MANAGING AGENCY PROBLEMS IN EARLY SHAREHOLDER CAPITALISM: AN EXPLORATION OF LIVERPOOL SHIPPING IN THE 18TH CENTURY*

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Abstract

We exploit a historical setting that offers an unusually clean test of the relationship between asset ownership and management incentives: captain-ownership of vessels engaged in transatlantic shipping during the 18th century. Although contingent compensation aligned incentives between captains and shipowners regarding most events, there existed one hazard that could not easily be managed by contractual incentives: the threat of capture by privateering vessels of an enemy nation. We exploit variation over time and across routes to explore the relationship between the capture threat and equity ownership. We find that vessels were significantly more likely to have a captain-owner when they undertook wartime voyages on routes that were particularly susceptible to encounters with enemy privateers. We also find, after accounting for endogeneity, that vessels with captain-owners were less likely to be captured than those with non-owner captains. JEL codes: D23, J33, L14, L23, L91

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I. INTRODUCTION

At least since the publication of *The Modern Corporation and Private Property* by Berle and Means in 1932, scholars have devoted attention to the separation of ownership and control that characterizes modern industrial management. Agency theorists beginning with Jensen and Meckling (1976) focused on asset ownership as an effective way to align incentives between managers and shareholders. Perhaps as a result of their prescription, U.S. corporations dramatically increased the equity ownership of CEOs during the last 20 years of the twentieth century (Hall and Liebman 1998). However, although stock ownership by CEOs has become a prevalent incentive alignment mechanism among public companies, the precise behavior that ownership elicits is still subject to fierce debate (Hall and Murphy 2003; Bebchuk and Fried 2004).

The empirical evidence is mixed. Mehran (1995) found that stock ownership by CEOs leads to better stock-market performance, as did Core and Larcker (2000) in their study of mandatory increases in top management's stock ownership. In contrast, Palia (2001), accounting for endogeneity in the establishment of CEO stock ownership levels, reports no evidence that CEO stock ownership leads to better firm share performance, and Bergstresser and Philippon (2006) show that stock ownership is positively associated with earnings manipulation.

Abowd and Kaplan (1999) note that it is difficult to measure the pay-performance relationship using stock market returns for at least two reasons. First, stock prices incorporate shareholder expectations, so expectations about the impact of a stock plan for a firm's CEO will affect the share price immediately upon the announcement of the plan (or even before, if shareholders anticipate the announcement). Second, if firms already provide nearly optimal incentives to top management, then a modest increase in incentives via stock ownership should lead to little change in performance. In response to these challenges, a recent literature has examined the effect of CEO stock ownership on other firm behaviors, including leverage, R&D intensity, and diversification (Cohen, Hall, and Viceira 2000; Coles, Daniel, and Naveen 2006).

We continue in the tradition of these studies. In particular, we exploit a historical setting that offers an unusually clean test of the relationship between equity ownership and behavior: captain-ownership of vessels engaged in transatlantic shipping from Liverpool during the 18th century, at the dawn of British shareholder capitalism. The typical vessel of this time had be-

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tween two and eight owners, each contributing capital toward its purchase and operation. A vessel's activities took it far from the oversight of these owners. When a vessel ran aground, was captured, or delivered its cargo late or damaged, it was rarely clear whether the culprit was poor captaincy or unavoidable hazards. While a captain was primarily concerned with his life and was presumably subject to classic shirking incentives, owners were primarily concerned with the freight and the ship. In sum, one can conceive of each vessel as a floating corporation with the captain as the CEO, and subject to principal-agent problems similar to those that afflict modern firms (Leeson 2007).

In principle, contingent compensation might serve to reduce divergence between captain and owner incentives. Shipowners indeed used a variety of performance-based compensation schemes to motivate captains, notably sales commissions and "primage" bonuses for successful delivery of cargo. These apparently sufficed to align captain and owner incentives in a wide variety of circumstances. However, there existed at least one hazard that could not easily be managed by contractual incentives: the threat of capture by privateering vessels of an enemy nation during wartime. Maritime protocol provided that when a captain's vessel was captured by privateers, the captain and crew would be treated reasonably well and returned to their home country expeditiously. Thus, upon being approached by a privateer, a ship captain's choice set included 1) give up and be treated well or 2) fight and perhaps escape, but risk one's life in the process. In this instance, conventional contract-based compensation was not sufficient to elicit the desired resistance by captains. In contrast, a captain who had equity ownership in the vessel would be more motivated to attempt to resist capture.

The likelihood of encountering enemy privateers varied both with time (i.e., wartime vs. peacetime) and with voyage route. This variation allows us to explore the effect of the capture threat on the pattern of captains' vessel ownership, and the effect of such ownership on vessel performance. We exploit a unique database of Liverpool vessels that traversed the Atlantic Ocean in the 18th century. For each ship we observe the identity of the owners, the identity of the ship captain, the route pursued for each voyage, and various outcome measures. We augment this with information on vessel construction characteristics, the sailing history of each vessel, and the experience of the captain. Roughly 20% of the sample's voyages involve a vessel whose captain is also a part-owner, but these are not distributed randomly across routes and time. We find that vessels are significantly more likely to have a captain-owner when they undertake wartime voyages on routes that are particularly susceptible to encounters with enemy privateers.

We then examine the performance consequences of captains' vessel ownership. We address endogeneity in the performance estimation by exploiting a key feature of these voyages: their duration. The typical voyage in our sample lasts more than one year. We therefore observe several hundred vessels that begin their journey during peacetime, but do not conclude until after war has broken out, thus exposing them to wartime hazards unexpectedly. We find that, for such vessels, those with captain-owners are less likely to be captured than those with non-owner captains.

We also consider alternative explanations for our results. Chief among these is the possibility of endogenous matching based on risk-aversion or captain experience (Ackerberg and Botticini 2002). For example, if captains vary in risk-aversion, and if financial risk-aversion is correlated with risk-aversion concerning personal safety, then the observed patterns might arise from risk-loving captains' willingness to invest wealth in a vessel, sail on routes with greater threat of privateering, and resist when approached by a privateer. Although we do not have instruments with which to address this issue, we are able to draw inferences from alternative measures of voyage performance. For example, captain-owned vessels take longer to complete their voyage than do non-owned vessels. This suggests that a captain pilots his vessel more carefully when he has an ownership stake, which is more consistent with an incentive-alignment explanation than with endogenous matching.

Beyond its connection to the CEO compensation literature, this study is related to three other streams of extant literature. First, it builds upon prior research in organizational economics on the role of asset ownership in shaping the incentives of economic actors and in affecting organizational performance (Baker and Hubbard 2003; Nickerson and Silverman 2003; Forbes and Lederman 2010). Second, it contributes to the economic history literature concerning institutional solutions to problems associated with far-flung economic transactions (Greif 1993). Within the specific area of maritime trade, this study relates to prior work on sea-loans and "commenda" in 14th-century Venice (Gonzalez de Lara 2004; Williamson 2010); whereas those studies focus on the risk-sharing attributes of various contractual arrangements, this study emphasizes incentive alignment. Third, this paper joins a handful of recent studies of institutions that shaped or were shaped by the slave trade, including the role of port-specific human capital in fostering Liverpool's dominance of the trade within Britain (Behrendt 2007), innovations in financial credit that contributed to Britain's dominance of the trade in the 18th century (Pearson and Richardson 2008), and the enduring impact of the trade on current patterns of underdevelopment in Africa (Nunn 2008).

The paper proceeds as follows. Section II describes Liverpool's transatlantic shipping during the 18th century, noting systematic differences between wartime and peacetime hazards as well as differences in exposure to these hazards for "direct" (Liverpool-North America) voyages vs. "triangle" (Liverpool-Africa-North America) voyages. Section III discusses the strengths and limitations of the contractual incentives used by shipowners to manage their captains. This shapes our expectations regarding where captain-ownership should be prevalent, and what performance consequences captain-ownership should have. Sections IV-V explore the pattern of vessel ownership, and the performance outcomes associated with this ownership. Section VI considers alternate explanations for the results. Section VII concludes.

II. LIVERPOOL TRANSATLANTIC SHIPPING IN THE 18TH CENTURY

The port of Liverpool received its charter from King John in 1207, eight years before the signing of the Magna Carta. The town relied heavily on fishing and on trade with Ireland until the 1660s, when commerce with the West Indies was triggered by the growing demand for sugar and by the development of nearby inland towns into textile manufacturing centers (Ascott, Lewis, and Power 2006). Thanks to a series of infrastructure projects in the first half of the 18th century, Liverpool found itself both equipped with an improved harbor and increasingly connected to interior manufacturing towns such as Manchester. The cost of transporting textiles from these towns to Liverpool, and of transporting foreign goods to these towns, dropped dramatically as a result. Whereas Liverpool's port volume was a distant fourth to London, Bristol, and Whitehaven in 1700, by 1770 the town had become Britain's second-largest port for direct trade, and the dominant port by far for the slave trade. Reflecting Liverpool's success in transatlantic commerce, the town's population exploded from 5,000 in 1700 to nearly 80,000 by the end of the eighteenth century. In comparison, Bristol's population rose from 25,000 to 68,000 over the same period.

<u>Direct (non-slave) trade and triangle (slave) trade</u>

The British transatlantic trade of the 18th century consisted of two distinct categories (see Figure I). In the direct trade, a ship carried manufactured goods such as textiles to North America and returned with agricultural goods such as sugar, tobacco, and cotton. In the triangle trade, a ship carried manufactured goods such as textiles, weapons, and jewelry to the west coast of Africa, traded these goods for humans who had been enslaved by local chiefs or by European agents living on the coast, and then transported the human cargo to North America for sale in the West Indies or mainland colonies. They would then either carry agricultural goods or letters of credit back to England from North America, hoping to complete the entire journey in 12 months so as to repeat the event the following year (Behrendt, 2001).

[INSERT FIGURE I HERE]

In the direct trade, one or more individuals joined to purchase a vessel. The owners shared the cost of vessel purchase, maintenance, insurance, and operation. For vessels with multiple owners, it was common practice to designate one owner as the "ship's husband," akin to a managing partner, who had the responsibility and authority to make operational decisions. The owners hired a captain (although the owners might identify and hire the captain before purchasing the vessel). The captain would then hire the crew. The ship's husband would place an advertisement in the local newspaper to announce the expected departure of the ship within a certain date range and to solicit freight from parties who were interested in exporting goods from Liverpool to the North American destination. Exporters would then contract with the ship's husband to ship the goods on the vessel.

Ultimately, the vessel would sail from Liverpool to, say, Richmond, Virginia, and the captain would deliver the goods to agents as instructed by the exporters. The ship would then perform similar activities to bring goods back to Liverpool. Throughout the voyage, the cargo remained the property of the exporters, but vessel owners were liable for any damage en route. Vessel owners purchased insurance for their vessels, and also purchased insurance to cover the cargo. The trip from Liverpool to North America typically took 2-3 months each way, and the process of distributing/selling/purchasing/loading goods in North America made for a total trip of 8-10 months. The ship would then rest at Liverpool for 2 or more months, undergoing repairs and awaiting the organization of the next load of North America-bound goods that it would carry (see Figure II).

[INSERT FIGURE II HERE]

The typical ship that was used in the direct trade cost £1,500-£2,500 to purchase, equivalent to roughly $250,000-$400,000 today (based on conversion rates in Rediker, 2007: 191). Crew wages were typically £25/month, or £200-£250 for the voyage excluding a possible performance bonus for the captain called "primage." In addition, the vessel owners provided food for the mariners during the voyage at a cost of roughly £25/month. Vessel owners would also frequently incur port fees, insurance fees, depreciation and repairs to the ship. In a detailed study of one major shipowner, Ville (1987) found that a ship's wage cost was roughly 30% of overall variable costs. As Table I indicates, revenue for a fully loaded voyage might reach £1500, thus yielding £750 profit ($125,000 today) on a successful year-long voyage.

[INSERT TABLE I HERE]

The triangle trade bore many similarities to the direct trade (Figure II). Again, one or more individuals jointly purchased a vessel, appointed a ship's husband, and hired a captain who then assembled a crew. However, in the slave trade the owners of the vessel also owned the cargo. There was virtually no third-party contract carriage of slaves. Thus, when one or more individuals joined to purchase a vessel, they shared all of the costs associated with a direct-trade voyage plus the cost of the cargo to be carried from Liverpool to the African coast. Separately, the captain faced a more difficult challenge assembling a crew, as many mariners resisted working on slave ships either for ethical reasons or because of the greater risks associated with such vessels (including slave rebellions and the threat of exposure to diseases for which Europeans had little immunity). Consequently, a substantial minority of mariners on a slaving ship were either tricked or coerced into joining the crew (Christopher 2006).

Ultimately, the vessel would sail from Liverpool to a designated spot on the west African coast, and the captain would trade goods for slaves. For most Liverpool-launched voyages, the vessel captain would barter directly with the local chiefs or their representatives to trade goods for slaves.[1] The captain would also purchase food for the slaves from trade partners on the African coast. A vessel typically embarked only 10-20 slaves per day, and thus might stay on the coast for several weeks.

After embarking the slaves, the ship would then sail to, say, Kingston, Jamaica. The trip across the Atlantic Ocean, called the "middle passage," typically took nine weeks. Although slave merchants occasionally relied on agents in the Americas to sell slaves, typically the captain was responsible for the sale of the slaves. The demand for slaves fluctuated across locations with the season (Behrendt 2007), and supply of slaves varied with the number of vessels engaged in the trade. A key factor in obtaining high prices was the captain's judgment regarding which market to approach and when to accept a less-than-ideal price in the West Indies vs. pursuing an uncertain, but potentially better, price in Virginia or the Carolinas. The ship might then purchase goods to transport back to Liverpool, but on many voyages the ship would return to Liverpool empty. This was due to the tight time constraint on the voyage. The cycle time of a slave voyage was roughly a full year even without spending time purchasing tobacco, sugar, and the like in North America. It was often more profitable to return empty, holding letters of credit, in time to run another voyage than to return full but miss the window for the next voyage.

