# Managing Agency Problems in Early Shareholder Capitalism:

# Liverpool Shipping in the 18th Century*

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**Abstract**

We explore the relationship between asset ownership and incentives in a historical setting: captain-ownership of vessels engaged in 18th-century transatlantic shipping. Although contingent compensation aligned incentives between captains and shipowners regarding most events, one difficult-to-contract hazard was the threat of capture by an enemy nation's privateering vessels. We exploit variation across time and routes to study the relationship between capture threat and equity ownership. Vessels were more likely to have captain-owners when undertaking wartime voyages on routes susceptible to privateers. Also, vessels with captain-owners were less likely to be captured than those with non-owner captains.

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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 two decades of the 20th 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, recent work has examined the effect of CEO stock ownership on other firm behavior, including leverage, R&D intensity, and diversification (e.g., 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 between 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 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 18$^{th}$ 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 characteristics 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: duration. The typical voyage 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 non-owned vessels. This suggests that a captain pilots his vessel more carefully when he has an ownership stake, which is more consistent with incentive alignment 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 Brit-

ain'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. Section III discusses the strengths and limitations of the contractual incentives used by shipowners to manage 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 alternative explanations. Section VII concludes.

## II. Transatlantic Shipping in the 18th Century

*A. Direct (non-slave) trade and triangle (slave) trade*

The British transatlantic trade of the 18th century consisted of two distinct categories. 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 transported the human cargo to North America for sale in the West Indies or mainland. 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).

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, one owner was designated as "ship's husband," akin to a managing partner, who had responsibility and authority to make operational decisions. The owners hired a captain (although the owners might hire the captain before purchasing the vessel), who then hired the crew. The ship's husband placed an advertisement in the local newspaper to announce the expected departure of the ship 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 goods to agents as instructed by the exporters. The ship would then perform similar activities to bring goods back to Liverpool. Throughout the voyage, 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 the cargo. The trip from Liverpool to North America typically took 2-3 months each way, and the process of distributing, selling, purchasing, and 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 organization of the next load of North America-bound goods that it would carry.

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, excluding a possible performance bonus for the captain called "primage." In addition, the vessel owners provided food for the mariners. Vessel owners would also frequently incur port fees, insurance fees, depreciation and repairs to the ship. As Table 1 indicates, revenue for a voyage might reach £2000, thus yielding up to £1000 profit ($160,000 today) on a successful year-long voyage.

**Table 1**: Financial information for typical voyages

| Typical direct-trade voyage: | Typical triangle-trade voyage: |
|---|---|
| <u>Fixed cost</u>: | <u>Fixed cost</u>: |
| Vessel £1,500-£2,500 initial purchase | Vessel £1,500-£2,500 initial purchase |
| <u>Per-voyage cost</u>: | <u>Per-voyage cost</u>: |
| Wages £225-£275 (16-member crew) | Wages £650-£700 (29-member crew) |
| Food £225-£275 | Food £1,100-£1,300 |
| Insurance, port fees, repairs £350 | Insurance, port fees, repairs £500 |
| | Cargo cost £1,500-£3,000 |
| Revenue: up to £1,500-£2,000 | Revenue: up to £8,500-£9,000 |
| Contribution: up to £750-£1,000 | Contribution: up to £3,500-£4,000 |
| Vessel life: typically 5-10 voyages | Vessel life: typically 2-6 voyages |

Triangle trade bore many similarities to direct trade. Again, one or more individuals purchased a vessel, appointed a ship's husband, and hired a captain who then assembled a crew. However, in the slave trade the vessel owners also owned the cargo. There was virtually no third-party contract carriage of slaves. Thus, when those who joined to purchase a vessel shared all costs associated with a voyage, plus the cost of the cargo to be carried from Liverpool to the African coast.

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, vessel captains bartered directly with local chiefs or their representatives to trade goods for slaves. 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.

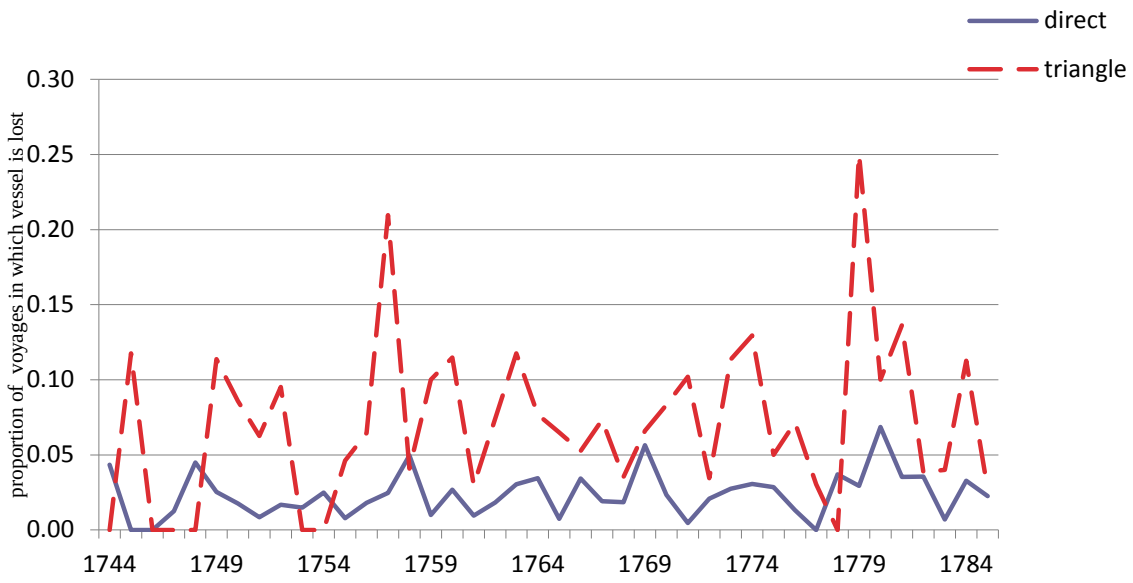
After embarking the slaves, the ship would then sail to, say, Kingston, Jamaica. The trip across the Atlantic Ocean, called the "middle passage," typically took nine weeks. Although slave merchants occasionally relied on agents in the Americas to sell slaves, typically the captain was responsible for sale of the slaves. 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 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 1 indicates, the costs for a slave-

trade crew were typically around £55/month, or £660 for the voyage (excluding bonuses 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 £4,000 per year-long voyage.

