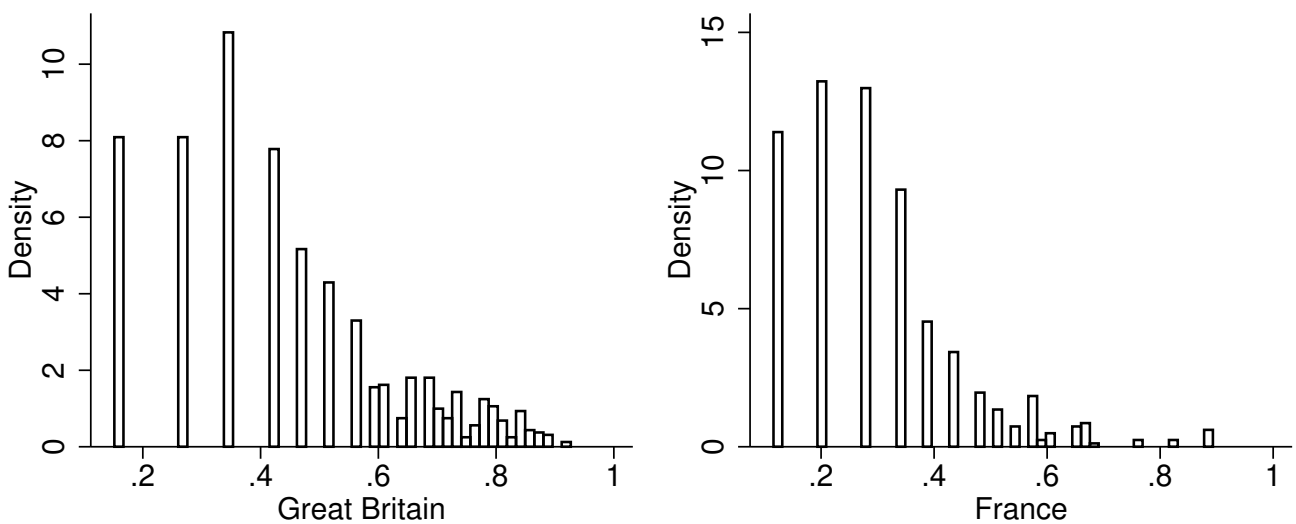
$$\begin{aligned} \hat{\Phi}_j &= \frac{\hat{\sigma}^2_\Phi}{\hat{\sigma}^2_\Phi + \hat{\sigma}^2_\epsilon / n_j} \ln \bar{Y}_j + \left(1 - \frac{\hat{\sigma}^2_\Phi}{\hat{\sigma}^2_\Phi + \hat{\sigma}^2_\epsilon / n_j}\right) \ln \bar{Y} \\ &= \psi \ln \bar{Y}_j + (1 - \psi) \ln \bar{Y}, \end{aligned} \tag{8}$$

ψ represents the shrinkage factor and reflects the reliability of $\ln \bar{Y}_j$ as an estimate of Φ_j.

4.2 Owner Value-Added Estimates

Figure 2 reports the distribution of estimates of the reliability (ψ) of mean (prior) outputs of owners in predicting the owner's value-added in time t. The mean estimates of ψ in Great Britain and in France are 0.450 and 0.308, with standard deviations of 0.198 and 0.155. The higher estimates of reliability in Great Britain reflect the fact that we observe more observations per owner in Great Britain than in France, which leads to a higher precision in the estimates.

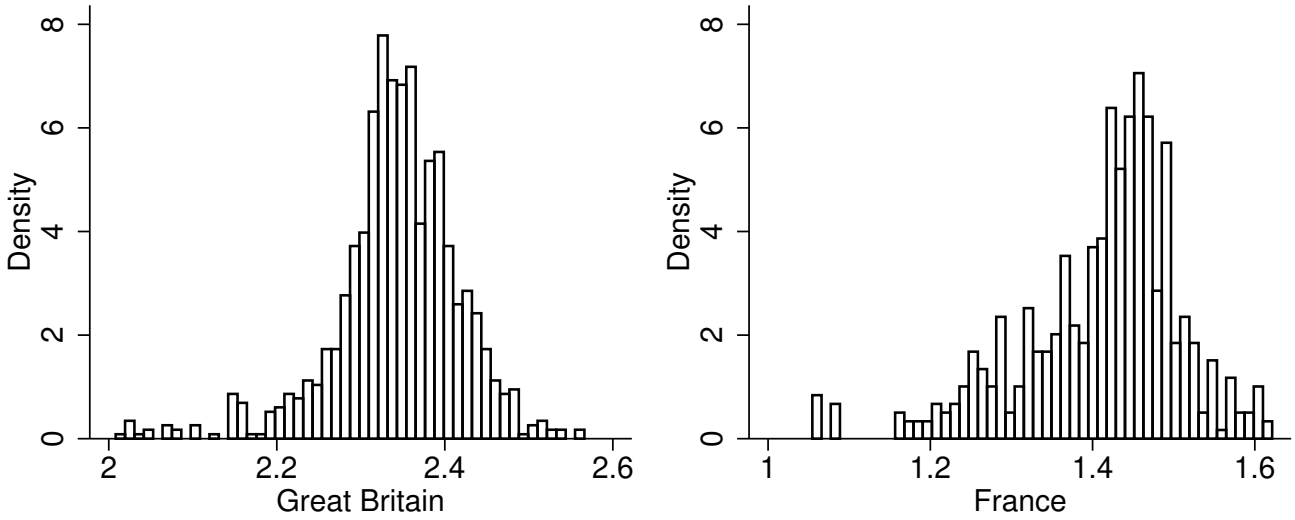
Figure 2: Distribution of Reliability Estimates (ψ)