As with direct-trade ships, the typical ship engaged in the slave trade cost £1,500-£2,500 to purchase. "Fitting out" the ship – that is, purchasing the requisite manufactured goods for trade in Africa – cost an additional £1,500-£2,500. The crew of a slave ship was larger than that

[1] At some slave ports, resident European agents rather than captains would trade with the local chiefs or their representatives. But Liverpool vessels typically did not go to these ports.

of a direct-trade ship, primarily because of the need for more guards to thwart slave rebellions. The crew also included a few members with distinct skills, such as a surgeon and carpenters. These crew members commanded higher wages than the average mariner. As Table I indicates, the costs for a slave-trade crew were typically around £55/month, or £660 for the voyage (excluding sales commissions and privilege slave payments for the captain and surgeon). In addition, as with the direct trade voyages, vessel owners incurred expenses related to food, insurance, port fees, depreciation and repairs. These were all higher for slave-trade than for direct trade voyages, as food was necessary for both crew and slaves, the warmer water through which a slave ship sailed caused more damage to the vessel, and insurance rates reflected the higher perceived risk of such voyages. Nevertheless, given an average voyage carrying 250 slaves, the value of cargo in-transit was approximately £8,750 and profits could be as high as £3,900 per year-long voyage.

The triangle trade thus offered higher potential profits, but at the cost of substantially higher risk. Figure III shows the rate of vessel loss for reasons unrelated to war – sinking, running aground, etc. – for direct-trade and triangle-trade voyages between 1744 and 1785. As the Figure shows, the frequency of vessel destruction was substantially higher in the triangle trade than in the direct trade throughout this period.[2]

[INSERT FIGURE III HERE]

Wartime: The threat of privateers

In addition to the traditional hazards of sailing, a key man-made hazard was related to warfare. Britain was at war for roughly half of the eighteenth century. France was its most enduring foe, but Britain also fought against Spain, Prussia, Bavaria, and the United States. During wartime, the volume of transatlantic voyages tended to decrease (see Figure IV), primarily due to

[2] Given that vessels carried insurance, why should the owners care about loss of the ship and/or cargo? Many owners chose to insure their vessels/cargo for less than full value to save on insurance costs. Further, cargo insurance typically measured value by the purchase cost of the items, not the anticipated sale value across the ocean. Thus, even if all went smoothly with an insurance payout, the payout was typically substantially below market value. Finally, insurance payouts did not always go smoothly. There is ample evidence of insurers who went bankrupt during times of frequent vessel capture/loss as well as of insurers who paid only after costly litigation over the payouts (see Crowhurst 1977, chapter 3; Kingston, 2007a).

the increased risks of wartime voyages. Belligerent states unleashed their navies and weaponized civilian vessels to prey upon the merchant fleets of their enemies. The bulk of this was carried out by civilian ships, known as privateers, that sailed under "letters of marque" authorizing them to capture enemy merchant ships and cargo. According to maritime protocol, a privateer was obligated to treat the crew of a captured ship relatively well (Brooke 1853).[3] In particular, the officers of a captured ship were to be treated like gentlemen. The captain and crew would be returned to England fairly expeditiously, often as part of a mariner exchange.

[INSERT FIGURE IV HERE]

Three historical examples will serve to illustrate merchant vessel-privateer interactions. During the War of Austrian Succession (1740-1748), the 14-crew-member *Ann Galley* was approached by a French privateer carrying an estimated 100 men as it neared Antigua, Jamaica. Captain Nehemiah Holland chose to resist rather than give up the vessel:

> The French boarded the *Ann Galley* three several times, but were driven back each time with considerable loss…. The *Ann Galley* did not lose a single man. The defence was conducted with considerable skill. Preparations had been made by barricades to protect the crew against boarding; and trains of powder were laid to explode every time the assault was made, which wrought havoc amongst the boarders. The *Ann Galley* took fire twice during the engagement.
>
> On the ship's return to Liverpool, Captain Holland was presented by his owners with a silver punch bowl, containing two gallons, with the following inscription engraved: "The gift of the owners, to Nehemiah Holland, Captain of the *Ann Galley*, who, with inimitable bravery, preserved and defended her against the infinitely superior force of a French enemy, August 21, 1746." (Williams 1897: 79-80)

During the American Revolution, the *Molly* successfully resisted an American privateer, at the cost of the captain's life:

[3] One major 18th-century war erupted ostensibly because of British outrage over the mistreatment of a captain whose vessel was commandeered by a Spanish vessel (the 1739 War of Jenkins' Ear).

> Captain Seddon, of the *Molly*, of Liverpool, who was killed in an engagement, in September, 1779, with an American frigate, of superior force, also displayed the most undaunted courage. The frigate carried twenty-two guns on deck, besides quarter-deck and forecastle guns: she was eventually beaten off by the *Molly*. (Troughton 1810: 166; Brooke 1853: 460)

Finally, the *Nanny* was less successful at repelling an American privateer during the American Revolution. As Captain Beynon wrote from captivity to the vessel's owners on June 2, 1779:

> On the 20th of May, off Cape Finisterre [near Spain], saw a ship in chase of us. Being resolved to know the weight of his metal, before I gave up your property, I prepared to make the best defence I could. Between eight and nine o'clock he came alongside, with American colours, hailed, and told me to haul my colours down; I desired him to begin and blaze away, for I was determined to know his force before I gave up to him. The engagement began, and lasted about two hours, our ships being close together, having only room to keep clear of each other; our guns told well on both sides; we were soon left destitute of rigging and sails; as I engaged him under my topsails and jib, we were sadly shattered below and aloft. I got the *Nanny* before the wind, and fought an hour that way,--one pump going,--till we had upwards of seven feet water in the hold: I thought it then almost time to give up the battle, as our ship began to be waterlogged. We were so close that I told him I had struck, and hauled my colours down. The privateer was in a sad shattered condition. By the time we were all overboard the *Nanny*, the water was up to the lower deck. When Captain Brown heard the number of men I had, he asked me what I meant by engaging him so long; I told him as I was then his prisoner, I hoped he would not call me to any account for what I had done before the colours were hauled down. He said he approved of all I had done, and treated my officers and myself like gentlemen. [Recounted in Brooke 1853: 459-460][4]

As Figure V shows, the risk that a British ship would be captured by an enemy privateer was dramatically higher during wartime than during peacetime.[5] This risk was substantially

[4] In all historical accounts of which we are aware, the captain of a captured vessel always explains that he gave up reluctantly after a fierce fight or when faced with overwhelming odds. This may be an accurate depiction of events, or it may be evidence of the impossibility of monitoring captains' behavior.

[5] Although pirates posed an enduring threat of capture to ships, the actual number of Liverpool vessels captured by pirates was dwarfed by the number of vessels captured by enemy privateers.

higher for triangle voyages than for direct voyages. On direct trade routes, a vessel leaving Liverpool would sail around the north of Ireland and remain far to the north of enemy vessels for most of the voyage to the West Indies. In contrast, a triangle-trade vessel could sail around the north of Ireland, but was vulnerable for extensive periods as it sailed south to the African coast and then through the Middle Passage.

[INSERT FIGURE V HERE]

British vessel owners frequently responded to the wartime threat by organizing convoys (Crowhurst 1977, chapter 7). Outbound convoys from Liverpool were not afforded military protection; the value of being in a convoy when attacked by privateers was primarily the reduced likelihood that any particular ship would be captured. Convoys were difficult to organize across the middle passage, because of the great uncertainty in embarking slaves on the African coast. Although convoy travel reduced the odds of a ship's capture, it introduced at least two downsides: convoys tended to move more slowly than individual vessels, and the glut of goods delivered simultaneously by a convoy's vessels might yield lower prices than otherwise.

III. HAZARDS, DISCRETION, AND COMPENSATION FOR THE VESSEL CAPTAIN

The above description of transatlantic shipping in the 18th century suggests a range of areas in which vessels faced potential hazards and in which captain discretion or effort might affect the outcome. These hazards varied in intensity across routes and across time. Table II lays out several distinct hazards and distinguishes between their effect on the captain and the vessel/cargo owner. The table indicates at least three margins along which a captain's interests might differ from those of the vessel owners: caring for the cargo, negotiating for best prices, and resisting privateers.[6]

[6] The captain presumably had a strong incentive to prevent the vessel from sinking in mid-ocean, as his life depended on staying afloat. In principle, the captain's incentive to avoid sinking near shore, or running aground, was more muted because he would likely survive such an event. Nevertheless, we assume that the captain remained interested in not sinking, if only to avoid the sometimes-physical recriminations from the surviving crew.

[INSERT TABLE II HERE]

<u>Caring for the cargo</u>

A vessel owner's profits were inversely related to the damage inflicted on cargo during a voyage. Consequently, the vessel owner had a strong financial interest in the cargo's safe delivery. In contrast, a captain had no direct interest in reducing cargo damage; to the extent that proper care required effort, a captain without a specific incentive might shirk on such care.

This issue was particularly problematic for slave-trade voyages. Left to his own devices, a captain would almost certainly spend less effort than owners would like in keeping slaves alive and healthy. Slave insurrections were common on vessels (Behrendt, Eltis, and Richardson 2001), and the fear of a slave uprising was pervasive among the crew (Rediker, 2007). Further, captain and crew feared exposure to diseases for which they had little immunity. A captain's natural preference would be to keep slaves locked in the hold of the vessel, although this would dramatically increase the incidence of sickness and death among them.

Vessel owners addressed this hazard by providing captains with performance bonuses that varied with the sale price of the cargo. Whereas almost all other crew members received a flat monthly wage for the duration of the voyage, captains typically earned both a monthly wage and a commission on sales revenue. In the direct trade, captains earned primage bonuses for the successful delivery of cargo to its destination. The primage bonus typically totaled 1%-2% of cargo value. Primage could double or perhaps triple a captain's compensation, from a wage per voyage of perhaps £50 to total voyage compensation of £100-£150.

Compensation for triangle-trade captains exhibited a similar but more intense bonus scheme. Captains received 2%-6% of sales revenue, depending on whether a European agent residing in Africa was involved in the purchase of slaves. In addition, captains frequently received a handful of "privilege slaves" – slaves for whom they would receive 100% of the sales price – conditional on keeping slave mortality below a specified rate during the voyage.[7]

[7] The slave-ship surgeon's job was to keep slaves healthy. Surgeons also received privilege slaves conditional on keeping mortality below a specified figure.

In 1750, the typical Liverpool ship carried 250 slaves and the average price for a slave in the West Indies was roughly £35. A captain who successfully completed this voyage would earn £60 or so in wages, but might then earn £200-500 in sales commissions plus £70-£150 from the sale of privilege slaves, for a total compensation of £300-£650. With incentive compensation totaling as much as ten times the base wage, the captain's performance-based payment scheme provided strong incentives with respect to his human cargo. This point was commonly highlighted by vessel owners; for example, in his 1771 letter to Captain Richard Smyth containing instructions and compensation details, ship's husband Matthew Strong noted "it suits as much your interest as ours to bring a good & healthy cargo" (Tuohy papers, cited in Rediker 2007: 193).

Negotiating hard for best prices

Whereas captains were rarely involved in price negotiations in the direct trade, in the triangle trade they were frequently involved in the purchase of slaves and food and usually involved in the sale of slaves. Although vessel owners were interested in buying at the lowest possible cost and selling at the highest possible price, the captain had no direct interest in this; to the extent that fierce negotiations required costly effort, a captain without a specific incentive might shirk on such effort.

The above-described sales commissions provided the captain with an incentive to bargain fiercely. With a sales commission that was a proportion of total revenue, the captain would be motivated to bargain for as high a sale price as possible. There was no explicit bonus for driving down costs. However, given that a captain faced a budget constraint (based on the manufactured goods carried from England to Africa) that was usually tighter than the physical constraints of the ship, the captain could maximize sales revenue by bargaining hard on purchase price and thus acquiring more slaves with a given budget. Thus, the high-powered sales commissions in the slave trade likely also served to motivate captains to bargain intensely.

Resisting privateers

As noted above, a key wartime hazard stemmed from the threat of privateers. Vessel owners wanted captains to resist capture fiercely, since capture by a privateer usually meant the total loss of vessel and cargo. A captain, given the choice between trying to resist a privateer and thus save his ship and cargo (but at some risk to his life), and surrendering the ship but preserving his life, would not internalize the owners' loss in his decisionmaking process.

The cargo-based performance compensation functioned less well at encouraging resistance to privateers than at addressing the previously described hazards. A captain who surrendered his vessel would forego the performance bonuses built into his contract. However, he would not internalize the cost of the loss of the vessel itself. Further, the cargo-based incentive might actually encourage a captain to incur an increased risk of capture: motivated by cargo prices and externalizing the cost of vessel loss, a captain might prefer to sail alone rather than as part of a convoy, racing ahead to deliver cargo before the price-reducing glut of goods arrived. Williams (1897) notes that Liverpool vessel owners in November 1776 publicly announced that they would collectively refuse to hire a captain who broke away from a convoy, suggesting tension between owner and captain incentives in this regard.

One mechanism that would encourage a captain to internalize a cost of vessel loss would be to have the captain own equity in the vessel. In such a case, the captain would balance the risks of resistance against not only the cargo-based performance bonus, but also the foregone future earning value of the vessel. The average captain-owned vessel had five owners. One-fifth of the total cost of the vessel would be roughly £400, roughly three times the likely primage bonus on a direct voyage and roughly equal to the expected commission bonus on a triangle voyage. Further, although the captain might be only a part-owner of the vessel, this partial-ownership share would typically consume nearly all of his investable wealth (whereas many vessel owners diversified their risk over multiple vessels), thus making vessel loss a significant portion of his decision calculus. On the margin, then, equity ownership in the vessel would make a captain more likely to resist privateers, and perhaps more likely to take pains to avoid running into privateers in the first place.