The triangle trade thus offered higher potential profits, at a cost of substantially higher risk. Figure 1 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 rate of vessel destruction was substantially higher in the triangle trade than in the direct trade throughout this period.[1]

**Figure 1**: Loss (excluding capture) of Liverpool transatlantic vessels, 1744-1785

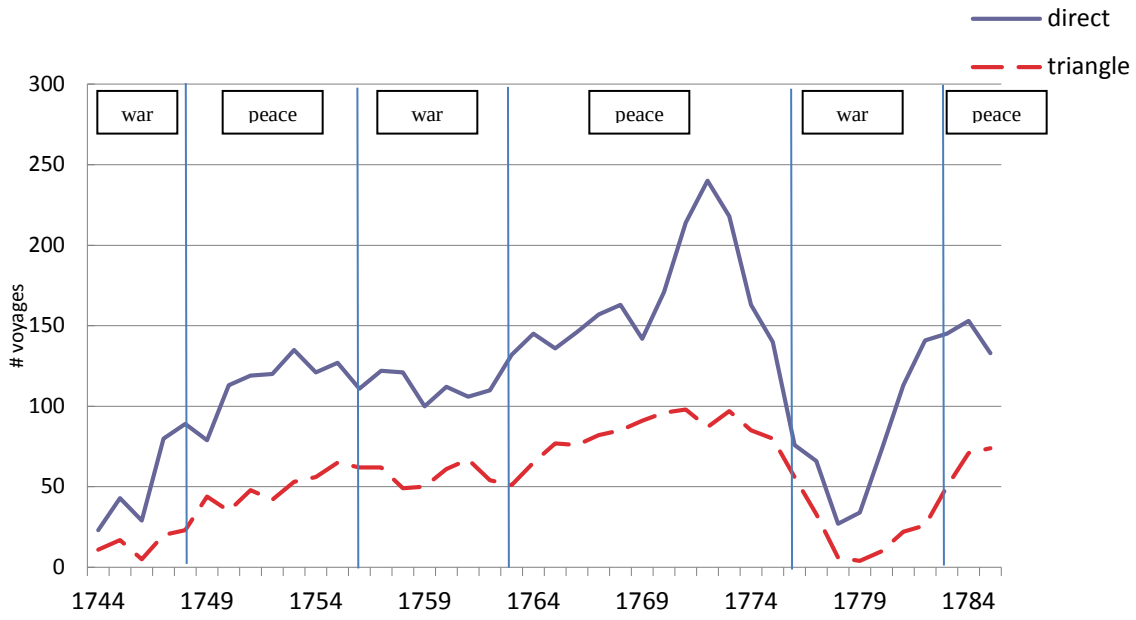



[1] Since vessels carried insurance, why should owners care about loss of ship or cargo? Many owners chose to insure vessels/cargo for less than full value to save on insurance costs. Further, cargo insurance typically measured value by purchase cost of the items, not anticipated sale value across the ocean. Thus, even if all went smoothly with an insurance payout, the payout would be below market value. And 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, ch 3; Kingston, 2007a).

*B. Wartime: The threat of privateers*

In addition to traditional hazards of sailing, a key man-made hazard 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 decreased (Figure 2), primarily due to the increased risks of wartime voyages. Belligerent states unleashed their navies and weaponized civilian vessels to prey upon 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 well (Brooke 1853). In particular, officers of a captured ship were to be treated like gentlemen. The captain and crew would be returned to England fairly expeditiously, as part of a mariner exchange.

**Figure 2**: Annual number of Liverpool transatlantic voyages, 1744-1785




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:

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*. (Brooke 1853: 460)

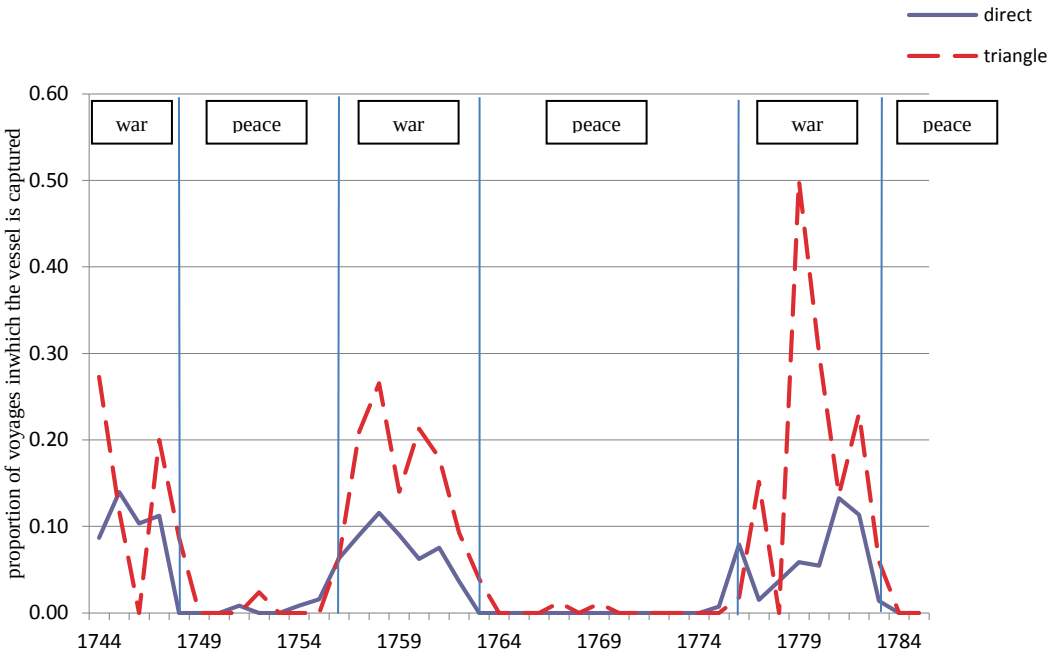
Finally, the *Nanny* was less successful at repelling an American privateer. As Captain Beynon wrote from captivity to the vessel's owners in June, 1779:

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. [Brooke 1853: 459-460][2]

As Figure 3 shows, the risk that a British ship would be captured by an enemy privateer was dramatically higher during wartime than during peacetime,[3] and was substantially higher for triangle voyages than for direct voyages. On direct trade routes, a vessel leaving Liverpool would sail 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 Africa and then through the Middle Passage.