Within Great Britain, mean estimates of ψ are highest in Liverpool (0.460), followed by London (0.432) and Bristol (0.431). In France, mean estimates of ψ are highest in Lorient (0.632), followed by Nantes (0.295) and Saint-Malo (0.259).

Figure 3 reports the distribution of the owner value-added ($\hat{\Phi}$) across Great Britain and France. In Britain, the mean of the value-added estimates is 2.343, with a standard deviation of 0.075. The means of the value-added estimates are 2.355, 2.342, and 2.330 in Bristol, Liverpool and London, respectively. As mentioned in Section 4.1, using the standardized tonnage variable to redo the analysis should decrease the owner value-added estimates, which is what we find. When using standardized tonnage, the mean of the value-added estimates in Britain is 1.969, with a standard deviation of 0.069. Similarly, the means of the value-added estimates drop to 1.98, 1.96, and 1.99 in Bristol, Liverpool and London.

Figure 3: Distribution of Owner Value-Added ($\hat{\Phi}$) in Great Britain and France



In France, the mean of the value-added estimates is 1.410, with a standard deviation of 0.099. Among the French ports, Saint-Malo owners have the highest value-added (1.435), followed by Nantes (1.395) and Lorient (1.183). When using standardized tonnage, the mean of the value-added estimates in France is 0.726, with a standard deviation of 0.081. The means of the value-added estimates drop to 0.755, 0.719, and 0.567 in Saint-Malo, Nantes, and Lorient.

In both Great Britain and France, we observe a large spread in terms of owner value-added. We also see a significant number of owners that appear to have extremely low value-added, which can be seen in the long left tails in the distributions in Figure 3. One possible interpretation of these left tails is the lack of competition in the slave trade industry prevented low performing owners from being forced from the market, as discussed in Section 2.1.

As a robustness check on whether the estimates of owner value-added measure the performance of the owners, we regress $\hat{\Phi}$ on three such performance measures. These include 1) the level of crowding, which is the number of slaves on board at departure from last slaving port per ship ton;[17] 2) the rate of mortality, which is the ratio of slave deaths between Africa and the Americas (which is reported as the variable *sladvoy* in the *Trans-Atlantic Slave Trade Database*) to the total slaves on board at departure from last slaving port; and 3) purchase time per slaves, which is defined as the number of days between the beginning and end of the slave purchasing process divided by the number of slaves on board at departure from last slaving port.

Table 4: Owner Value-Added ($\hat{\Phi}$) and Performance Measures[a]

	Great Britain			*France*		
	Crowding	Mortality	Purchase Time per Slave	Crowding	Mortality	Purchase Time per Slave
$\hat{\Phi}$	5.301***	-0.463***	-5.930*	3.911***	-0.332***	-5.89**
	(0.363)	(0.125)	(3.066)	(0.496)	(0.115)	(2.918)
Port Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.404	0.108	-0.044	0.328	0.110	-0.041
N	996	286	185	489	311	419

[a] Standard errors are reported in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

Table 4 reports the results from the regressions. All estimates on $\hat{\Phi}$ have the right sign. Higher $\hat{\Phi}$ is associated with higher level of crowding (loading more slaves on board per ton), lower mortality rate, and shorter purchasing time per slave. The higher crowding and lower mortality results suggest higher value-added owners were able to provide instructions and/or ships to load as many slaves on board as possible while maintaining lower mortality rates.

Variation in managerial quality across owners mattered significantly for the total number of slaves exported during the trans-Atlantic slave trade. Table 5 documents the impact on slave exports from the variation in owner value-added. In order to show the significance of the variation in owner ability, we replace all voyage owners in each country by the 10th, 20th, 30th,..., and 90th percentile owner based on the ordering of the coefficients on the owners' value-added estimates. We then compare the estimated number of slave exports under these counterfactual

[17] We follow Duquette (2014) by using slaves embarked, *slaximp*, (instead of slaves disembarked) divided by the ship's tonnage to measure crowding.