Surviving correspondence between ship husbands and captains indicates recognition that vessel ownership should motivate captains. William Davenport, one of the most active slave-trading merchants in 18th-century Liverpool, wrote extensive instructions to the captain of each of his vessels. For captains who were part-owners, Davenport opened the instruction letter with

"This ship, in which you have an interest," words that did not appear in his letters to non-owning captains (Davenport papers, cited in Radburn 2010). One may infer that this was intended to remind the captain-owner of his economic interest in protecting the vessel.

Could owners use mechanisms other than asset ownership to provide appropriate incentives? One might imagine a range of contractual provisions that would encourage a captain to internalize the loss of his vessel. For example, vessel owners could provide higher cargo-related bonuses – say, 8% or 10% of sales revenue – or offer a schedule of bonuses specifically for the repelling of privateers. But raising the cargo-related bonus could exacerbate the undesirable effect of encouraging a captain to avoid sailing with a convoy. And, given the challenge of monitoring action at sea, a contractual payment of bonuses for repelling a privateer would likely trigger claims for such payments even when a vessel did not encounter a privateer, or worse, might encourage a captain to seek a brief skirmish in order to earn the bonus. Alternatively, vessel owners could offer payments contingent on the safe return of the vessel or could demand the posting of bonds by the captain as surety against the vessel's safe return. But an inability to monitor the conditions under which a vessel was captured would make such contingency payments difficult to operationalize. There is no evidence of any such contractual provisions in British transatlantic shipping.

Alternatively, owners might refuse to subsequently hire captains who lost vessels to privateers. This reputation-based action might discipline captains by raising the future-income cost of surrendering a vessel. Yet this would require highly disciplined, coordinated effort among the bulk of vessel owners, which was difficult to arrange especially given the difficulty of discerning the true circumstances of battle. As noted above, shipowners attempted at least once to collectively blackball captains who broke away from convoys. But there are third-party witnesses to such action, and few excuses other than bad captaincy or willful misconduct. In contrast, battles with privateers usually had no disinterested witnesses and there was always the possibility that a captain who surrendered his vessel was truly overmatched by enemy privateers. The historical records suggest that captains suffered no reputational consequence for losing a ship to privateers. Captains who returned to England via prisoner exchange typically found new vessels to command easily; as an extreme example, Captain William Pearson lost two ships to privateers in consecutive years, but was back in command of another vessel by the following year (Ville 1987: 79).

[INSERT FIGURE VI HERE]

Theoretically, then, equity ownership appears to be a particularly effective mechanism with which to align captain's and owners' incentives to protect a vessel in the face of privateering threats. Figure VI suggests that equity ownership by captains tended to rise during wartime, particularly for vessels in the triangle trade. We expect that equity ownership by the captain would be more prevalent for vessels that faced higher levels of threat from privateers – specifically, for vessels engaged in the triangle trade during wartime. We also expect that vessels engaged in such trade that have captain-ownership would out-perform comparable vessels of which the captain is not an owner. We next describe the data that we use to test these predictions.

IV. DATA AND CHARACTERISTICS OF LIVERPOOL TRANSATLANTIC VOYAGES

Source documents on Liverpool shipping

An island nation, Britain has long based its military and economic prowess on its maritime strength. Britain's leaders consequently devoted considerable effort over several centuries to ensuring that its shipbuilding and merchant shipping industries should remain strong. During the mercantile economic regime of the 1500s-1800s, Britain enacted a series of increasingly stringent regulations to ensure that trade between Britain and her colonies would be conducted by British-built and British-owned vessels, with British captains and mostly British crews (Craig and Jarvis 1967).

As an artifact of these regulations, ships engaged in transatlantic trade were required to register with a British port and to provide, among other information, the place at which the vessel was built, the names of all owners, and the name of the vessel captain. In addition, several characteristics of the ship's construction were recorded. This information was recorded in Register books that were stored in the customs-house at each port. A duplicate copy of each Register book was sent to London for storage at a central office as well. Although every British port registered vessels from 1651 onward, most of the pre-1786 records were destroyed in fires during the eighteenth and nineteenth centuries. The entire central repository was destroyed during one of the large fires in London, and virtually all of the Bristol records faced a similar fate. Fortunately, two copies of the Liverpool Register books for the years 1744-1773 and 1779-1784 survived.

In addition to the registration documents, a vessel frequently filed paperwork for each voyage that it undertook. Depending on the year and the destination, vessel owners might file an application for a Mediterranean Pass, a Colonial Office Pass, or a similar document. Vessel voyages left footprints through non-government channels as well. Ships typically carried insurance for each voyage; Lloyds Insurance Company therefore collected information on the expected destination of each voyage. Local newspapers such as Liverpool's *Williamson's Register* carried voyage advertisements and announcements of the triumphant return (or catastrophic loss) of individual vessels.

As the above description might suggest, the original source documents are widely diffused. Fortunately, most of the key information from these documents has been assembled and cleaned by a series of historians in the furtherance of their own research agendas. We were therefore able to rely on the *Liverpool Registry of Merchant Vessels* (Richardson, Schofield, and Schwarz, undated) for the bulk of our data. This set of computer files compiles all relevant information from the Liverpool Registers 1744-1784. In addition, these files identify information regarding all known voyages undertaken by these vessels, including the captain for each voyage, the date and destination(s) of the voyage, and blunt measures of voyage outcome (e.g., returned safely; captured; lost at sea; ran aground; slave rebellion).

We augmented this with the *Trans-Atlantic Slave Trade Database*, a remarkable and publicly available database (www.slavevoyages.org) that records information about every single slave voyage that is known to have occurred, spanning the years 1514 through 1866 and covering ships of more than one dozen countries. This includes the same information as described above – date and destination of voyage, name of captain, name of owners, and outcome – and, where feasible, the duration of voyage and number of slaves carried. We use this to augment our analysis beyond the basic 1744-1785 time frame.

Throughout the time period of our sample, changes in ownership and captaincy were recorded on Certificates of Registry that traveled with the vessel and were not recorded in the Registry book. The Shipping Act of 1786 changed the law to require that all changes in ownership and captaincy must be recorded in the Registry book as well. The Act also required all vessels previously registered to re-register, so as to start the Register with a clean and accurate slate.[8]

IV.A Variables

We first look at the pattern of equity ownership by captains to determine whether we observe such ownership for triangle-trade voyages during wartime. We then examine the performance consequences of equity ownership for such voyages. Variable names and definitions are listed in Table III.

[INSERT TABLE III HERE]

<u>Dependent variables:</u>

<u>*CaptainOwner*</u>$_{ijkt}$ is a categorical variable set equal to 1 if, on voyage i by vessel j with captain k at time t, captain k is one of the owners of vessel j. This variable is also a key independent variable in our performance models. <u>*Captured*</u>$_{ijk}$ is a dummy variable set equal to 1 if, on voyage i by vessel j with captain k, the vessel is captured by a privateer. This is our key measure of voyage performance.

<u>Independent variables:</u>

[8] This highlights a weakness in our data. As noted above, we know the vessel owners as of the date of ship registration at Liverpool. But we might not observe all changes in share ownership, because pre-1786 such changes were not required to be recorded in the port Register books. Three comments. First, we do observe many ownership changes through the re-registration of vessels. There is anecdotal evidence that new owners preferred to re-register vessels to create a paper trail of ownership for legal purposes. 42% of our vessels are re-registered at least once during their lives. Second, to the extent that we miss ownership changes, this is likely to work against our finding results – if a new captain takes over a vessel and buys a share of the vessel at that point, but we do not observe the ownership change, then we will erroneously observe this as a non-owning captain. Since our estimations look for differences between vessel-owning and vessel-non-owning captains, such errors should bias our results toward insignificance.

Third, this divergence between ownership-at-registration and ownership-in-fact is likely to increase over time and/or voyages since registration. Below we run estimations based on only the first voyage undertaken by each vessel. Our qualitative conclusions do not change.

Our main prediction for equity ownership is that ownership by the captain will be particularly prevalent on triangle-trade voyages that occur during wartime. We first construct $\underline{\textit{Triangle}}_i$ as a categorical variable set equal to 1 if voyage i is destined for an African port. We also construct $\underline{\textit{Wartime}}_i$ as a categorical variable set equal to 1 if voyage i occurs during one of Britain's many eighteenth-century wars. Finally, we construct our main variable of interest, $\textit{Triangle-Wartime}_i$, as an interaction between these two variables.

We also include several control variables:

Vessel characteristics:

$\underline{\textit{NumOwners}}_j$ is a count of the number of owners of vessel j upon its registration. Agency theory suggests that greater fragmentation of ownership leads to lower incentives for any one principal to monitor an agent, which may increase the benefit of captain-ownership as a substitute for monitoring. That said, less than 1% of our observations involve vessels that boast more than ten owners, suggesting a lower level of fragmentation than in classic agency theory settings. Alternatively, controlling for the cost of a vessel, division of ownership among more people may imply a lower cost per person to purchase a share of the vessel, making captain-ownership more feasible.

$\underline{\textit{Tons}}_j$ is defined as the volume of cargo that vessel j can carry. Vessels of different sizes may be differentially able to escape from privateers. Alternatively, controlling for the number of owners, smaller vessels cost less per person to build or purchase, making captain-ownership more feasible.

Captain characteristics:

We construct three measures of a captain's prior experience. $\underline{\textit{CaptExperience-Triangle}}_k$ is defined as the number of triangle-trade voyages on which captain k has previously served as a captain. This would be equal to zero for captain k's first triangle-trade voyage, one for his second voyage, etc. $\underline{\textit{CaptExperience-Direct}}_k$ and $\underline{\textit{CaptExperience-Other}}_k$ are defined analogously for captain k's previous direct-trade and "other" voyages (i.e., voyages to destinations in the Baltic Sea, Mediterranean, or Ireland), respectively. A captain's wealth increased with the number of successful voyages that he concluded. Thus, greater previous experience likely provides a captain with the financial resources necessary to buy a share of a ship. Also, a more experienced captain was likely a better captain, either by virtue of lessons learned during the voyages, or because the simple act of surviving multiple voyages revealed information about his underlying quality.[9] To the extent that "better" captains might demand shares of vessels, captain experience again would likely be associated with vessel ownership. As described above, triangle-trade voyages offered far more compensation for captains than direct-trade (or "other" voyages. Thus, whereas a captain's slave-trade voyages augmented both experience and wealth, non-slave-trade voyages augmented his experience but did less for his wealth.

Time-trend characteristics:

We also include voyage-decade categorical variables. These are included to control for any time trend in the prevalence of captain-ownership. Since each decade encompasses both wartime years and peacetime years, we are still able to identify a wartime effect while including the voyage-decade effects. In robustness checks we replace these with voyage-year fixed effects. The results of our models are unchanged with the exception that *Wartime* falls to insignificance; all but five years are either fully war years or fully peace years.

In unreported models, we also include destination-region variables. We code two separate dummy variables for voyages whose North American destinations are in the West Indies or in what is now the U.S. mainland, respectively. For triangle-trade voyages, we code dummy variables for seven regions on the West African coast (Senegambia, Sierra Leone, Windward Coast, Gold Coast, Bight of Benin, Bight of Biafra, and Guinea). The coefficients on these variables are never significant, and collectively they do not increase the explanatory power of the models significantly. Their inclusion does not change substantively the coefficients on the other variables.

Tables IV and V show summary statistics for our sample. Because our empirical setting involves four distinct regimes – wartime-triangle, peacetime-triangle, wartime-direct, and peacetime-direct – and because the proportions of triangle and direct voyages are different in wartime vs. peacetime, Table IV presents the descriptive statistics separately for each regime.

Compared to direct-trade vessels, vessels on triangle-trade voyages are characterized by a higher prevalence of equity ownership by captains, a greater number of owners, and lower

[9] Behrendt (1991) notes that the death rate among slave-trade captains was roughly 15% on each voyage.

tonnage. Given the higher cost and greater risk of a triangle-trade voyage, the greater number of owners presumably reflects desire to diversify risk by taking smaller shares of multiple vessels or by limiting one's investment in a given vessel. The lower tonnage is consistent with the historical record. As for the greater equity ownership by captains, Section II indicated that the discretion/effort of captains in the triangle trade was more consequential than that in the direct trade; although Section III proposed that contractual provisions could manage this discretion, it is possible that owners relied to a degree on equity ownership to manage this. The descriptive statistics show evidence of specialization by captains in type of voyage undertaken: captains of triangle-trade voyages had more prior experience in the triangle trade than did direct-trade captains, while captains of direct-trade voyages had more prior experience in the direct trade. Although direct-trade captains had more overall prior voyages, we note that the typical direct-trade voyage took less time than the typical triangle-trade voyage, so that actual sailing time would likely be comparable.

Within the triangle trade, vessels on wartime voyages have more owners and are more likely to involve equity ownership for captains than vessels on peacetime voyages. The higher number of owners may reflect a desire to diversify risk further in the face of privateering threats. The increased equity ownership for captains is consistent with the predictions in Section III above. Interestingly, within the direct trade, equity ownership by captains goes down during wartime, while the experience profile of captains changes slightly. This might reflect a preference for the relatively risk-averse captains in the direct trade to exit the industry in the face of higher risk or more depressed conditions of the wartime market.