**Figure 3**: Capture of Liverpool transatlantic vessels by enemy privateers 1744-85




British vessel owners frequently responded to the wartime threat by organizing convoys (Crowhurst 1977, ch. 7). Outbound convoys from Liverpool were not afforded military protection;

[2] In all accounts of which we are aware, the captain of a captured vessel 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.
[3] 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.

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 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 moved more slowly than individual vessels, and the glut of goods delivered simultaneously by a convoy's vessels yielded lower prices than otherwise.

## III. Hazards, Discretion, and Motivation of Vessel Captains

The above description of 18th-century transatlantic shipping suggests several areas in which vessels faced potential hazards and captain discretion or effort might affect the outcome. These hazards varied in intensity across routes and time. Table 2 lays out several distinct hazards and distinguishes between their effect on the captain and on 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.[4]

**Table 2**: Hazards and Incentive Alignment in Transatlantic Shipping

| Hazard | Vessel/cargo owner concern | Intrinsic captain concern | Incentive-alignment mechanism |
|---|---|---|---|
| Vessel sinks in mid-ocean | Yes | Yes | Already aligned |
| Vessel sinks near shore | Yes | Probably | Bonus based on sales revenue of cargo |
| Vessel arrives too late to get good price for cargo | Yes | No | Bonus based on sales revenue of cargo |
| Cargo suffers damage | Yes | No | Bonus based on sales revenue of cargo |
| Captain bargains weakly re: slave prices | Yes | No | Bonus based on sales revenue of slaves |
| Slave mortality | Yes | No | Bonus based on survival of slaves |
| Vessel is captured by enemy privateers | Yes | No | **Vessel ownership** |

[4] The captain had a strong incentive to avoid sinking mid-ocean, as his life depended on staying afloat. His incentive to avoid sinking near shore, or running aground, might be muted because he would likely survive such an event. Still, we assume that he remained interested in not sinking, if only to avoid the sometimes-physical remonstrances from the surviving crew.

*A. Caring for the Cargo*

A vessel owner's profits were inversely related to 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 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 ship, 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 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 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" – for whom they would receive 100% of the sales price – conditional on keeping slave mortality below a specified rate during the voyage.

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).

*B. Negotiating 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 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 a high sale price. There was no explicit bonus for driving down costs. However, given that a captain faced a budget constraint (based on the 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.

*C. 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 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.

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 shipowners 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 was only a part-owner of the vessel, this partial-ownership share would 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 them 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, in Radburn 2009). One may infer that this is intended to remind the captain-owner of his economic interest in protecting the vessel.

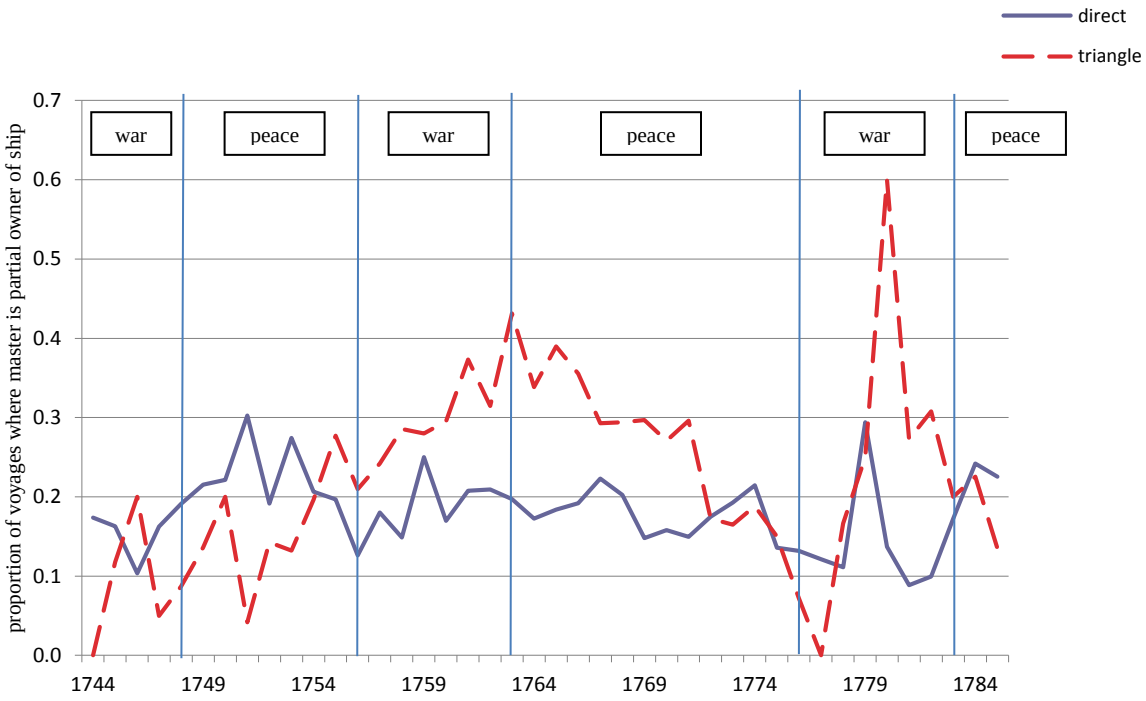
Could owners use mechanisms other than asset ownership to provide appropriate incentives? One might imagine a range of contractual provisions that would encourage a captain to internalize the loss of his vessel. For example, vessel owners could provide higher cargo-related bonuses – say, 8% or 10% of 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 bonus scheme for repelling a privateer would likely trigger claims for such payments even when a vessel did not encounter one, 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 safe return of the vessel or could demand that the captain post a bond 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 such contractual provisions in British transatlantic shipping.