Table 5: Slave Voyage Output (Share of Actual) Under 10th and 90th Percentile Owners, 1700-1800

	Unstandardized Tonnage						*Standarized Tonnage*					
	Great Britain			*France*			*Great Britain*			*France*		
Decade	10th	90th	90/10	10th	90th	90/10	10th	90th	90/10	10th	90th	90/10
1701-10	1.00	1.00	1.00	0.98	1.01	1.03	1.00	1.00	1.00	0.98	1.01	1.03
1711-20	0.93	1.05	1.13	0.95	1.05	1.10	0.92	1.03	1.12	0.97	1.04	1.07
1721-30	0.90	1.09	1.13	0.92	1.14	1.24	0.93	1.05	1.12	0.93	1.12	1.20
1731-40	0.93	1.07	1.15	0.84	1.17	1.38	0.93	1.06	1.13	0.87	1.14	1.31
1741-50	0.92	1.06	1.16	0.79	1.11	1.41	0.92	1.07	1.16	0.83	1.08	1.30
1751-60	0.91	1.10	1.21	0.96	1.05	1.10	0.91	1.10	1.21	0.97	1.05	1.08
1761-70	0.91	1.09	1.19	0.94	1.07	1.15	0.91	1.08	1.19	0.95	1.05	1.11
1771-80	0.91	1.08	1.19	0.87	1.10	1.27	0.91	1.08	1.19	0.87	1.08	1.23
1781-90	0.92	1.10	1.20	0.90	1.12	1.24	0.92	1.08	1.16			
1791-1800	0.94	1.07	1.14	0.92	1.06	1.15	0.95	1.06	1.12			
Mean	0.93	1.07	1.16	0.91	1.09	1.21	0.93	1.06	1.14	0.92	1.07	1.17

owners with the actual number of slave exports in the data. We only report the 10th and 90th percentile results, along with the 90/10 ratio.

The variation in owner value-added to slave voyage output is slightly higher in France than in Great Britain. In Great Britain, slave exports increase by slightly more than 7% under the 90th percentile owner, but the decrease in slave exports under the 10th percentile owner is a little less than 7%, with a 90/10 ratio of 1.16. With a 90/10 ratio at 1.21, French slave exports would increase by 9% under the 90th percentile owner but would decrease by 9% under the 10th percentile owner. The 90/10 ratios are slightly smaller when using standardized tonnage as the capital input.

These magnitudes are significant. In the case of the 90th percentile owner, the estimated slave exports imply 15,758 and 7,371 more slaves would have been exported from Africa each decade on average during the British and French slave trades. Summing these averages over the decades for which we have estimates translates into nearly 217,000 more slaves exported during the combined slave trade of Great Britain and France in the 18th century. This number drops to 186,000 when using standardized tonnage as the capital input. Our sample only represents 56% of the recorded slaves exported by the British and French during the 18th century, which means, if our estimates are unbiased, the number of slaves exported under the 90th percentile owner would be nearly double. These results suggest owners played a significant role in determining how many slaves arrived in the Americas during the trans-Atlantic slave trades.

4.3 Owner Value-Added, Competition, and Family Business

The existence of variation in owner value-added, despite the fact that we already control for labor, capital, and other controls, begs the question of why this variation persists. As in Bloom and Van Reenen (2007), we test the effects of two factors, competition and family ownership, on owner value-added. As discussed in Section 2.1, both mercantilist policies reducing competition and the importance of family networks for financing slave voyages served as barriers to entry in the slave trade. The presence of these market inefficiencies may have an effect on owner value-added by influencing the pool of owners or the incentives for effort.

Competition: We consider two categories of variables. The first is the competition among owners in a decade. We use two alternative measures for this competition. One is the number of competing owners in a decade. Another one is the Herfindahl index using market shares of owners in a decade. The second category of variable is the availability of captains. We use the ratio of the number of captains to the number of owners in a decade as our measure.[18]

Owners' Controls: We also include a vector of owner characteristics as controls. These include dummies of the Royal African Company (in the case of Great Britain), owners being a company, family business, captains being family members, and the number of owners of the voyage.

Table 6: Summary Statistics of Owners' Characteristics and Competition Variables

	Great Britain		*France*	
	Mean	Std. Dev.	Mean	Std. Dev.
Owners' Controls:				
RAC	0.004	0.065		
Company	0.320	0.465	0.248	0.429
Family Business	0.081	0.263	0.014	0.115
Family Captain	0.110	0.296	0.022	0.144
Number of Owners of the Voyage	2.955	2.275	1.361	0.601
Competition:				
Captain/Owner Ratio	1.755	0.490	1.425	1.262
Number of Competitors/100	1.103	0.527	0.951	0.560
HHI	0.038	0.029	0.048	0.085

Table 6 reports the summary statistics of the owners' and competition controls. The Royal African Company owned only a small share (0.4%) of British voyages in the 18th century, with

[18] We also construct these competition measures based on a 5-year period. Results are similar.

all of them concentrated in the first three decades. A significant portion of the voyages were owned by companies (32% in Great Britain and 25% in France). Family business was more prevalent in the British slave trade than in the French, with 8.1% of British voyages and 1.4% French voyages owned by family businesses. British owners were also more likely to hire family members to be voyage captains (11%) than were French owners (2.2%).