[INSERT TABLES IV and V HERE]

V. DETERMINANTS OF EQUITY OWNERSHIP AND VOYAGE PERFORMANCE

V.1. Equity ownership

The univariate comparisons reported in Section IV do not control for numerous factors that conceivably contribute to equity ownership by captains and to the performance of a voyage. In this section we report on multivariate tests that seek to control for vessel characteristics, voyage characteristics, and captain characteristics. For voyage i by vessel j with captain k in year t, we estimate the following specification:

$$CaptainOwner_{ijkt} = \alpha Triangle_i + \beta Wartime_i + \lambda Triangle_i{*}\,Wartime_i + \theta \boldsymbol{X}_{ijk} + \gamma_t + \varepsilon_{ijkt} \qquad (1)$$

Where $\boldsymbol{X}_{ijk}$ is a vector of voyage, vessel, and captain characteristics, γ_t is a fixed effect for decade, and ε_{ijkt} is an error term. Although *CaptainOwner* is a categorical variable, we report our main results using a linear probability model. We focus on the linear probability model because our main variable of interest is an interaction term. Ai and Norton (2003) have demonstrated the difficulty of interpreting interaction terms in non-linear estimations. We also show that our results are robust to a logit formulation. We also verified that the marginal effect of the interaction term in the logit specification is similar to its linear-probability counterpart in sign and significance, using the method suggested by Ai and Norton (2003).

[INSERT TABLE VI HERE]

Table VI reports on the determinants of equity ownership by captains. Models 1 through 4 provide results for voyage characteristics, including our main variable of interest. The coefficients are stable in magnitude, sign and significance across the models. In Model 4, which has the most explanatory power according to the likelihood ratio test, the coefficient for *Triangle* is positive and statistically significant at the 1% level. Triangle-trade voyages are more frequently characterized by equity ownership by captains, even after one controls for other voyage characteristics. Although the point estimate for *Wartime* negative, it is not statistically significant. Finally, the coefficient for *Triangle*Wartime* is positive and statistically significant at the 5% level. During wartime, triangle-trade voyages are more likely to have captain equity ownership. A Wald test indicates that the positive effect of the interaction term more than offsets the negative point estimate on *Wartime*; the sum of the two coefficients is significantly greater than zero at the 10% level.

In Models 5 and 6 we introduce vessel characteristics, notably *NumOwners* and *Tons*. The coefficient on *NumOwners* is positive and significant across both models. Vessels with more owners are more likely to include equity ownership for captains. In contrast, the coefficient for *Tons* is never statistically significant, and the point estimate is of no economic significance.

The inclusion of vessel characteristics depresses the effects of triangle-trade voyages. In particular, the coefficients on both *Triangle* and *Triangle*Wartime* lose magnitude, and the coefficient on the *Triangle* main effect becomes statistically insignificant. At the same time, the coefficient on *Wartime* increases in magnitude and becomes significant at the 10% level. As discussed above, vessels on triangle-trade voyages have more owners than their direct-trade counterparts, especially during wartime. This may explain the effect on the triangle-trade coefficients.

Finally, in Model 7 we introduce captain characteristics, specifically the number of voyages of different types that a vessel's captain has previously captained. All three experience variables have coefficients that are positive and statistically significant. A test for equality of coefficients indicates that the coefficient for *CaptainExp-Triangle* is significantly larger than that for either *CaptainExp-Direct* or *CaptainExp-Other*. Thus, the effect of experience in the lucrative triangle trade is significantly greater than the effect of experience in the direct trade or non-Atlantic trade. This is consistent with the expectation that, among other things, captain experience can relax a captain's wealth constraint – prior triangle voyages are associated with the amassing of sufficient wealth to afford a share of a vessel; prior direct or non-Atlantic voyages are less likely to provide similar wealth.

In Model 7, the coefficient for *Triangle*Wartime* continues to be positive and statistically significant at the 5% level. Thus, equity ownership by captains is more prevalent in triangle-trade voyages during wartime even after controlling for other voyage, vessel, and captain characteristics. The coefficient on Triangle*Wartime is more than twice the coefficient on Wartime (in absolute value terms), although the Wald test indicates that the sum of the two coefficients is no longer significantly different from zero.

We show robustness to a logit formulation in Models 4a and 7a, which replicate Models 4 and 7. Our qualitative conclusions are unchanged in these results.

[INSERT TABLE VII HERE]

V.1.1. Equity ownership – robustness checks

The above estimation, at the voyage level, is predicated on the assumption that shipowners select a route for each voyage and then select the appropriate captain-ownership mode to govern the captain. If vessels are not at risk of switching between route types, or of switching captains or captain-ownership types, then this assumption is violated and estimation is more appropriately conducted at the vessel level. Descriptive analysis indicates that roughly 25% of all vessels that undertake two-plus voyages sail on both direct and triangle routes during their lives, 28% of such vessels change master-ownership mode at least once. These percentages are higher if one restricts the analysis to vessels that sail three-plus voyages, four-plus voyages, and so on. Thus there appears to be some level of variation in voyage route and captain-ownership for a given vessel. Nevertheless, to address this concern, we re-estimate the results on a sub-sample that only includes the first voyage undertaken by each registered vessel. These results are presented in Table VII, Models 4b and 7b. They are essentially identical to the full-sample results except that the coefficient for *Wartime* becomes insignificant.

As a second robustness check, in Models 4c and 7c we replace voyage-decade fixed effects with voyage-year fixed effects. In these models the key interaction variable *Triangle***Wartime* continues to be positive and statistically significant.

V.2. Voyage Performance:

In the previous sub-section we established that shipowners at the dawn of shareholder capitalism appear to have emphasized equity ownership by captains in ways consistent with agency theory. Notably, captains of vessels that were especially exposed to privateering threats were more likely to own a share of the ship than captains of other vessels. In this sub-section we turn to performance consequences: did equity ownership in such vessels affect captains' behavior? A classic endogeneity challenge in exploring this is the likelihood that shipowners selected a captain's equity ownership with the goal of optimizing expected performance of the vessel. One way to address this would be through instrumental variables. However, it is difficult to conceive of instruments that would be correlated with the likelihood of captain ownership but not with the performance-related error term. To overcome this, we exploit the fact that triangle-trade voyages took at least a year from departure to return. Thanks to the long duration of a voyage, many vessels departed during peacetime but were still en route after war had broken out. We therefore focus our attention on triangle-trade vessels that begin their voyage before, and end their voyage after, a war "shock." In the 1744-1785 data, we have the outbreak of the Seven Years War (1756) and the American Revolution (1776). As noted in Section IV, we have additional data on triangle-trade voyages from Liverpool throughout the 18th century from the *Slave Voyages database*. We use this to augment our sample with voyages at the outbreak of the War of Austrian Succession (1739) and the French Revolutionary War (1792). We also exploit two instances in which the French joined ongoing wars mid-way (joining the War of Austrian Succession in 1744 and the American Revolution in 1778), thus dramatically escalating the privateer risk to British vessels.

This identification strategy rests on the assumption that the outbreak of war was an unforeseen shock. We justify this in two ways. First, the historical record suggests that, although the general prospect of war was always in the background during the 18th century, the actual timing of war declarations was not anticipated by Britishers (Williams 1897). Second, we invoke the admittedly limited data on British marine insurance premia from two different sources to identify the point at which insurance premia rose around a war. Kingston (2007b) shows that while insurance rates for voyages to the Caribbean and between Britain and North America rose somewhat in the year leading up to the declaration of the Seven Years War, rates rose more substantially at the time that war was declared and then again as news of captured ships began to arrive.[10] Surviving accounts of individual merchants from the 1770s indicate a similar pattern; merchant William Davenport faced a jump in insurance rate that roughly corresponded to the formal outbreak of the American Revolution, and a higher rate after American privateers began to capture British vessels (Radburn 2010). This suggests that British marine insurers, and pre-

[10] Kingston (2007b: 12-13) describes one merchanthouse that paid 6% on shipments to Jamaica in May 1756, just before war was declared, 8% in August; and 12.5% in February 1757, driven by news of captured ships.

sumably the vessel owners who were insured, did not anticipate the privateer threat before the outbreak of war, and perhaps not even at the moment of war declaration.[11]

Given this context and given the difficulty of pinpointing the moment at which British shipowners perceived the privateering threat, we examine performance using two different cutoffs around the outbreak of war. The first uses the official date of war declaration as the shock. For this cutoff, our sample includes all vessels that departed from Liverpool in the 12 months preceding the date of war declaration.[12] The second uses the date of the first capture of a Liverpool vessel as the shock. In all four wars, the first capture occurred in the Caribbean, roughly two months sailing from Liverpool. Therefore, for this cutoff, our sample includes all vessels that departed from Liverpool in the 12 months preceding the date of the first capture *and* in the two months following the capture. When we include the two instances of war escalation due to belated French entry, we again include all vessels that departed from Liverpool in the 12 months preceding the date of escalation.

Table VIII presents data on the frequency of captain-ownership and capture by privateers during the "war declaration" and "first capture" samples, respectively. The table presents the results of a difference of means test for proportion of vessels captured, as a function of captain ownership vs. non-ownership. As the table indicates, captain-owned vessels were less likely to be captured than non-owned vessels across both cutoffs and various aggregations across wars. In five out of six cases, this difference is statistically significant. Thus it appears that captain-ownership was associated with a lower likelihood of vessel capture in the face of a war "shock."

[INSERT TABLE VIII HERE]

Of course, the univariate comparisons reported above do not control for numerous factors that conceivably contribute to the performance of a voyage. We next report on multivariate

[11] For example, the British may not have expected the American rebels to launch a credible fleet of privateers.

[12] The Continental Congress's March 23, 1776 authorization of Letters of Marque occurred far from Britain, such that Britishers would not have learned about the event immediately. Since it took two months for news to cross the Atlantic, we include vessels that departed from Liverpool in the 12 months preceding March 23, 1776, *and* vessels that departed up to two months afterward.

tests. Although the limited number of observations – especially the limited number of vessels that are captured during the "war shock" period – constrain the statistical significance of the results, we find consistent point estimates for the variable of interest. For voyage i of vessel j with captain k, we estimate the following specification:

$$\mathit{Captured}_{ijk} = \delta \mathit{CaptainOwner}_{ijk} + \phi \boldsymbol{Z}_{ijk} + \varepsilon_{ijk} \qquad (2)$$

where $\boldsymbol{Z}_{ijk}$ is a vector of voyage, vessel, and captain characteristics and ε_{ijk} is an error term.

[INSERT TABLE IX HERE]

Table IX reports on the performance of a voyage, measured by avoidance of capture, as a function of captain ownership, captain triangle-trade experience, and several voyage characteristics.[13] We use our more favorable cutoff, based on date of first capture, for these estimations. In Models 1-4 we focus only on the initiation of the four wars. In Models 5-8 we also include the dates of French entry into ongoing wars. For the first four models in Table IX, the point estimate on *CaptainOwner* is negative. This point estimate is statistically significant at the 10% level in Model 1. Although the coefficient is not significant in Models 2 through 4, in which we introduce additional variables likely to explain performance, it retains roughly the same magnitude across all four estimations. These results are echoed in Models 5-8. Again, the point estimate on *CaptainOwner* is negative across all four models; the coefficient is significant in two of the four models. While these results do not provide conclusive evidence in support of a link between captain-ownership and avoidance of capture, the stable, negative coefficient strongly suggests such a link, given the constraints of the data.

V.3. Alternate explanations

V.3.1. Endogenous matching

[13] We are unable to include captain direct-trade or other-trade experience measures because the Slave Voyages database, from which we obtain the voyages during the French Revolutionary War and the War of Austrian Succession, only contains triangle-trade voyages.

Perhaps the most likely alternate explanation for our results is the possibility of endogenous matching (Ackerberg and Botticini 2002). If captains vary in risk-aversion, and if financial risk-aversion is correlated with risk-aversion concerning personal safety, then our pattern of results might arise from risk-loving captains' willingness to invest wealth in a vessel, sail on routes with greater threat of privateering, and resist when approached by privateers. The traditional method for addressing endogenous matching is to utilize an instrument that affects the matching but does not affect the asset-ownership choice. It is difficult to conceive of a feasible instrument in this instance (studies in the literature typically use geographic variation, which is particularly inappropriate for shipping).

However, we are able to draw inferences from two alternative measures of voyage performance: voyage duration and the difference between anticipated number of slaves transported and the actual number transported (the "shortfall"). Our reasoning is as follows: if the above results are attributable to endogenous matching according to risk-preference, then captain-owners should also exhibit risk-seeking behavior along other dimensions of performance. In contrast, if the results are attributable to an incentive-alignment explanation, then captain-owners should exhibit cautious behavior, aimed at protecting their vessel, along other dimensions of performance. With respect to voyage duration, the incentive-alignment explanation would be consistent with longer duration for captain-owned vessels – on the assumption that a captain will pilot a vessel more carefully when he owns equity in it – while the endogenous matching explanation would be consistent with, if anything, a shorter voyage duration.

Regarding the "shortfall" in slaves embarked, as noted in Section II a triangle-trade vessel typically spent several weeks along the West African coast in order to embark slaves at a fairly low rate per day. The larger the vessel, the longer this would take. During this time the vessel was vulnerable to both natural threats and, in wartime, privateers. The incentive-alignment explanation would be consistent with a greater shortfall for captain-owned vessels, because captain-owners should trade off capacity utilization against the risk to the vessel more steeply than would non-owners. In contrast, the endogenous matching explanation would be consistent with a smaller shortfall for captain-owned vessels, as risk-seeking captains would likely weigh less heavily the danger of prolonged exposure along the coast.

V.3.1.1. Duration

The Slave Voyages data includes a start date for all triangle-trade voyages, and an end date for a subset of these voyages. End-date information exists for 632 of the successfully completed wartime voyages and 1619 successfully completed peacetime voyages between 1739 and 1794. Table X shows the mean completion time for subsets of these voyages. As the Table indicates, captain-owned vessels take significantly longer than non-captain-owned vessels to complete their voyages. In peacetime, captain-owned vessels take 18 days longer, making the trip roughly 4.5% longer than non-captain-owned vessels. In wartime, captain-owned vessels take 43 days longer, adding more than 10% to the duration of a voyage.