Alternatively, owners might refuse to hire captains who had lost vessels to privateers, thus 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. Such captains 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).

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 4 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 will be more prevalent for vessels that faced higher levels of privateering threat – that is, 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.

**Figure 4**: Captain-Ownership on Liverpool transatlantic voyages, 1744-1785




## IV. Data and Characteristics of Liverpool Voyages

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). 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, almost all pre-1786 records were destroyed in fires during the nineteenth centuries. Fortunately, copies of the Liverpool Register books for 1744-1773 and 1779-1784 survived.

In addition to registration documents, a vessel frequently filed paperwork for each voyage. Depending on the year and destination, vessel owners might file applications for a Mediterranean

Pass, Colonial Office Pass, or similar document. Voyages left footprints through non-government channels as well. Lloyds Insurance Company collected information on the expected destination of most voyages, and local newspapers such as *Williamson's Register* carried voyage advertisements and announcements of the triumphant return (or catastrophic loss) of vessels.

As the above description suggests, the original source documents are widely diffused. Fortunately, most of the key information has been assembled and cleaned by historians in the furtherance of their own research. We were able to rely on *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, the files identify information regarding all known voyages undertaken by these vessels, including the captain for each voyage, date and destination(s) of the voyage, and blunt measures of voyage outcome (e.g., returned safely; captured; sank; slave revolt).

We augmented this with the *Trans-Atlantic Slave Trade (TAST) Database*, a remarkable, publicly available database that records information on every known slave voyage, spanning the years 1514-1866. This includes the same information as described above – date and destination of voyage, name of captain, name of owners, and outcome – and, where feasible, voyage duration and number of slaves carried. We use this to augment our analysis beyond the 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.[5]

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

[5] This highlights a weakness in our data. As noted above, we know vessel owners as of the date of ship registration. 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 re-registration of vessels. There is anecdotal evidence that new owners desired 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 buys a vessel share upon taking command, but we do not observe this, then we will erroneously observe him as a non-owning captain. Since our estimations look for differences between owner- and non-owner-captains, such errors will bias our results toward insignificance. Third, divergence between ownership-at-registration and ownership-in-fact is likely to increase over time since registration. In section V we also run estimations based on only the first post-registration voyages undertaken. Our qualitative conclusions do not change.

consequences of equity ownership for such voyages. Variable names and definitions are listed in Table 3.

**Table 3**: 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 (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 |

*A. Dependent variables*

*CaptainOwner*$_{ijkt}$ is a categorical variable 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. *Captured*$_{ijk}$ 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.

*B. Independent variables*

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 construct *Triangle*$_i$ as a dummy variable equal to 1 if voyage i is destined for an African port. We construct *Wartime*$_i$ as a dummy

variable equal to 1 if voyage i occurs during one of Britain's many 18th-century wars. Finally, we construct our main variable of interest, *Triangle-Wartime*$_i$, as an interaction between these variables.

*C. Control variables*

We control for two vessel characteristics. *NumOwners*$_j$ is the number of owners of vessel j upon its registration. 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. Alternatively, division of ownership among more people may imply a lower cost per owner to purchase the vessel, making captain-ownership more feasible. *Tons*$_j$ is the tonnage volume of cargo that vessel j can carry. Vessels of different sizes may be differentially able to escape from privateers. Alternatively, smaller vessels cost less per owner to build or purchase, making captain-ownership more feasible.

We construct three measures of a captain's prior experience. *CaptExperience-Triangle*$_k$ is the number of triangle-trade voyages on which captain k has previously served as a captain. This equals zero for captain k's first triangle-trade voyage, one for his second voyage, etc. *CaptExperience-Direct*$_k$ and *CaptExperience-Other*$_k$ are defined analogously for captain k's previous direct-trade and "other" voyages (e.g., voyages to destinations in the Baltic Sea, Mediterranean, or Ireland), respectively. A captain's wealth increased with the number of successful voyages 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 (Behrendt 1991). 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.

We include voyage-decade fixed effects to control for time trends in prevalence of captain-ownership. Since each decade includes both war years and peace years, we can identify a wartime

effect while including voyage-decade effects.

In unreported models, we also include destination-region variables. We code two dummy variables for voyages whose North American destinations are in the West Indies or in 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 significantly increase the explanatory power of the models. Their inclusion does not change substantively the coefficients on the other variables.

Table 4 shows summary statistics for our sample. Since our empirical setting involves four regimes (wartime-triangle, peacetime-triangle, wartime-direct, and peacetime-direct) and the proportions of triangle and direct voyages differ in wartime vs. peacetime, Table 4 presents statistics separately for each regime.

**Table 4**: Descriptive Statistics

| Peacetime | Triangle | | Peacetime | Direct | | *Difference, triangle vs. direct*[a] |
|---|---|---|---|---|---|---|
| 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*[b] | Wartime | Direct | *Difference, wartime vs. peacetime*[c] | |
| 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 voyages is 7,079. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.
[a] Upper panel: difference between mean for peacetime-triangle voyage and mean for peacetime-direct voyage. Lower panel: difference between mean for wartime-triangle voyage and mean for wartime-direct voyage.
[b] difference between mean for wartime-triangle voyage and mean for peacetime-triangle voyage.
[c] difference between mean for wartime-direct voyage and mean for peacetime-direct voyage.

Compared to direct-trade vessels, vessels on triangle-trade voyages exhibit a higher prevalence of equity ownership by captains, a greater number of owners, and lower tonnage. Given the greater cost and risk of a triangle-trade voyage, the greater number of owners may reflect 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 direct-trade voyages took less time than triangle-trade voyages, 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 direct trade to exit the industry in the face of higher risk or more depressed conditions of the wartime market. We explore this further when considering alternative explanations.