Competition was more intense in Great Britain than in France, which is consistent with the historical background described in Section 2. On average, each British owner would be competing with 110 other owners in a decade, while each French owner would be competing with 95 other owners in the same time period. The market was a bit more concentrated in France (0.05) than in Britain (0.04). The relative supply of captains in Great Britain was also higher than in France. On average, there would be 1.76 captains for each British owner compared to 1.43 captains for each French owner in a decade.

Table 7 reports the regression result when we regress our owner value-added estimates on the competition levels and the various owners' characteristics. Columns 1 to 4 report the regression results for Great Britain, while columns 5 to 8 report the results for France. The first two columns for each country report the results without port dummies, while the last two columns for each country report the results with port dummies. Several results emerge.

First, owner value-added tends to be higher when competition among owners are more intense in some specifications. When port fixed effects are included, a one standard deviation increase in the market concentration (HHI) is associated with a decrease in owner value-added by 0.12 standard deviation and 0.82 standard deviation in Great Britain and in France. In France, one standard deviation increase in the number of competitors is associated with an increase in owner's value-added by 0.17 standard deviation.

Second, the availability of captains correlates negatively with owner value-added estimates in Great Britain and France. But, in both countries, the correlations between the owner value-added estimates and captains' availability are small in magnitude.

Third, owners being a family business has a negative correlation with the owner value-added estimates. If the owner is in a family business in Britain, the owner's value-added would decrease by approximately 0.20 standard deviation. While it is not statistically significant, a French family business's value-added would be 0.22 to 0.24 standard deviation lower than non-

Table 7: Owner's Value-Added, Competition, and Family Business[a]

	Great Britain				*France*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RAC	-0.155***	-0.136***	-0.159***	-0.147***				
	(0.028)	(0.028)	(0.030)	(0.030)				
Company	0.025***	0.029***	0.039***	0.035***	0.018*	0.038***	0.015	0.022**
	(0.007)	(0.006)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)	(0.011)
Family Business	-0.014*	-0.015*	-0.015*	-0.015*	-0.019	-0.004	-0.024	-0.022
	(0.008)	(0.008)	(0.008)	(0.008)	(0.034)	(0.035)	(0.033)	(0.033)
Family Captain	0.009	0.010	0.008	0.009	-0.119***	-0.131***	-0.113***	-0.114***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.032)	(0.033)	(0.031)	(0.031)
Number of Owners	0.001	0.001	0.001	0.001	0.010	0.009	0.005	0.008
of the Voyage	(0.001)	(0.001)	(0.001)	(0.001)	(0.007)	(0.008)	(0.007)	(0.007)
Captain/Owner Ratio	-0.010**	-0.005	-0.013**	-0.005	-0.012***	-0.006*	-0.007***	-0.001
	(0.005)	(0.005)	(0.006)	(0.006)	(0.002)	(0.003)	(0.003)	(0.004)
Number of	0.001		-0.015*		0.052***		0.054***	
Competitors/100	(0.006)		(0.009)		(0.008)		(0.010)	
HHI		-0.299**		-0.323***		-0.200***		-0.872***
		(0.097)		(0.121)		(0.059)		(0.178)
Bristol			-0.012	-0.018				
			(0.013)	(0.013)				
Liverpool			0.022*	-0.011				
			(0.013)	(0.013)				
Other British Ports			-0.041*	-0.041*				
			(0.022)	(0.022)				
Nantes							0.090*	-0.516***
							(0.046)	(0.139)
Saint-Malo							0.164***	-0.399***
							(0.048)	(0.125)
Other French Ports							0.118**	-0.461***
							(0.048)	(0.140)
Adj. R^2	0.046	0.055	0.052	0.056	0.228	0.171	0.271	0.261
Unique Owners	351	351	351	351	144	144	144	144

[a] Standard errors are reported in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

family business. Also, if the French owner hired a family member as the captain, the owner's value-added would be lower by 1.15 standard deviation.

Fourth, owner value-added tends to increase when the owner is part of a company, except in the case of the Royal African Company. The negative correlation between owner value-added and the Royal African Company is consistent with our discussion in Section 2.1 about mercantilist policies insulating firms from competition and, thus, decreasing owner value-added.

The positive effect of competition among owners might work through a selection mechanism in which worse owners exit the market. To look at this mechanism, we test whether higher levels

of competition among owners are associated with a reduction in the dispersion in the owners' value-added (as suggested by Syverson (2004a, 2004b)). We regress the level of dispersion (defined as the interquartile difference in owner value-added in a five-year period in the country) on our competition measures and find that owner-level competition has a negative marginal effect on dispersion. When the number of competing owners was used, the coefficient was -0.120 with a standard error of 0.069. When HHI was used, the coefficient was 1.466 with a standard error of 0.137.