[INSERT TABLES X AND XI HERE]

It is possible that the captain-owned vessels sail to different locations on the African coast than do non-captain-owned vessels, or embody other systematic differences that affect duration. In Table XI we report the results of multivariate estimation. Using ordinary least-squares estimation, we regress voyage duration on captain-ownership, wartime, a captain-owner/wartime interaction term, and several other voyage and captain characteristics. As Table XI shows, the coefficient on *Captain-Owner* is positive and significant in all estimations. In the fully specified model, a captain-owner takes nearly 13 days longer to complete a voyage, or 3% longer than a non-owner when controlling for all other factors. The coefficient on *Wartime* is significant before introducing region or decade effects, but falls to insignificance once these effects are included. While the point estimate for *CaptainOwner***Wartime* is always positive, it is never statistically significant. Thus the estimations indicate that the captain-owner effect on duration is not sensitive to wartime or peacetime; captain-owners are equally "slow" during times of peace and times of war. Although these results would be more conclusive if the duration gap between captain-owners and non-owners increased in the face of wartime threats, the positive effect of *CaptainOwner* on duration is more consistent with a captain whose ownership leads him to be more concerned about the vessel than with a risk-seeking captain who both welcomes an ownership share and is comfortable pursuing dangerous routes and battling with privateers.

V.3.1.2. "Shortfall" in slaves embarked

The Slave Voyages database also includes information on the anticipated number of slaves that a voyage will embark, and the actual number transported (or an "imputed" number transported.) These data exist for 2054 of the Liverpool voyages between 1739 and 1794.[14] We construct a variable, *Shortfall*, equal to the difference between anticipated and actual-or-imputed number of slaves transported. Table XII shows the mean shortfall for subsets of these voyages. Although there is little difference between captain-owners and non-owners in the overall data, there is a marked difference within the subsample of large vessels, defined as vessels with a tonnage exceeding 130 tons (the mean vessel tonnage in these data is 133 tons). As the second panel of Table XII shows, small vessels have significantly smaller shortfalls than large vessels, presumably because it took less time to fill up a smaller vessel. Further, for large vessels a captain-owner has a significantly larger shortfall than a non-owner.

The third panel explores this further, by dividing large-vessel voyages into wartime and peacetime voyages. The captain-owner shortfall "gap" is driven by wartime voyages. During wartime, vessels with captain-owners have an average shortfall of 108 slaves, more than twice the shortfall on vessels whose captains were not owners. And whereas non-owners had similar shortfall levels during wartime and peacetime, captain-owners were sensitive to wartime, more than doubling their shortfall as compared to peacetime. As discussed above, whether in wartime or peacetime, a greater shortfall for captain-owners is more consistent with an incentive explanation for vessel ownership than with endogenous matching.

We find different results for smaller vessels, as shown in the fourth panel of Table XII. Neither wartime vs. peacetime voyages nor captain-owner vs. non-owner voyages exhibit significant differences in shortfall. Captains were not sensitive to wartime conditions, regardless of

[14] An explanation of the imputation procedure is available at http://slavevoyages.org/tast/database/ methodology-14.faces. Given the noise inherent in an imputation procedure, we exclude outlier observations in which the imputed number of slaves embarked is more than double or less than 50% of the anticipated number. This leaves us with 1960 observations.

their equity ownership in vessels, when those vessels were small. As noted above, it is possible that this is due to the shorter length of time needed to load a small vessel.

[INSERT TABLES XII AND XIII HERE]

Again, it is possible that captain-owned vessels visit ports with different slave-embarkation patterns than non-captain-owned vessels, or embody other systematic differences that affect the shortfall. In Table XIII we report the results of multivariate estimations. Using ordinary least-squares estimation, we regress shortfall on captain-ownership, wartime, a captain-owner/wartime interaction term, and several other voyage and captain characteristics. Models 1-4 present results for the large-vessel subsample, and Models 5-8 present results from the small-vessel subsample. For large vessels – which would have to spend substantial time along the coast to be filled – the coefficients on the main effects *CaptainOwner* and *Wartime* are positive and significant in all four estimations. The coefficient on the *CaptainOwner***Wartime* interaction term exhibits exhibits the same pattern of significance. Thus, captain-owners incur higher shortfalls than non-owners, and this shortfall "gap" increases during wartime. Captain-owners' higher level of shortfalls is more consistent with a captain whose ownership stake leads him to be more concerned about the vessel than with a risk-seeking captain.

The results are more equivocal for small vessels. Coefficients on *CaptainOwner*, *Wartime*, and the interaction term *CaptainOwner***Wartime* are never significant. One interpretation is that, for small vessels, the length of time needed to fill the vessel is sufficiently small that captain behavior is not affected by a tradeoff between time spent on the coast and filling the vessel.

V.3.2. Wartime switching across routes – endogenous matching on captain experience

A second alternative explanation might relate to a re-sorting of captains across direct- and triangle-trade voyages during wartime, to endogenously match highly experienced captains to wartime-triangle voyages. If wartime brings a wave of retirements among captains, or if wartime triggers a migration of triangle-trade captains to direct-trade work or vice-versa, then our results might be affected by these switches. As above, we lack a feasible instrument to address this. However, we can draw inferences from descriptive data.

Figure VII shows the average experience level of triangle-trade captains over time. After an initial period in which experience grows (since all captains start with zero experience given the left-truncation of our data), captain experience appears generally stable through both war and peace.[15] The one exception is a brief change in the middle of the American Revolution, during which direct-trade and other-trade experience briefly increase while triangle-trade experience fluctuates. It is possible that this fluctuation is due to the unusually low number of voyages that took place in these years, such that a small number of extreme values can significantly affect averages. This implies that, for a 2- or 3-year period beginning in 1778, there was a greater-than-usual reliance on captains who migrated from the direct-trade to the triangle trade. Overall, though, it does not appear that wartime triggers an unusual exodus of captains that might drive our results.[16]

[INSERT FIGURES VII AND VIII HERE]

Figure VIII shows for each year the proportion of voyages whose captains have switched from direct trade to triangle trade, and vice versa. The maximum proportion of voyages whose captains switch in a given year is roughly 0.07. The Figure indicates a slightly increased likelihood that a voyage will have a "switching" captain as war breaks out or as war comes to an end; three of the seven years with the highest proportions of switching to triangle-trade occur within one year of war or peace breaking out, as do three of the five years with the highest proportions of switching to direct-trade. Table XIV pursues this by presenting results of difference of means tests between wartime and peacetime levels of switching, and between switching in "transition years" (first and last years of peace, and first and last years of war) and non-transition years. As

[15] Recall that in our estimations we drop the first three years of data to account for the left-truncation of experience.

[16] Although not presented in Figure VII, average triangle-trade experience of captains is similarly stable before and during the War of Austrian Succession, and before, during, and after the French Revolutionary War.

the table shows, none of the differences in means are statistically significant. It does not appear that the main results of this study are attributable to migration or retirement of captains.

[INSERT TABLE XIV HERE]

V.3.3. Changes in bargaining power

Finally, a third alternative explanation could rest on changes in relative bargaining power that occur during wartime. Perhaps shipowners always prefer to have captains own a share in the vessel, but captains are generally risk-averse and therefore prefer not to do so, leading to the peacetime pattern of ownership. During wartime, as the number of voyages undertaken goes down, captains scramble for work on the dramatically fewer available voyages, and shipowners use their bargaining strength to coerce captains into share ownership. Although this explanation would appear to be consistent with the wartime increase in equity ownership among captains on triangle-trade voyages, it is inconsistent with the wartime decrease in equity ownership among captains on direct-trade voyages, which experienced wartime declines in voyages nearly as steep as those in the triangle trade.

VI. CONCLUSION

In this paper we use historical data on Liverpool transatlantic shipping to examine the effect of equity ownership on top manager behavior. We found that the pattern of equity ownership by captains in the vessels that they piloted was not random. Rather, vessels that were at particular risk of attack by enemy privateers were significantly more likely to have captains who were also part-owners. This is consistent with an agency view of equity ownership. Owners preferred that captains resist privateers fiercely. But it was difficult to construct contractual incentives to elicit such behavior. Partial ownership of the vessel by the captain was one mechanism by which to align captains' and owners' incentives regarding the privateer threat, and consequently to elicit desired behavior from captains.

We then found that equity ownership was associated with a lower likelihood that a vessel would be captured by privateers. Difference of means tests indicated a statistically significant reduction. Multivariate estimation indicated a stable, negative effect of captain-ownership on the likelihood of being captured by privateers, although the statistical significance of this relationship varied across models. Overall, the use of equity ownership by Liverpool vessel owners, and the effect of equity ownership on vessel captains' behavior, appears to be largely consistent with agency theory's predictions about the modern use and effect of equity on shareholder and top management behavior.

We considered three alternative explanations for these results – endogenous matching, waves of captain retirements or migration during wartime, and a wartime change in bargaining power between shipowners and captains. Subsidiary analyses generated results that appear to be more consistent with an incentive-alignment rationale than with these explanations.

The evidence of the efficacy of captain ownership in Liverpool shipping is notable given the inconsistent results regarding the influence of CEO stock ownership in contemporary organizations. As scholars and policymakers continue to debate the precise behavior elicited by top-management-team stock ownership today, our results provide useful evidence concerning the effect of equity ownership in an analogous setting. These results also enhance our understanding of the range of mechanisms used to support far-flung and difficult-to-monitor economic transactions in the days when communications lagged far behind physical trade.

Further, our results – drawn from the eighteenth century – are also interesting in light of economic history's favored explanation for the decline of British industry in the twentieth century: that the United Kingdom was relatively slow to adopt corporate capitalism and reap the coordinating benefits of the managerial visible hand (Erlbaum and Lazonick 1984; Hannah 1976). There was at least one industry, shipping, in one place, Liverpool, where the British appear to have been early to realize that giving managers a stake in the firm enables economic activities that might otherwise be inhibited by agency costs. Of course, there are many paths by which this early realization of the agency problem could fail to become an early adoption of modern shareholder capitalism. One that deserves attention, we think, is that captain ownership took root in the triangle trade, an industry that quite rightly became tainted with illegitimacy. Our early snapshot combines with later analyses to admit the intriguing possibility that the

British political economy may have discarded valuable experience in corporate governance in its repudiation of the slave trade (Clarkson 1788; Anonymous 1884; Rediker 2007; Ingram and Silverman 2012).

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Table I: Crude financial statement for "typical" voyages

Typical Liverpool-West Indies voyage:		Typical Liverpool-Biafra-West Indies voyage:	
Voyage costs:		Voyage costs:	
• Vessel	£1,500-£2,500 initial purchase	• Vessel	£1,500-£2,500 initial purchase
• Wages	£225-£275 (16 crew members; total wage bill ≈ £26/month)	• Wages	£650-£700 (29 crew members; total wage bill ≈ £51/month)
• Food	£225-£275 (16 crew members; total food bill ≈ £26/month)	• Food	£1,100-£1,300 (29 crew members, plus 250 slaves for part of voyage)
• Insurance, port fees, maintenance & repair	£350	• Insurance, port fees, maintenance & repair	£500
		• Cargo cost	£1,500-£3,000
Vessel life:	up to 15-20 voyages	Vessel life:	up to 8-10 voyages
Financial return:	up to £750-£1,000 if all goes well	Financial return:	up to £3,000-£4,000 if all goes well

Liverpool-West Indies crew complement (monthly wage)		Liverpool-Biafra-West Indies crew complement (monthly wage)	
Captain	£5.0 *	Captain	£5.0 *
1st mate	£4.0	Surgeon	£4.0 *
2nd mate	£3.0	1st mate	£4.0 *
Boatswain	£1.5	2nd mate	£3.0
Cook	£1.5	3rd mate	£3.0
Seaman, five	£1.3	Carpenter	£3.0
½-seaman, two	£1.0	Cooper	£3.0
Boy, four	£0.75	Surgeon's mate	£1.5
Total:	£26	Boatswain	£1.5
		Cook	£1.5
		Seaman, eight	£1.5
		½-seaman, three	£1.0
		Landsman, two	£1.0
		Boy, six	£0.75
		Total:	£51

* Plus performance bonuses as described in Section III.