## V. Determinants of Equity Ownership and Voyage Performance

### *A. 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 control for vessel, voyage, and captain characteristics. For

voyage i by vessel j with captain k in year t, we estimate the following specification:

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

where $\boldsymbol{X}_{ijk}$ is a vector of voyage, vessel, and captain characteristics, $\gamma_t$ is a fixed effect for decade, and $\varepsilon_{ijkt}$ 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).

**Table 5**: 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 clustered at the captain level are reported in parentheses. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5 reports on determinants of captain equity-ownership. Models 1-4 provide results for voyage characteristics, including our main variable of interest. The coefficients are stable in magnitude, sign and significance across the models. Throughout these models, the coefficient on *Triangle* is positive and statistically significant at the 1% level. Triangle-trade voyages are more frequently characterized by captain equity-ownership, even after one controls for other voyage characteristics. Although the point estimate for *Wartime* is negative, it is not statistically significant. Finally, the coefficient on *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.

Models 5 and 6 introduce vessel characteristics. In both models, the coefficient on *NumOwners* is positive and significant. Vessels with more owners are more likely to exhibit captain equity-ownership. In contrast, the coefficient on *Tons* is not statistically significant, and the point estimate is of no economic significance. Inclusion of vessel characteristics depresses the effect of triangle-trade voyages. 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.

Model 7 introduces captain-experience measures. All three variables have positive and statistically significant coefficients. A test for equality of coefficients indicates that the coefficient on *CaptainExp-Triangle* is significantly larger than that on either *CaptainExp-Direct* or *CaptainExp-Other*. 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, experience relaxes a captain's wealth constraint – prior triangle voyages are associated with amassing sufficient wealth to afford a share of a vessel; non-triangle voyages are less likely to provide comparable wealth.

In Model 7, the coefficient on *Triangle*Wartime* continues to be positive and statistically significant at the 5% level. 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 that on *Wartime* (in absolute value), although a Wald test indicates that the sum of the coefficients no longer differs significantly 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.

The above estimation, at the voyage level, is based on an assumption that shipowners select a route for each voyage and then select the appropriate captain-ownership mode. 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 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. The percentages are higher if one restricts analysis to vessels that sail three-plus voyages, four-plus voyages, and so on. Thus there appears to be variation in voyage route and captain-ownership for a given vessel. Nevertheless, to address this concern we re-estimate the model on a sub-sample that only includes the first voyage undertaken by each vessel. Results appear in Table 6, Models 4b and 7b. They are essentially identical to the full-sample results except that the coefficient on *Wartime* becomes insignificant.

As a second robustness check, in Table 6, Models 4c and 7c we replace decade effects with year effects. The results are unchanged.

*C. 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. We now 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 cor-

**Table 6**: Robustness checks – re-estimation of Models 4 and 7 from Table 5

| | First voyage only for each vessel | | Voyage-year effects | |
|---|---|---|---|---|
| | (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) |
| | | | | |
| Fixed effects | Decade | Decade | Year | Year |
| 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 clustered at the captain level are reported in parentheses,. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

related with the likelihood of captain ownership but not with the performance-related error term. Instead, we exploit the fact that triangle-trade voyages took at least a year from departure to return. Consequently, many vessels departed during peacetime but were still en route when war broke out. We focus our attention on triangle-trade vessels that begin their voyage before, and end their voyage after, a war "shock." The 1744-1785 data includes 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 the *TAST* database. We use this to augment our sample with voyages at the out-

break of the War of Austrian Succession (1739) and French Revolutionary War (1792). We also exploit two instances in which the French joined ongoing wars (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 a shock. We justify this in two ways. First, the historical record suggests that, although the general prospect of war was always present 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 points at which 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 when war was declared and then again as news of captured ships began to arrive.[6] Surviving accounts of individual merchants 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 2009). This suggests that British marine insurers, and presumably vessel owners, did not anticipate the privateer threat before outbreak of war, and perhaps not even at the moment of war declaration.[7]

Given this context and the difficulty of pinpointing the point at which British shipowners perceived the privateering threat, we examine performance using two different cutoffs for outbreak of war. The first is the official date of war declaration. For this cutoff, we include all vessels that departed from Liverpool in the 12 months preceding the date of war declaration.[8] The second is the date of the first capture of a Liverpool vessel. In all four wars, the first capture occurred in the Caribbean, roughly two months sailing from Liverpool. Therefore, for this cutoff, we include all vessels that departed Liverpool in the 12 months preceding the date of the first capture *and* the two months

[6] Kingston (2007b: 12-13) describes one merchanthouse that paid 6% on trips to Jamaica in May 1756, just before war was declared, 8% in Aug; and 12.5% in Feb 1757, driven by news of captured ships.
[7] E.g., the British may not have expected the American rebels to launch a credible fleet of privateers.
[8] The Continental Congress's March 23, 1776 authorization of Letters of Marque occurred in Philadelphia. 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.

following the capture. When we include the two instances of war escalation due to belated French entry, we again include all vessels that departed Liverpool in the 12 months preceding the date of entry.

Table 7 presents data on the frequency of captain-ownership and capture by privateers during the "war declaration" and "first capture" samples. The table presents results of a difference of means test for proportion of vessels captured, as a function of captain 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 and economically significant. Thus it appears that captain-ownership was associated with a lower likelihood of vessel capture in the face of a war "shock."

**Table 7**: Performance after war shock: Difference of means

| **Cutoff:** date of declaration of war | | | | |
|---|---|---|---|---|
| | Seven Years War and American Revolution only | | All four wars | |
| | Captain owner | Captain not owner | Captain owner | Captain not owner |
| Vessel captured | 0 | 8 | 2 | 17 |
| Vessel not captured | 35 | 162 | 47 | 280 |
| **Proportion captured** | **0.00** | **0.05 *** | **0.04** | **0.06** |

| **Cutoff:** date of first capture of Liverpool vessel | | | | |
|---|---|---|---|---|
| | Seven Years War and American Revolution only | | All four wars | |
| | Captain owner | Captain not owner | Captain owner | Captain not owner |
| Vessel captured | 1 | 25 | 2 | 37 |
| Vessel not captured | 28 | 124 | 36 | 210 |
| **Proportion captured** | **0.03** | **0.17 **** | **0.05** | **0.15 *** |

| **Cutoff:** date of first capture of Liverpool vessel and date of escalation of war via belated French entry | | | | |
|---|---|---|---|---|
| | Seven Years War and American Revolution only | | All four wars | |
| | Captain owner | Captain not owner | Captain owner | Captain not owner |
| Vessel captured | 1 | 35 | 2 | 49 |
| Vessel not captured | 29 | 157 | 38 | 264 |
| **Proportion captured** | **0.03** | **0.18 **** | **0.05** | **0.16 **** |

Notes: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. "All four wars" includes Seven Years War, American Revolution, War of Austrian Succession, and French Revolutionary Wars. Data for Seven Years War and American Revolution come from Liverpool Registers. Data for War of Austrian Succession and French Revolutionary Wars come from the *TAST* database.