4.4 Robustness Check on the Effect of Competition on Owner Value-Added

There might be concern that the relationship between owner value-added and competition is not causal. We attempt to tackle this problem by examining the effect of the outbreak of the Seven Years' War between Great Britain and France on owner value-added. Stein (1979) provides a detailed historical description of the war's effect on the slave trade, which we summarize here. Lasting from 1756 to 1763, the Seven Years' War involved most of the great powers of the time with Great Britain and France being the two major combatants. The war affected the slave trade and its trade routes greatly. During the war, the British navy ruled the seas and captured many French colonies, including the important slave trade destinations of Guadeloupe, Martinique, Saint Lucia, and Grenada. Ties between French colonists and British slave traders developed, as British slave traders began exporting slaves to their new markets. The volume of French slave voyages decreased by almost 85% during this period compared to seven years before and seven years after the war (Table 8). After the signing of the peace treaty between Great Britain and France in 1763, though, French colonists continued to import from British slave traders, refusing to relinquish their newly developed commercial ties and recognize the reestablishment of the French owners' monopoly. In our sample, the percentage of French slave voyages whose principal port of disembarkment was Guadeloupe, Martinique, Saint Lucia, or Grenada decreased from 25% in the ten-year period before the war to approximately 8% in the ten-year period after the war, while these percentages for British slave voyages increased from 0.2% to 11%. The market for French slave owners became smaller as more slave voyages

disembarked in fewer ports. For instance, the percentage of slave voyages disembarked in St. Domingue increased from approximately 70% before the war to almost 90% after the war in our sample. At the same time, the market for British slave owners became bigger. If we use the number of slaves exported as a measure of market size, the ratio of the French market size relative to British ones decreased from 65% before the war to 51% after the war. As Holmes and Schmitz (2010) suggest, a smaller (bigger) market means less (more) competition for the French (British) slave owners.[19] This continued until formal French involvement in the American Revolutionary War in 1777.

Table 8: Number of Voyages to French Slave Ports Around the Seven Years' War[a]

	Great Britain	*France*
Before Seven Years' War	460	274
During Seven Years' War	439	46
After Seven Years' War	838	309

[a] Each of the periods consist of seven years. The French slave ports include Guadeloupe, Martinique, Saint Lucia, and Grenada.

We test this exogenous change in the level of competition by comparing the value-added estimates of owners who financed slave voyages before and after the Seven Years' War. We only want to consider those owners whose slave trading took place mainly in the periods immediately before and after the war. In particular, we consider owners who, on average (weighted by the slave exports), financed slave voyages between 1747 and 1756 with their last voyage no later than 1756, and owners who, on average, financed slave voyages between 1763 and 1773 with their first voyage no earlier than 1763.[20] This includes 72 owners in Great Britain and 41 owners in France.[21]

We then regress these owners' value-added estimates on a dummy of post Seven Years' War and the other owner controls used in Table 7. As columns (1) and (3) of Table 9 show, after

[19] Notice the competition as a result of the Seven Years' War is slightly different from our other measures of competition in the paper, which have all been measurements from strictly within a country.

[20] We vary the periods before and after the Seven Years' War from 7 years to 14 years, 14 years being the maximum period considered because the post-Seven Years' War period then stretches to the beginning of the American Revolutionary War. Results are similar.

[21] We understand the British may not be a perfect control group for the French, but data limitations prevent us from using an alternative nation as a control group. For example, only one Dutch and one Portuguese owner can be identified between the years 1747 and 1773 with the necessary coverage of the variables needed to perform our estimation.

Table 9: Seven Years' War, Competition, and Owner Value-Added[a]

	Great Britain		*France*	
	(1)	(2)	(3)	(4)
Post Seven Years' War	0.039**	0.038**	-0.030	-0.001
	(0.017)	(0.018)	(0.026)	(0.034)
Captured Ports		0.009		0.063
		(0.045)		(0.084)
Post Seven Years' War				-0.273**
× Captured Ports				(0.147)
Company	0.081**	0.081***	-0.002	-0.008
	(0.026)	(0.026)	(0.041)	(0.040)
Family Business	0.003	0.004	0.022	-0.017
	(0.036)	(0.037)	(0.092)	(0.090)
Family Captain	0.129***	0.129***	0.047	0.014
	(0.045)	(0.045)	(0.424)	(0.415)
Number of Owners	0.009**	0.009**	0.034	0.024
of the Voyage	(0.004)	(0.004)	(0.031)	(0.031)
Adj. R^2	0.191	0.179	0.087	0.179
Unique Owners	72	72	41	41

[a] Standard errors are reported in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

controlling for owners' characteristics, there is still a decrease in French owner value-added by almost 0.4 standard deviation and an increase in British owner value-added by 0.6 standard deviation. In column (4) of Table 9, we interact the dummy of post Seven Years' War with a variable *Captured Ports*, which is the percentage of the owners' slaves whose principal port of disembarkment was Guadeloupe, Martinique, Saint Lucia, or Grenada. The estimate of the coefficient of the interaction term is -0.273 (with a standard error of 0.147), which suggests the value-added of those French owners who traded mostly in the captured ports decreased more than other French owners.[22] These results support the idea of a causal link between competition and owner value-added.