Table II: Hazards and Divergent Incentives

Hazard	Vessel owner/ cargo owner concern	Intrinsic captain concern	Compensation aligns incentives?
Vessel sinks in mid-ocean	Yes	Yes	Already aligned
Vessel sinks near shore	Yes	Probably	Bonus based on sales revenue of cargo
Cargo suffers damage	Yes	No	Bonus based on sales revenue of cargo
Slave mortality	Yes	No	Bonus based on survival of slaves
Vessel arrives too late to get good price for cargo	Yes	No	Bonus based on sales revenue of cargo
Vessel is captured by enemy privateers	Yes	No	**Vessel ownership**

Table III: List of Variables

Variable	Definition
Dependent variables	
CAPTAIN-OWNER$_{ijkt}$	1 if voyage i by vessel j at time t has a captain k whose name also appears on the list of vessel j's owners, else 0
CAPTURED$_{ijk}$	1 if vessel j on voyage i with captain k is captured by enemy privateers, else 0
Voyage characteristics	
TRIANGLE$_i$	1 if voyage i has a destination in Africa, else 0
WARTIME$_i$	1 if voyage i departs during a formally declared war involving Britain, else 0
TRIANGLE*WARTIME$_i$	Interaction term between TRIANGLE and WARTIME
VOYYEAR$_i$	Year in which voyage i departs from Liverpool 1730 (used in year or decade fixed effects)
Vessel characteristics	
NUMOWNERS$_j$	Number of owners listed for vessel j
TONS/1000$_j$	Gross tonnage of vessel j
TRIANGLE*NUMOWNERS$_{ij}$	Interaction term between TRIANGLE and NUMOWNERS
Captain characteristics	
CAPTEXPERIENCE-TRIANGLE$_k$	Number of prior triangle-trade voyages, on any Liverpool-registered vessel, that were captained by captain k
CAPTEXPERIENCE-DIRECT$_k$	Number of prior direct-trade voyages, on any Liverpool-registered vessel, that were captained by captain k
CAPTEXPERIENCE-OTHER$_k$	Number of prior non-triangle and non-direct voyages, on any Liverpool-registered vessel, that were captained by captain k

Table IV: Descriptive Statistics
(difference of means tests: *** = p < .01; ** = p < .05; * = p < .10)

Peacetime	**Triangle**		**Peacetime**	**Direct**		*Difference, triangle vs. direct*[c]
CaptainOwner	0.214		CaptainOwner	0.191		*
NumOwners	4.332		NumOwners	3.048		***
Tons	104.2		Tons	109.0		***
CaptainExp-Triangle	1.690		CaptainExp-Triangle	0.085		***
CaptainExp-Direct	0.584		CaptainExp-Direct	2.598		***
CaptainExp-Other	0.124		CaptainExp-Other	0.122		
CaptainExp-Total	2.398		CaptainExp-Total	2.805		***
Observations	1567		Observations	3262		
Wartime	**Triangle**	*Difference, wartime vs. peacetime*[a]	**Wartime**	**Direct**	*Difference, wartime vs. peacetime*[b]	
CaptainOwner	0.242	*	CaptainOwner	0.148	***	***
NumOwners	4.816	***	NumOwners	3.059		***
Tons	103.0		Tons	114.6	***	***
CaptainExp-Triangle	1.701		CaptainExp-Triangle	0.119	*	***
CaptainExp-Direct	0.563		CaptainExp-Direct	2.485		***
CaptainExp-Other	0.051	*	CaptainExp-Other	0.175	***	***
CaptainExp-Total	2.315		CaptainExp-Total	2.779		
Observations	670		Observations	1580		

Notes: Difference of means tests across subsamples of the population. The unit of analysis is the voyage. Total number of voyage observations is 7,079.
*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

[a] e.g., difference between mean of CaptainOwner for wartime-triangle voyage and mean of CaptainOwner for peacetime-triangle voyage
[b] e.g., difference between mean of CaptainOwner for wartime-direct voyage and mean of CaptainOwner for peacetime-direct voyage
[c] e.g., difference between mean of CaptainOwner for peacetime-triangle voyage and mean of CaptainOwner for peacetime-direct voyage

Table V: Correlation matrix (N = 7079 voyages)

	mean	s.d.	min	max	1	2	3	4	5	6	7	8	9
1 CaptainOwner	0.191	0.393	0	1									
2 Captured	0.029	0.169	0	1	0.003								
3 Triangle	0.316	0.465	0	1	0.054	0.056							
4 Wartime	0.318	0.466	0	1	-0.026	0.228	-0.027						
5 VoyageYear	1767	10.414	1748	1785	-0.029	-0.021	-0.015	-0.059					
6 NumOwners	3.502	2.447	1	21	0.288	0.014	0.271	0.023	-0.081				
7 Tons	108.6	56.1	10	600	0.012	-0.048	-0.058	0.031	0.202	0.038			
8 CaptainExp_Triangle	0.601	1.487	0	14	0.134	0.020	0.500	-0.005	0.079	0.141	0.040		
9 CaptainExp _Direct	1.935	3.081	0	24	0.064	-0.023	-0.299	-0.005	0.119	-0.103	0.149	-0.120	
10 CaptainExp _Other	0.127	0.728	0	16	0.057	0.006	-0.024	0.010	0.025	0.035	0.000	0.018	0.128

Table VI: Governance results – Captain-Ownership as a function of voyage, vessel, and captain characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(4a)	(7a)
Voyage characteristics									
Triangle	0.044 ***		0.043 ***	0.044 ***	-0.024	0.037	0.003	0.281 ***	0.108
	(0.016)		(0.016)	(0.016)	(0.016)	(0.024)	(0.027)	(0.101)	(0.225)
Wartime		-0.022	-0.020	-0.020	-0.026 *	-0.024 *	-0.025 *	-0.153	-0.198 **
		(0.014)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.094)	(0.099)
Triangle*Wartime				0.069 **	0.048 *	0.053 **	0.054 **	0.456 ***	0.414 **
				(0.028)	(0.026)	(0.027)	(0.026)	(0.174)	(0.178)
Vessel characteristics									
NumOwners					0.047 ***	0.048 ***	0.048 ***		0.300 ***
					(0.004)	(0.004)	(0.004)		(0.025)
Tons/1000					0.005	0.001	-0.135		-0.976
					(0.137)	(0.137)	(0.133)		(1.030)
Triangle*NumOwners						-0.015 **	-0.016 **		-0.106 **
						(0.007)	(0.007)		(0.045)
Captain characteristics									
CaptainExp-Triangle							0.038 ***		0.217 ***
							(0.007)		(0.037)
CaptainExp-Direct							0.012 ***		0.084 ***
							(0.003)		(0.020)
CaptainExp-Other							0.017 **		0.100 ***
							(0.009)		(0.047)
Decade fixed effects	Included	Included	Included	Included	Included	Included	Included	Included	Included
Constant	0.169 ***	0.188 ***	0.176 ***	0.177 ***	0.046 ***	0.031	0.007	-1.534 ***	-2.788 ***
	(0.020)	(0.020)	(0.021)	(0.021)	(0.027)	(0.028)	(0.028)	(0.140)	(0.231)
Observations	7079	7079	7079	7079	7079	7079	7079	7079	7079
F-statistic	3.16 ***	2.40 **	3.22 ***	3.86 ***	24.57 ***	21.83 ***	19.29 ***		
Wald statistic								24.96 ***	218.07 ***
R^2	0.006	0.004	0.006	0.008	0.087	0.089	0.114	0.008	0.108

Notes: Models 1-7 present linear probability models. Models 4a and 7a present logit models that replicate Models 4 and 7. Standard errors in parentheses, clustered at the captain level. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table VII: Robustness checks re: Governance – re-estimation of models 4 & 7 from Table VI

	First voyage only for each vessel		Voyage-year effects instead of voyage-decade	
	(4b)	(7b)	(4c)	(7c)
Voyage characteristics				
Triangle	0.087 ***	0.003	0.093 ***	0.005
	(0.019)	(0.033)	(0.020)	(0.034)
Wartime	-0.014	-0.022	-0.026	-0.066
	(0.019)	(0.018)	(0.064)	(0.056)
Triangle*Wartime	0.097 **	0.083 **	0.096 **	0.084 **
	(0.039)	(0.036)	(0.041)	(0.038)
Vessel characteristics				
NumOwners		0.052 ***		0.052 ***
		(0.004)		(0.004)
Tons/1000		0.012		-0.021
		(0.161)		(0.163)
Triangle*NumOwners		-0.011		-0.010
		(0.008)		(0.008)
Captain characteristics				
CaptainExp-Triangle		0.048 ***		0.048 ***
		(0.010)		(0.010)
CaptainExp-Direct		0.015 ***		0.016 ***
		(0.005)		(0.005)
CaptainExp-Other		0.019		0.020
		(0.012)		(0.014)
Decade fixed effects	Included	Included		
Year fixed effects			Included	Included
Constant	0.196 ***	0.001	-0.032	-0.167 **
	(0.022)	(0.032)	(0.041)	(0.065)
Observations	2811	2811	2811	2811
F-statistic	5.96 ***	19.98 ***	2.96 ***	6.76 ***
R^2	0.017	0.121	0.029	0.131

Notes: Linear probability models. Subsample is restricted to the first voyage of each registered vessel. Models 4b and 7b include decade fixed effects. Models 4c and 7c include year fixed effects. Standard errors in parentheses, clustered at the captain level. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table VIII: Performance after war shock: Difference of means tests

Cutoff = date of declaration of war

Seven Years War and American Revolution

	Captain owner	Captain not owner	
Vessel captured	0	8	
Vessel not captured	35	162	
Proportion captured	**0.00**	**0.05**	*

Seven Years War, American Revolution, War of Austrian Succession and French Revolutionary War

	Captain owner	Captain not owner	
Vessel captured	2	17	
Vessel not captured	47	280	
Proportion captured	**0.04**	**0.06**	not significant

Cutoff = date of first capture of Liverpool vessel

Seven Years War and American Revolution

	Captain owner	Captain not owner	
Vessel captured	1	25	
Vessel not captured	28	124	
Proportion captured	**0.03**	**0.17**	**

Seven Years War, American Revolution, War of Austrian Succession and French Revolutionary War

	Captain owner	Captain not owner	
Vessel captured	2	37	
Vessel not captured	36	210	
Proportion captured	**0.05**	**0.15**	*

Cutoffs = date of first capture of Liverpool vessel *and* date of escalation of war via belated French entry (in War of Austrian Succession and American Revolution)

Seven Years War and American Revolution

	Captain owner	Captain not owner	
Vessel captured	1	35	
Vessel not captured	29	157	
Proportion captured	**0.03**	**0.18**	**

Seven Years War, American Revolution, War of Austrian Succession and French Revolutionary War

	Captain owner	Captain not owner	
Vessel captured	2	49	
Vessel not captured	38	264	
Proportion captured	**0.05**	**0.16**	**

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table IX: Performance results: Vessel captured as a function of captain-ownership

	"Wartime shock" cutoff: first capture of Liverpool vessel [a]				"Wartime shock" cutoff: first capture of Liverpool vessel PLUS war escalation due to French entry [b]			
	(8a)	(9a)	(10a)	(11a)	(8b)	(9b)	(10b)	(11b)
CaptainOwner	-1.188 *	-1.225	-1.074	-1.039	-1.260 *	-1.370 *	-1.167	-0.973
	(0.749)	(0.786)	(0.781)	(0.784)	(0.741)	(0.762)	(0.779)	(0.784)
NumOwners		0.021	0.019	0.009		0.045	0.041	-0.000
		(0.062)	(0.064)	(0.068)		(0.059)	(0.060)	(0.068)
Tons		-0.004 *	-0.003	-0.005		-0.005 **	-0.004 *	-0.007 **
		(0.003)	(0.003)	(0.003)		(0.002)	(0.002)	(0.003)
CaptainExp-Triangle			-0.091	-0.076			-0.122	-0.130 *
			(0.088)	(0.090)			(0.089)	(0.090)
Seven Years War dummy [c]				0.727				1.014
				(1.094)				(0.709)
American Revolution dummy [c]				0.715				1.395 *
				(1.128)				(0.690)
French Revolution dummy [c]				1.041				1.492 *
				(1.160)				(0.766)
Constant	-1.702 ***	-1.294 ***	-1.231 ***	-1.794 *	-1.684 ***	-1.263 ***	-1.170 ***	-1.836 ***
	(0.178)	(0.459)	(0.467)	(1.082)	(0.155)	(0.400)	(0.405)	(0.654)
Observations	278	278	278	278	353	353	353	353
Wald statistic	2.51 *	5.20	5.65	7.45	4.08 **	9.19 **	11.42 **	17.00 **
Log likelihood	-111.0	-109.6	-109.2	-108.7	-143.7	-141.1	-140.0	-137.2
Pseudo R^2	0.015	0.027	0.031	0.036	0.014	0.031	0.039	0.058

Notes: Logit estimation. Standard errors in parentheses, clustered at the captain level. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

[a] Includes the outbreak of four wars (War of Austrian Succession; Seven Years War; American Revolution; French Revolutionary War)
[b] Includes the outbreak of the four wars cited in footnote a, plus French entries into two ongoing wars (Austrian Succession; American Revolution)
[c] The War of Austrian Succession is the omitted category

Table X: Duration of successfully completed voyages: Difference of means tests

	Captain owner		Captain not owner		Difference
Wartime voyages	458 days	[114 obs]	415 days	[349 obs]	43 days ***
Peacetime voyages	437 days	[265 obs]	409 days	[1068 obs]	28 days ***
Difference	19 days *		6 days		

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table XI: Duration of voyage as function of captain-ownership of vessel

	(12)	(13)	(14)	(15)	(16)
CaptainOwner	32.966 *** (7.166)	32.180 *** (7.170)	24.749 *** (7.389)	19.040 *** (7.049)	12.702 * (6.945)
Wartime		12.905 ** (6.616)	12.794 ** (6.578)	5.840 (6.500)	-7.531 (6.496)
CaptainOwner*Wartime		12.999 (15.662)	11.665 (15.576)	4.415 (14.849)	8.637 (14.350)
NumOwners			3.549 *** (1.166)	4.543 *** (1.124)	2.993 *** (1.101)
Tons			-0.140 *** (0.036)	-0.081 ** (0.037)	0.147 *** (0.042)
CaptainExp-Triangle			-0.106 (0.111)	-0.146 (0.105)	-0.131 (0.102)
Africa region fixed effects	No	No	No	Yes	Yes
Decade fixed effects	No	No	No	No	Yes
Constant	410.421 *** (3.292)	407.003 *** (3.702)	413.311 *** (8.043)	415.076 *** (11.334)	414.701 *** (11.729)
Observations	1796	1796	1796	1796	1796
F-statistic	21.16 ***	8.65 ***	8.79 ***	20.85 ***	24.41 ***
R^2	0.011	0.013	0.025	0.117	0.181

Notes: Linear probability models. Standard errors in parentheses, clustered at the captain level. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table XII: Shortfall in slaves embarked: Difference of means tests

All vessels

	Captain owner	Captain not owner	Difference
Wartime voyages	50 [115 obs]	37 [383 obs]	13
Peacetime voyages	35 [284 obs]	31 [1178 obs]	4
Difference	15	6	

All vessels

	Captain owner	Captain not owner	Difference
Vessels > 130 tons	66 [125 obs]	44 [596 obs]	22 **
Vessels <= 130 tons	28 [274 obs]	26 [965 obs]	2
Difference	38 ***	18 ***	