We next report on multivariate tests. Although the limited number of observations – notably the small number of vessels captured during the "war shock" – constrains statistical significance, we find consistent point estimates for the variable of interest. For voyage i of vessel j with captain k, we estimate the following:

$$Captured_{ijk} = \delta CaptainOwner_{ijk} + \phi \boldsymbol{Z}_{ijk} + \varepsilon_{ijk} \ , \qquad (2)$$

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

Table 8 reports on the performance of a voyage, measured by avoidance of capture, as a function of captain ownership. We use our more favorable cutoff, based on date of first capture, for these estimations. In Models 1-4 we focus only on the Seven Years War and American Revolution. In Models 5-8 we include all four wars. For the first four models in Table 8, the point estimate on *CaptainOwner* is negative. This point estimate is statistically significant at the 10% level in Models 1 and 2. Although the coefficient is not significant in Models 3-4, which include additional variables likely to explain performance, it retains roughly the same magnitude. These results are similar 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 of a

**Table 8**: Performance results: Vessel captured as a function of captain-ownership

| | Seven Years War and American Revolution | | | | All four wars | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| CaptainOwner | -1.866* | -1.771* | -1.587 | -1.487 | -1.260* | -1.353* | -1.149 | -0.971 |
| | (1.034) | (1.048) | (1.059) | (1.068) | (0.742) | (0.763) | (0.780) | (0.784) |
| NumOwners | | -0.026 | -0.033 | -0.015 | | 0.040 | 0.036 | -0.001 |
| | | (0.079) | (0.081) | (0.083) | | (0.061) | (0.062) | (0.069) |
| Tons | | -0.007 | -0.005 | -0.007 | | -0.005** | -0.004 | -0.008** |
| | | (0.004) | (0.004) | (0.005) | | (0.003) | (0.003) | (0.004) |
| CaptainExp-Triangle | | | -0.143 | -0.156 | | | -0.124 | -0.130 |
| | | | (0.104) | (0.106) | | | (0.089) | (0.090) |
| War Dummies | No | No | No | Yes | No | No | No | Yes |
| Constant | -1.501*** | -0.754 | -0.645 | -0.434 | -1.684*** | -1.244*** | -1.151*** | -1.836** |
| | (0.187) | (0.548) | (0.554) | (0.620) | (0.156) | (0.407) | (0.411) | (0.659) |
| Observations | 222 | 222 | 222 | 222 | 353 | 353 | 353 | 353 |
| Wald statistic | 5.69** | 8.46** | 10.72** | 11.29** | 4.08** | 9.03** | 11.27** | 17.00** |
| Log likelihood | -95.6 | -94.2 | -93.0 | -92.8 | -143.8 | -141.3 | -140.2 | -137.3 |
| Pseudo $R^2$ | 0.029 | 0.043 | 0.055 | 0.057 | 0.014 | 0.031 | 0.039 | 0.058 |

Notes: Logit estimation. Standard errors in parentheses. Unit of analysis is the voyage. Models 1-4 include outbreak of Seven Years War and American Revolution, plus belated French entry into American Revolution. Models 5-8 include outbreak of Seven Years War, American Revolution, War of Austrian Succession, and French Revolutionary War, plus belated French entry into War of Austrian Succession and American Revolution. *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

link between captain-ownership and avoidance of capture, the stable, negative coefficient suggests such a link, given the constraints of the data. Taking the point estimates at face value, a non-captain-owned vessel with mean values for all characteristics experiences a 15% likelihood of capture; this falls to 5% for a comparable captain-owned vessel.

## VI. Alternative Explanations

*A. Endogenous Matching on Captain's Risk-aversion*

Perhaps the most likely alternative explanation for our results is 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 requires an instrument that affects matching but not asset-ownership choice. It is difficult to conceive of a feasible instrument in this instance.

However, we are able to draw inferences from two other measures of voyage performance: voyage duration and the difference between anticipated number of slaves transported and actual number transported (the "shortfall"). If the above results are due 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 due to incentive-alignment, then captain-owners should exhibit cautious behavior, aimed at protecting their vessel, along other performance dimensions. With respect to voyage duration, the incentive-alignment explanation is consistent with longer duration for captain-owned vessels – assuming that a captain pilots a ship more carefully when he is part-owner – while endogenous matching is consistent with, if anything, shorter 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, embarking 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.

The *TAST* database includes a start date for all Liverpool triangle-trade voyages, and an end date for 632 successfully completed wartime voyages and 1,619 successfully completed peacetime voyages between 1739 and 1794. We use these data to construct a measure of voyage duration in days. Table 9 shows mean duration for subsets of these voyages. Captain-owned vessels take significantly longer than non-captain-owned vessels to complete their voyages. In peacetime, captain-owned vessels take 18 more days, making the trip 4.5% longer than non-captain-owned vessels. In wartime, captain-owned vessels take 43 more days, adding 10% to voyage duration.

**Table 9**: Duration of successfully completed voyages

| | 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 | |

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

Table 10 reports results of multivariate estimation. Using ordinary least-squares estimation, we regress voyage duration on captain-ownership, wartime, a captain-owner/wartime interaction term, and other voyage and captain characteristics. 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 *Captain-Owner***Wartime* is always positive, it is never statistically significant. Thus the estimations indicate that the captain-owner effect on duration is not sensitive to war; captain-owners are equally "slow" during peacetime and wartime. 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.