4.5 Captain's Contribution to Voyage Output

One approach to assess the captain's contribution to voyage output is to ask what is the difference in the owner value-added estimates had captains been randomly assigned to owners and voyages in our data. In order to assess this, we follow the approach in Chetty, Friedman, and Rockoff

[22] Almost no British owners in our sample traded in these four ports before the war, so the coefficient of the interaction term is not identified.

(2014) to estimate forecast bias by regressing predicted outputs based on observables excluded from the value-added model on value-added estimates. These observables ($\mathbf{P}^*_{it}$) include variables on captains' characteristics such as a captain's experience, the ratio of captains to owners (a proxy for captains' availability in the market), and a dummy on whether the captain is a family member of the owner. Note that while this is called forecast bias in the literature, it is not a bias in our context, because it is the owner's responsibility to find a good captain.[23] The estimation of our "forecast bias" is done in the following way.

First, we regress the output residuals $\ln Y_{it}$ on the vector $\mathbf{P}^*_{it}$ and our baseline controls to obtain residual captain characteristics $\mathbf{P}_{it}$.

We then regress $\ln Y_{it}$ on $\mathbf{P}_{it}$, including owner fixed effects:

$$\ln Y_{it} = \tau_i + \rho \mathbf{P}_{it}, \tag{9}$$

and construct predicted values $\ln Y^p_{it} = \hat{\rho}\mathbf{P}_{it}$.

We then regress $\ln Y^p_{it}$ on $\hat{\Phi}_j$, including time fixed effects as before. The degree of forecast bias due to selection on captain characteristics are 2% in Great Britain and 25% in France.

Another approach to assess the captain's contribution is to estimate and analyze captain value-added to the slave trade. We follow the same sample data selection process we used for the owner's analysis described in Section 3. In particular, we first drop the observations with missing information on ship tonnage, crew size, or slaves disembarked. We also drop voyages in which captains appear in the data less than three times. However, because a significant portion of French captains appeared only once, and less than 50 French captains appeared at least three times in the data (see right panel of Figure 4), we only do the analysis for British captains. This leaves us with 3675 British voyages and 757 unique captains. Among these 757 British captains, the average number of appearances in the final sample is 4.587, with a standard deviation of 2.159.

We then follow the same procedure described before to estimate captain value-added to slave voyage output. In particular, we first run an OLS regression of $\ln Y^*_{ijt}$ on $\ln \hat{K}_{it}$ and $\ln L_{it}$ with

[23] In the context of the teacher value-added literature, if good students are assigned to a particular teacher, the value-added is not really the teacher's contribution.