Vessels > 130 tons

	Captain owner	Captain not owner	Difference
Wartime voyages	108 [38 obs]	53 [150 obs]	55 ***
Peacetime voyages	48 [87 obs]	41 [446 obs]	7
Difference	60 ***	12	

Vessels <= 130 tons

	Captain owner	Captain not owner	Difference
Wartime voyages	21 [77 obs]	27 [233 obs]	-6
Peacetime voyages	30 [197 obs]	25 [732 obs]	5
Difference	-9	2	

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table XIII: Shortfall in slaves embarked as function of captain-ownership of vessel
(OLS estimation, *** = p < .01; ** = p < .05; * = p < .10)

	--------- Vessels above 130 tons ---------				--------- Vessels below 130 tons ---------			
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
CaptainOwner	22.988 *** (8.306)	21.794 ** (8.705)	21.800 ** (8.694)	9.289 (8.612)	1.244 (4.505)	-2.197 (4.617)	-1.339 (4.549)	-3.069 (4.595)
Wartime	21.210 *** (7.143)	21.920 *** (7.043)	30.321 *** (7.660)	26.656 *** (7.647)	-0.175 (4.310)	-0.047 (4.315)	0.044 (4.284)	-4.081 (4.451)
CaptainOwner*Wartime	48.282 *** (18.182)	40.914 ** (18.018)	41.754 ** (17.918)	30.403 * (17.417)	-10.388 (10.051)	-9.782 (10.003)	-7.526 (9.844)	-4.854 (9.708)
NumOwners		2.133 * (1.289)	2.066 (1.290)	1.511 (1.242)		1.208 (0.780)	0.461 (0.784)	-0.556 (0.789)
Tons		0.196 *** (0.041)	0.177 *** (0.041)	0.242 *** (0.043)		0.251 *** (0.074)	0.198 *** (0.076)	0.287 *** (0.077)
CaptainExp-Triangle		-0.496 (0.888)	-0.685 (0.888)	0.062 (0.864)		-0.021 (0.058)	-0.006 (0.057)	0.003 (0.056)
Africa region fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Decade fixed effects	No	No	No	Yes	No	No	No	Yes
Constant	38.157 *** (3.895)	-9.802 (11.446)	-5.218 (22.317)	-9.498 (17.046)	26.196 *** (2.342)	-0.485 (7.143)	-2.473 (7.895)	-2.469 (8.041)
Observations	721	721	721	721	1239	1239	1239	1239
F-statistic	7.76 ***	8.05 ***	5.66 ***	8.13 ***	0.42	2.86 **	5.25 ***	6.94 ***
R^2	0.027	0.055	0.069	0.144	0.001	0.008	0.037	0.075

Notes: Linear probability models. Standard errors in parentheses, clustered at the captain level. Unit of analysis is the voyage.
*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table XIV: Captains' switching between direct and triangle routes: Difference of means tests

Proportion of voyages whose captain has switched route type since his last voyage

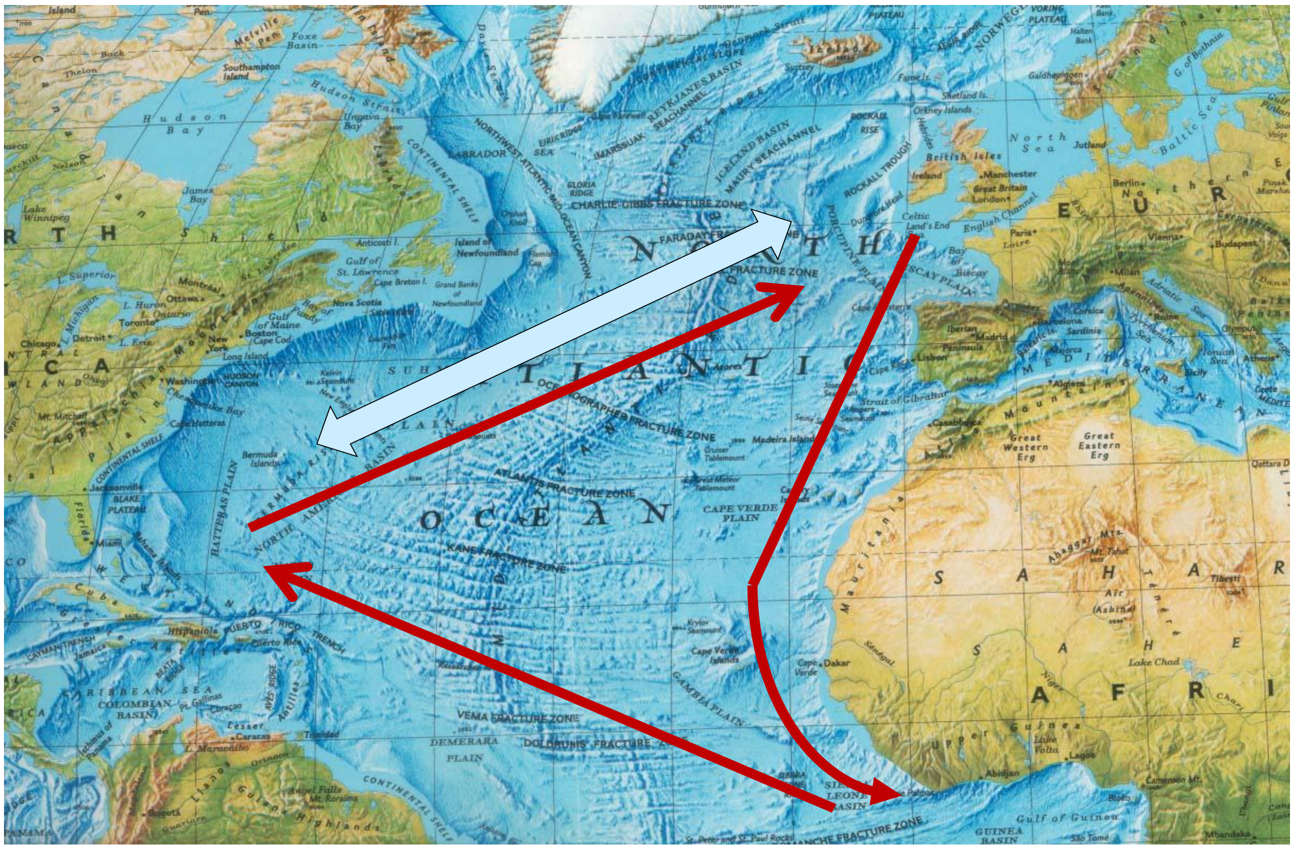
	Switch to direct	Switch to triangle	Difference
Wartime voyages	.026	.028	.002
Peacetime voyages	.016	.039	.023
Difference	-.010	.011	

	Switch to direct	Switch to triangle	Difference
Voyages in "transition years"	.021	.030	.009
Voyages in other years	.021	.044	.023 *
Difference	.000	.014	

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure I: Map of "direct trade" (non-slave trade) and "triangle trade" (slave trade) routes

Liverpool and Transatlantic Trade



West Indies trade
(textiles/rice/salt/Irish immigrants to WI and colonies; sugar/cotton/tobacco back)

Slave trade
(textiles/guns/jewels to Africa; human slaves to WI and colonies; either empty or sugar/cotton/tobacco back)

1

Figure II: Timeline for "direct trade" (non-slave trade) and "triangle trade" (slave trade) voyages

Non-slave voyage – 8-10 months

Purchase vessel (or repair vessel)

Hire captain

Advertise for 3rd-party cargo

Hire crew

Load goods

Sail vessel to N.Amer. destination

Arrive; deliver goods

Pick up goods for return haul

Sail vessel to origin

Arrive; deliver goods; pay captain and crew; receive payment from 3rd-party cargo-shippers

Slave voyage – 12+ months

Purchase vessel (or repair vessel)

Hire captain

Assemble cargo

Hire crew

Load goods

Sail vessel to Afr. Destination(s)

Trade goods for slaves

Sail vessel to N.Amer. Destination(s)

Sell slaves

Sail vessel to origin (often without goods)

Arrive; pay captain and crew; receive and deposit letters of credit

Figure III: Loss (excluding capture) of Liverpool transatlantic vessels, 1744-1785