**Table 10**: Duration of voyage as function of captain-ownership of vessel

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| CaptainOwner | 32.966*** | 32.180*** | 24.749*** | 19.040*** | 12.702* |
| | (7.166) | (7.170) | (7.389) | (7.049) | (6.945) |
| Wartime | | 12.905** | 12.794** | 5.840 | -7.531 |
| | | (6.616) | (6.578) | (6.500) | (6.496) |
| CaptainOwner*Wartime | | 12.999 | 11.665 | 4.415 | 8.637 |
| | | (15.662) | (15.576) | (14.849) | (14.350) |
| NumOwners | | | 3.549*** | 4.543*** | 2.993*** |
| | | | (1.166) | (1.124) | (1.101) |
| Tons | | | -0.140*** | -0.081** | 0.147*** |
| | | | (0.036) | (0.037) | (0.042) |
| CaptainExp-Triangle | | | -0.106 | -0.146 | -0.131 |
| | | | (0.111) | (0.105) | (0.102) |
| Africa region fixed effects | No | No | No | Yes | Yes |
| Decade fixed effects | No | No | No | No | Yes |
| Constant | 410.421*** | 407.003*** | 413.311*** | 415.076*** | 414.701*** |
| | (3.292) | (3.702) | (8.043) | (11.334) | (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. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The *TAST* 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 2,054 of the Liverpool voyages between 1739 and 1794.[9] We construct a variable, $Shortfall_i$, equal to the difference between anticipated and actual-or-imputed number of slaves transported. Table 11 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 exceeding 130 tons (mean vessel tonnage in these data is 133 tons). As the second panel of Table 11 shows, small vessels have significantly

[9] An explanation of the *TAST* database's 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 expected number, leaving us with 1,960 observations.

smaller shortfalls than large vessels, presumably because it took less time to fill up a smaller vessel. For large vessels a captain-owner has a significantly larger shortfall than a non-owner.

**Table 11**: 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.

The third panel explores this further, dividing large-vessel voyages by wartime and peacetime. 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, per the fourth panel of Table 11. Neither wartime vs. peacetime nor captain-owner vs. non-owner voyages exhibit significant differences. Captains were not sensitive to war, regardless of 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.

Table 12 reports results of multivariate estimation. 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, the coefficients on *CaptainOwner* and *Wartime* are positive and significant in all estimations. The coefficient on the *CaptainOwner*Wartime* interaction term exhibits the same pattern of significance. Thus, captain-owners incur higher shortfalls than non-owners, and the shortfall "gap" increases during war. In the fully specified model, a captain-owner has a shortfall of 9 slaves more than a non-captain owner during peacetime, and this gap rises to 40 slaves during wartime. This pattern 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.

**Table 12**: Shortfall in slaves embarked as function of captain-ownership of vessel

| | Vessels > 130 tons | | | | Vessels <= 130 tons | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| CaptainOwner | 22.988*** | 21.794** | 21.800** | 9.289 | 1.244 | -2.197 | -1.339 | -3.069 |
| | (8.306) | (8.705) | (8.694) | (8.612) | (4.505) | (4.617) | (4.549) | (4.595) |
| Wartime | 21.210*** | 21.920*** | 30.321*** | 26.656*** | -0.175 | -0.047 | 0.044 | -4.081 |
| | (7.143) | (7.043) | (7.660) | (7.647) | (4.310) | (4.315) | (4.284) | (4.451) |
| Captai-nOwner*Wartime | 48.282*** | 40.914** | 41.754** | 30.403* | -10.388 | -9.782 | -7.526 | -4.854 |
| | (18.182) | (18.018) | (17.918) | (17.417) | (10.051) | (10.003) | (9.844) | (9.708) |
| NumOwners | | 2.133* | 2.066 | 1.511 | | 1.208 | 0.461 | -0.556 |
| | | (1.289) | (1.290) | (1.242) | | (0.780) | (0.784) | (0.789) |
| Tons | | 0.196*** | 0.177*** | 0.242*** | | 0.251*** | 0.198*** | 0.287*** |
| | | (0.041) | (0.041) | (0.043) | | (0.074) | (0.076) | (0.077) |
| CaptainExp-Triangle | | -0.496 | -0.685 | 0.062 | | -0.021 | -0.006 | 0.003 |
| | | (0.888) | (0.888) | (0.864) | | (0.058) | (0.057) | (0.056) |
| Africa region F.E.s | No | No | Yes | Yes | No | No | Yes | Yes |
| Decade F.E.s | No | No | No | Yes | No | No | No | Yes |
| Constant | 38.157*** | -9.802 | -5.218 | -9.498 | 26.196*** | -0.485 | -2.473 | -2.469 |
| | (3.895) | (11.446) | (22.317) | (17.046) | (2.342) | (7.143) | (7.895) | (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. Unit of analysis is the voyage. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The results are more equivocal for small vessels. Coefficients on *Captain-Owner*, *Wartime*, and the interaction term *CaptainOwner*Wartime* are never significant. One interpretation is that, for