Figure 4: Distribution of Captains' Appearances in the Data

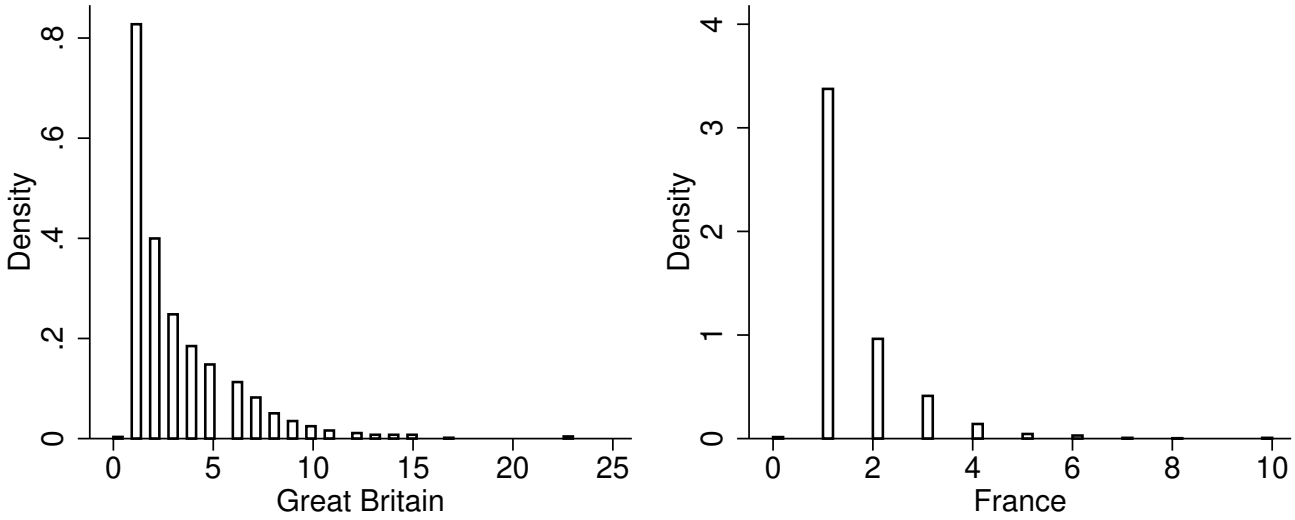
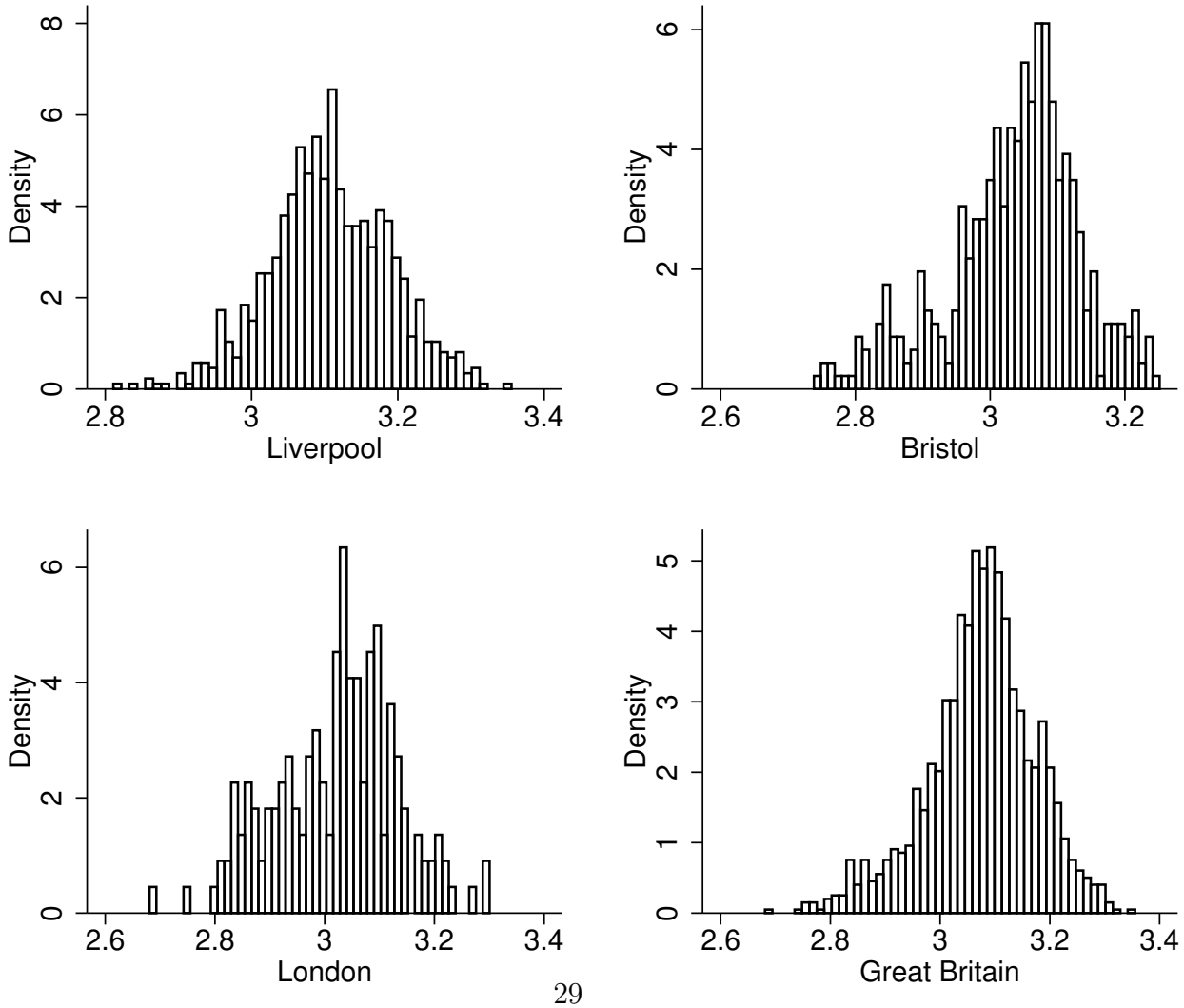


Figure 5: Distribution of Captain Value-Added ($\hat{\Phi}$) in Great Britain



captain fixed effects as in equation (4).[24] The resulting estimates of the capital share (α) and labor share (β) are 0.387 and 0.281 (with standard errors being 0.026 and 0.024), which are slightly smaller than those obtained from the owner's analysis.

We then construct our value-added estimator for captains by decomposing the variance of the error terms in the OLS regression, as described in equations (6)-(8). Figure 5 shows the distribution of the value-added estimates of British captains. The mean of the value-added estimates is 3.07, with a standard deviation of 0.10. The means of the value-added estimates are 3.04, 3.11, and 3.02 in Bristol, Liverpool and London, respectively. As in the distribution of the owners' value-added estimates, the left tail of the value-added distribution is rather long, indicating the survival of bad captains in the industry. When using standardized tonnage, the mean of the value-added estimates is 2.67, with a standard deviation of 0.15. The means of the value-added estimates drop to 2.62, 2.72, and 2.59 in Bristol, Liverpool and London.