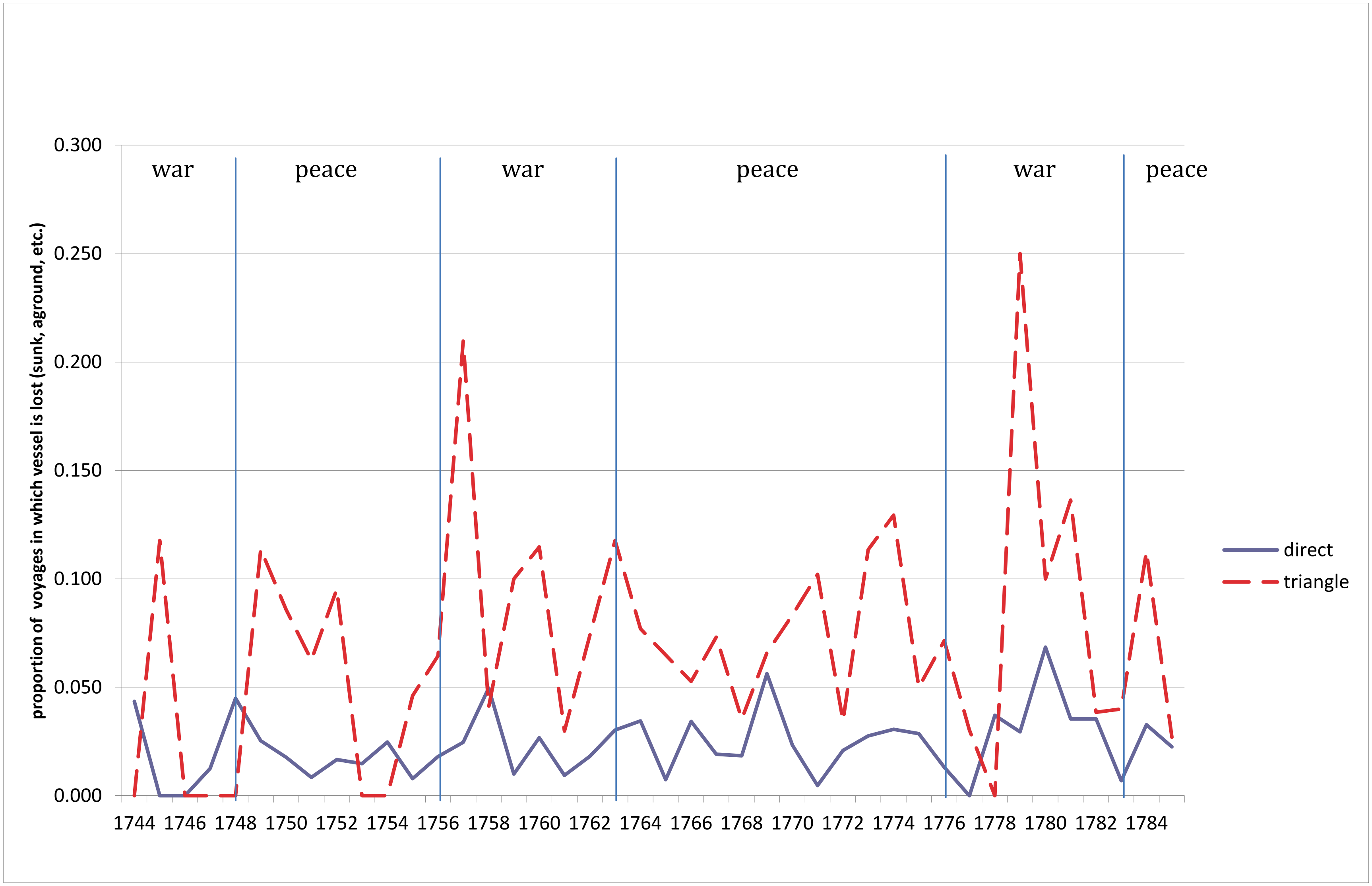


Figure IV: Annual number of Liverpool transatlantic voyages, 1744-1785

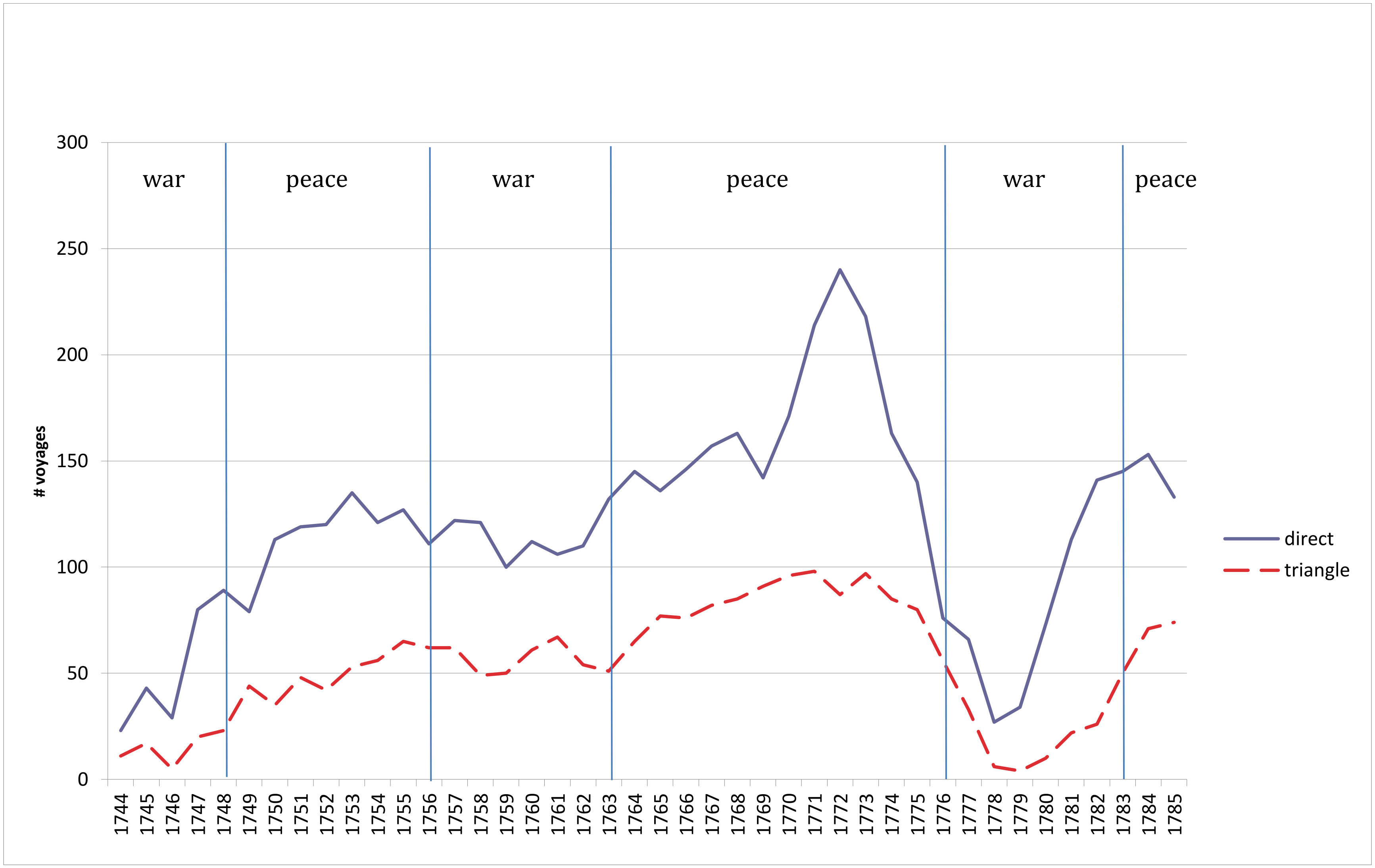


Figure V: Capture of Liverpool transatlantic vessels by enemy privateers, 1744-1785

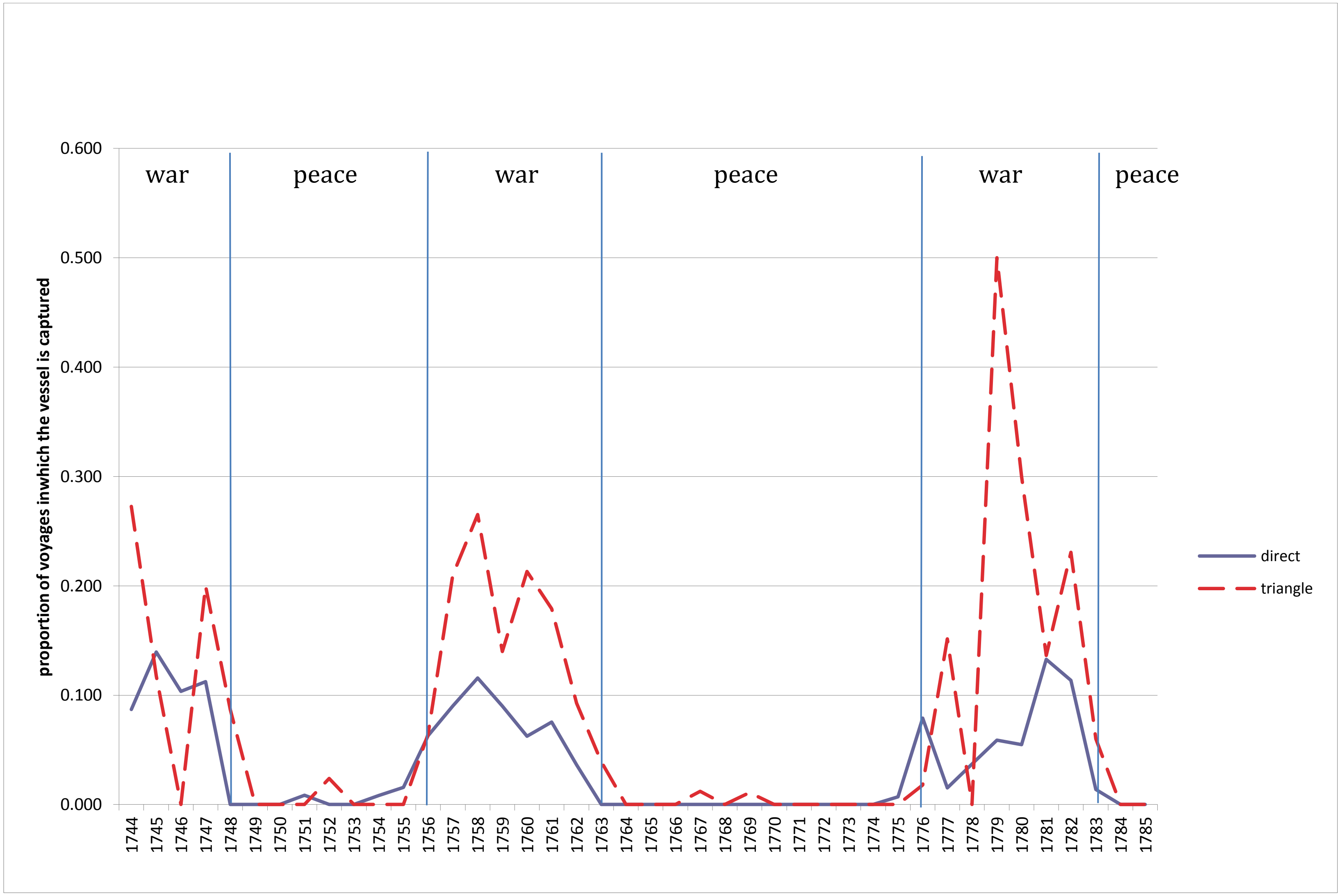


Figure VI: Captain-Ownership on Liverpool transatlantic voyages, 1744-1785

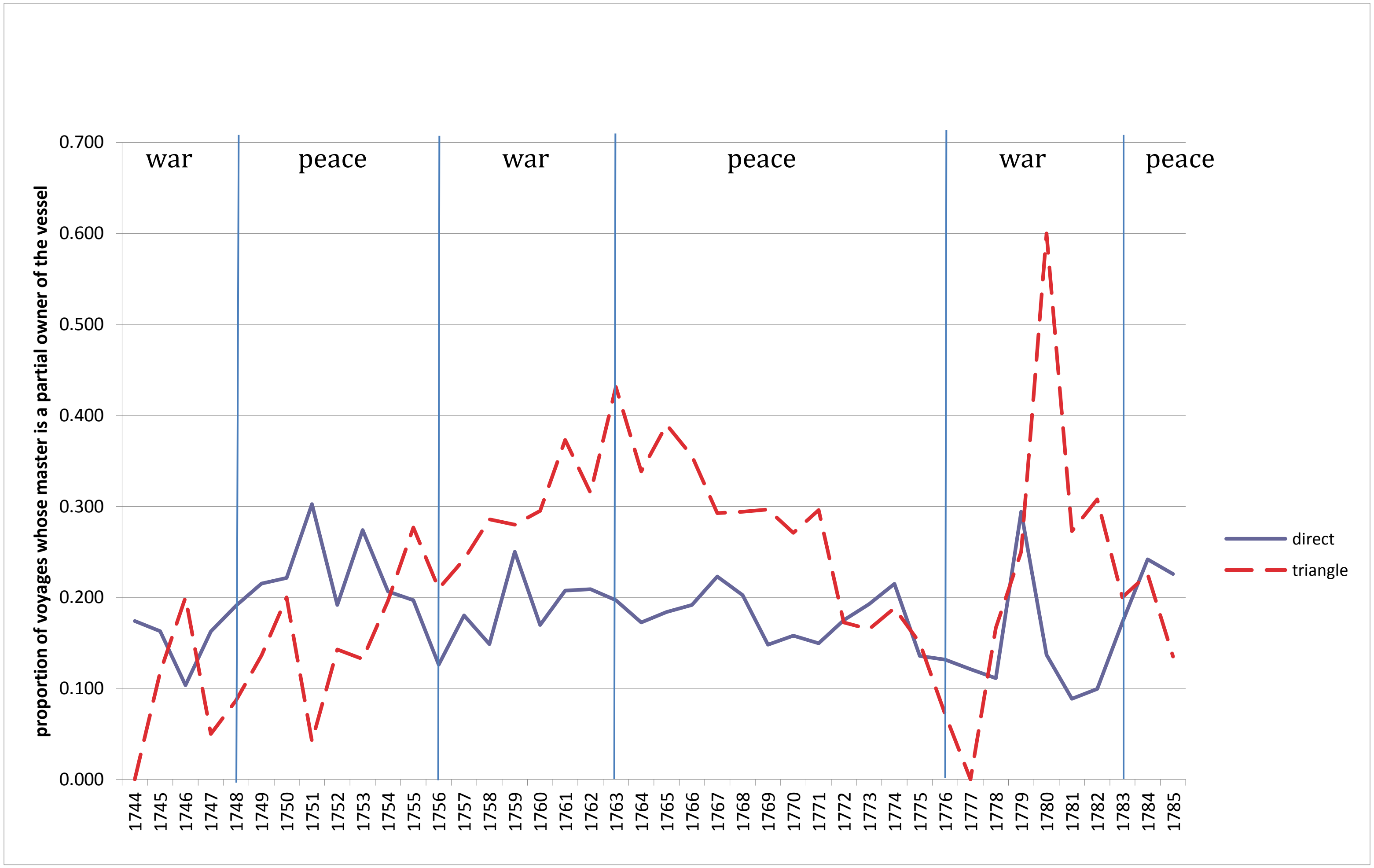


Figure VII: Average captain experience for triangle voyages, 1744-1785

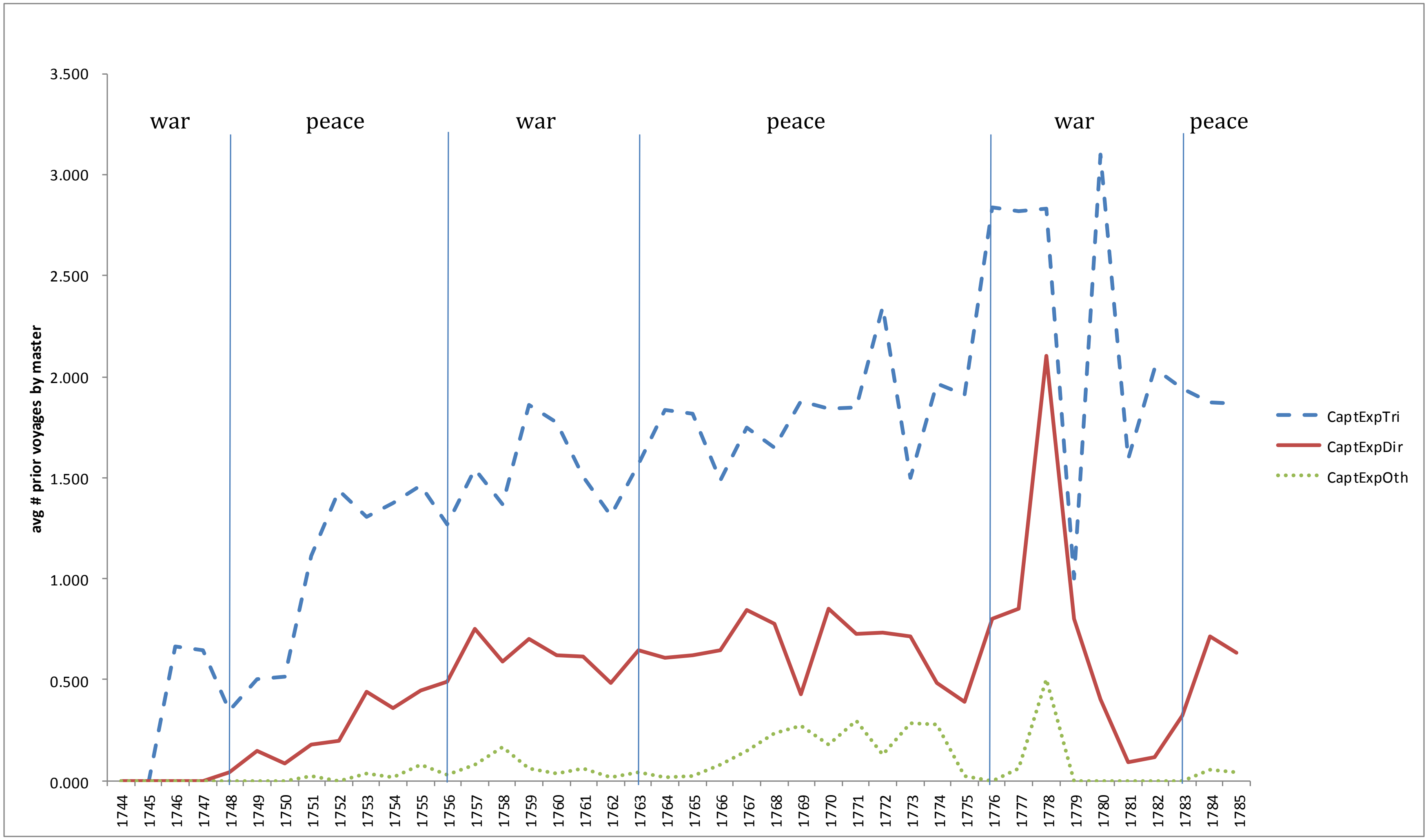


Figure VIII: Route-switching by Captains – proportion of all voyages in given year whose captain has switched route type since his previous voyage