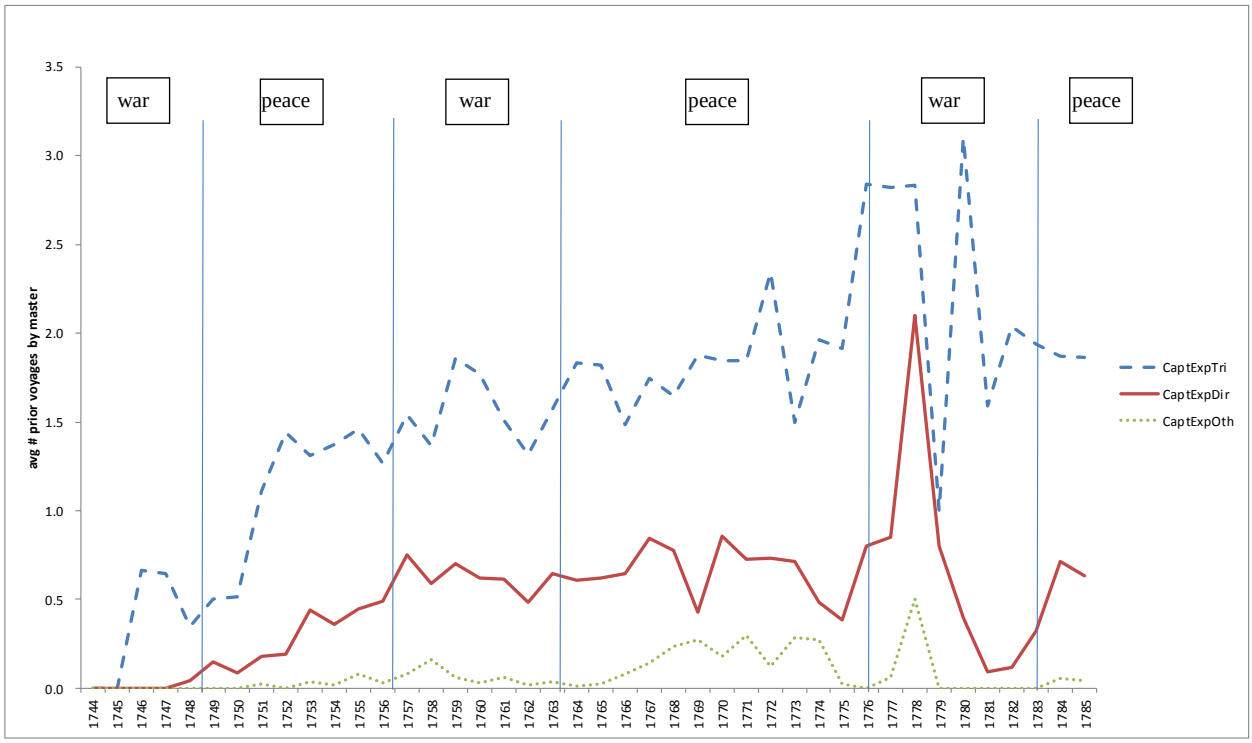
small vessels, the length of time needed to fill the vessel is sufficiently small that captain behavior is not affected by a tradeoff between time spent on the coast and filling the vessel.

*B. Endogenous Matching on Captain's 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 5 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.[10]

**Figure 5:** Average captain experience for triangle voyages, 1744-1785




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

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 in these years, such that a small number of extreme values can significantly affect averages. This implies that, for a two- or three-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. [11]

**Figure 6:** Route-switching by captains – proportion of all voyages in given year whose captain has switched route type since his previous voyage

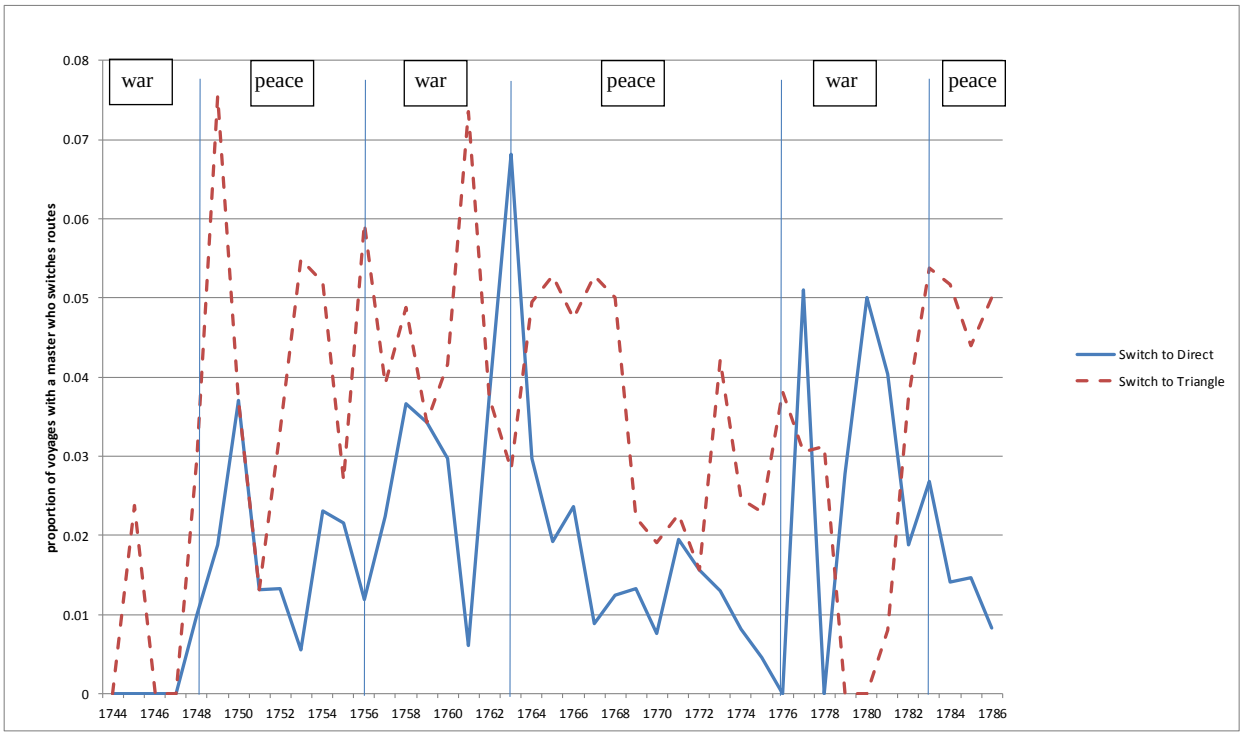



Figure 6 shows for each year the proportion of voyages whose captains have switched from direct trade to triangle trade, and vice versa. The maximum proportion of voyages whose captains switch in a given year is roughly 0.07. The Figure indicates a slightly increased likelihood that a voy-

[11] Although not presented in Figure 5, 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.

age 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 13 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 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.

**Table 13**: Captains' switching between direct and triangle routes:
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.

*C. 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 triangle trade.

## VII. Conclusion

In this paper we used 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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