Table 10: Slave Voyage Output (Share of Actual) Under 10th and 90th Percentile Captains, 1700-1800

	Great Britain					
	Unstandardized Tonnage			*Standardized Tonnage*		
Decade	10th	90th	90/10	10th	90th	90/10
1701-10	0.92	1.07	1.16	0.93	1.14	1.23
1711-20	0.89	1.12	1.24	0.85	1.22	1.43
1721-30	0.87	1.21	1.38	0.88	1.14	1.28
1731-40	0.89	1.10	1.24	0.87	1.14	1.30
1741-50	0.93	1.07	1.15	0.91	1.10	1.21
1751-60	0.92	1.08	1.17	0.88	1.12	1.28
1761-70	0.90	1.09	1.22	0.85	1.15	1.35
1771-80	0.89	1.11	1.24	0.86	1.14	1.32
1781-90	0.89	1.11	1.25	0.89	1.12	1.26
1791-1800	0.93	1.06	1.15	0.91	1.07	1.18
Mean	0.90	1.10	1.22	0.88	1.13	1.28

Table 10 reports the variation in captain value-added to slave voyage output. Overall, the variation in captain value-added is higher than that of owner value-added, with a 90/10 ratio of 1.22. If all voyages were piloted by the 90th percentile captain, the estimated number of slaves exported during the British slave trade would be 21,099 higher each decade on average, nearly 211,000 more slaves exported over the course of the 18th century. This number increases to 269,000 when using standardized tonnage as the capital input. The 90/10 ratio also increases

[24] Of course, j refers to the captain here instead of the owner.

Table 11: British Captain Value-Added, Competition, and Family Business[a]

	(1)	(2)	(3)	(4)
RAC	-0.135***	-0.125***	-0.128***	-0.120***
	(0.031)	(0.032)	(0.033)	(0.032)
Company	-0.027**	-0.071***	-0.007	-0.011
	(0.008)	(0.007)	(0.010)	(0.010)
Family Business	-0.014**	-0.041***	-0.009	-0.014**
	(0.008)	(0.007)	(0.008)	(0.007)
Family Captain	-0.016	-0.014	-0.017*	-0.014
	(0.010)	(0.011)	(0.010)	(0.010)
Number of Owners	-0.001	0.002**	-0.003**	-0.002
of the Voyage	(0.001)	(0.001)	(0.001)	(0.001)
Owner/Captain Ratio	0.212***	0.133***	0.167***	-0.099***
	(0.020)	(0.019)	(0.021)	(0.018)
Number of Competitors/100	0.040***		0.018***	
	(0.005)		(0.006)	
HHI		0.916***		2.101***
		(0.280)		(0.285)
Bristol			0.008	0.001
			(0.0140	(0.010)
Liverpool			0.064***	0.100***
			(0.011)	(0.009)
Other British Ports			0.046**	0.053***
			(0.019)	(0.019)
Adj. R^2	0.181	0.146	0.202	0.227
Unique Captains	757	757	757	757

[a] Standard errors are reported in brackets. ***, **, and * indicate significance at the 1%, 5% and 10% levels.

to 1.28.

Table 11 reports the regression results when we regress the captains' value-added estimates on the competition and owners' controls. Several results emerge.

First, family business and captain value-added are negatively correlated. If the owner of the voyage was part of a family business, the captain value-added is lower by 0.1 to 0.4 standard deviation. If the captain worked for his family, the captain's value-added is lower by 0.14 standard deviation, but the correlation is not statistically significant.

Second, if a captain worked for a company, instead of individual owner, the captain's value-added is lower by approximately 0.1 to 0.2 standard deviation, but the correlation is not statistically significant when port dummies are included.

Third, if a captain worked for the Royal African Company, the captain's value-added is lower

by approximately 1.3 standard deviation.

Fourth, the correlation between the level of competition and captain value-added is not clear. When the number of competing captains increase by 1 standard deviation, it is associated with an increase in captain value-added by 0.2 to 0.4 standard deviation. However, when market concentration increases by 1 standard deviation, it is associated with an increase in captain value-added by 0.1 to 0.2 standard deviation.

5 Conclusion

Managerial quality during the trans-Atlantic slave trade was no less important to the structure and outcomes of the industry than the role played by modern-day managers on contemporary issues, such as the firm size distribution, typically studied by economists. Our paper quantifies the impact of management, in the form of a owner and captain value-added to slave voyage output, on the number of slaves exported during the trans-Atlantic slave trade. Slave exports increase (decrease) by 7% (7%) and 9% (9%) under the 90th (10th) percentile owners in the cases of Great Britain and France, respectively, while slave exports increase (decrease) by 10% (10%) under the 90th (10th) percentile captains in Great Britain. We also find that value-added of owners and captains are strongly associated with family business and market structure. To determine whether competition's effect on owner value-added might be causal, we exploit the outbreak of the Seven Years' War. The war changed the market sizes and, thus, levels of competition in the British and French slave trades. Our results support the idea of a causal link between competition and owner value-added. Overall, our results are important for economic historians of the African slave trades, because they show taking into account the role played by owners and captains is crucially important for understanding voyage-level outcomes.

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