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Agents with Principles: The Control of Labor in the Dutch East India Company, 1700 to 1796

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Abstract

Principal-agent problems plagued early modern corporations. The existing literature emphasizes the potential benefits provided by private trade in aligning the interests of company agents to those of their principals. We contribute to this line of work by analyzing the organizational and social mechanisms that may help address principal-agent problems in the presence of private trading opportunities. Drawing on personnel records of more than half a million seafarers employed by the Dutch East India Company (VOC) over nearly a century, we show that monitoring was effective in reducing desertion when private trade was conceived as a market activity subordinated to hierarchy. Social bonds were more effective in preventing desertion when the company elevated private trade above hierarchy. Our analysis clarifies how early corporations could maintain control over a geographically dispersed and diverse labor force in the absence of modern tools of organizational governance.

Keywords

organizations, labor, comparative/historical sociology, economic sociology

Malfeasance and smuggling were common among early trading companies. As Adam Smith (1776:957) highlighted, "negligence, profusion and malversation of their own servants" prevailed. The world's first joint stock corporation, the *Vereeinigde Oostindische Compagnie* (hereafter VOC), was no exception to this pattern. Although initially considered illicit, the pursuit of individual gains via private trade was widespread, especially among the elite of the VOC, and surged at the beginning of the eighteenth century (Lequin 1982). Through access to the VOC's monopoly, seafarers leveraged the company's existing infrastructure and obtained individual gains on the side (Adams 1996; McVay 1996). The company's poor financial situation in those years called for a radical reorganization. In 1742, the VOC initiated a dual system of company monopoly and private trade under the impetus of Baron Gustaaf Willem van Imhoff, its newly appointed Governor-General. The reorganization of the intra-Asian trade

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coupled restrictions on select commodities—such as spices, opium, copper, and tin—with reforms that encouraged seafarers across the ranks to pursue trading opportunities outside of those goods (Nierstrasz 2012). By legitimizing private trade, the VOC sought to strike a balance between its need for control and the interests of its servants.

The existing literature on early modern corporations like the VOC recognizes that the management of seafarers (i.e., agents) was a primary concern for managers (i.e., principals) of those companies (Adams 1996; Carlos and Nicholas 1990; Erikson and Bearman 2006; Sgourev and van Lent 2015). Long travel distances and widespread information asymmetry exposed principals to agents' opportunism. As Ville and Jones (1995:2) put it, "[O]pportunism c[ould] take various forms . . . all of which involve a[n] [agent] attempting to maximise his or her utility function in a manner inconsistent with the best interests of the firm." Kinship ties, patrimonial relationships, and coalitions were widely used to manage this problem and to regulate trade and labor (Adams 1996). In the eighteenth century, however, the decline of normative patrimonialism called for a different approach. As a result, companies increasingly granted private trade privileges in an effort to align the interests of their seafarers with those of their managers (Carlos and Nicholas 1990; Erikson and Bearman 2006; Hejeebu 2005).

From the perspective of economic and sociological theory, several issues complicate the pairing of private trade and control of the workforce. First, economic theory suggests that the simultaneous pursuit of private activity and work for a company creates additional risk of opportunism, as it tends to draw employees' attention away from their managers' goals (Holmstrom and Milgrom 1991, 1994). Indeed, when wages are unresponsive to organizational performance, agents' attention will primarily be directed toward the pursuit of private opportunities (Hejeebu 2005; Seth 2012). This was particularly true of early modern companies (Adams 1996), where contractual terms were specified over a period of years and provided fixed wages to seafarers. Hierarchical control remained an organizational lever to address concerns about opportunism. Which dimensions of hierarchy were effective in reducing principal-agent problems in this context remains to be explored.

Second, corporations tend to tolerate private trade when it provides them with financial benefits. To reap such benefits, hierarchical control often must be downplayed in favor of autonomy. For instance, the British East India Company (EIC) limited surveillance of its agents and endorsed private trade because of its persistent shortage of financial resources; but these measures also allowed the company to obtain valuable information on new markets and goods (Erikson 2014; Erikson and Bearman 2006). The VOC likewise reduced regulations and elevated the importance of private trading above hierarchy in the late eighteenth century, a time when its profitability was declining (Nierstrasz 2012; Sgourev and van Lent 2015). In that period, hierarchical authority was still nominally in place "but it was no longer an effective disciplinary device" (Adams 1996:25). Under these conditions, social bonds may play a role in reducing moral hazard (Miller 2005), although the effectiveness of such bonds is unclear in light of trading companies' increasing scale of operations (Erikson and Bearman 2006). It remains to be seen which types of social bonds served to attenuate principal-agent problems.

Addressing these questions is fundamental to improving our understanding of how early companies maintained control over their servants across vast colonial empires. To investigate the relative importance of hierarchical control and social bonds in reducing seafarers' opportunism, we require a comparative design, in which the same kinds of workers or the same kinds of organizations are observed over an extended period of time, with systematic variation in the regulation of private trade. We conceive of opportunism broadly, as instances in which self-interested agents behave in ways that deviate from the goals of their principals (for a similar argument, see

Shapiro 2005). Working for the VOC allowed access to information and resources that seafarers could leverage to pursue their own interests, for instance, by engaging in independent trade in the core commodities monopolized by the company, "jumping ship" to work for another trading company, or pursuing economic advancement that did not involve trade at all, but which leveraged information or poached personnel from the VOC. Most of these deviations ultimately involved seafarers' abandonment of the organization. Within our historical case, desertion represents a form of turnover that entailed the willful violation of contractual obligation with the VOC. This view of agent opportunism aligns with that observed in other trading companies that struggled to "prevent desertion by senior staff . . . and a desire by [the] men to escape the company's service once they had scraped together a few pounds" (Jones and Ville 1996:907). Given variation in its reliance on private trading and the availability of individual-level information on desertion, the VOC offers a unique case study to trace the impact of hierarchy and social bonds on the control of labor in early capitalism.[1]

To consider the benefits of hierarchical and social mechanisms of control, we rely on two different perspectives. We first highlight the benefits that various dimensions of hierarchical control provide in reducing desertion. In particular, we argue that monitoring of agents—whether by experienced leaders, the enforcement of written rules, or the supervision of lower positions by higher ones (see Weber 1968)—is most effective in preventing desertion when private trading is a market activity subordinated to hierarchy. Subsequently, we describe the role of social bonds, in particular reputational concerns and community ties (Greif 2006a, 2006b), and argue that they are most effective in preventing desertion when private trading is a market activity elevated above hierarchy. Under this scenario, attachment to an organization is less *likely* to be obtained through monitoring than via social bonds. To test our arguments, we use personnel records that track desertion among more than half a million seafarers in the Dutch East India Company.

PRINCIPAL-AGENT PROBLEMS IN EARLY MODERN COMPANIES

Several empirical investigations of the principal-agent problem involve early trading companies (Adams 1996; Carlos and Nicholas 1988, 1990; Erikson and Bearman 2006). The conditions in which these companies operated made them particularly prone to challenges in managing their agents. Agents (i.e., seafarers) worked at long distances from home, leading to incomplete information on their whereabouts and dealings (Smith 1776). The risk of agents' opportunistic behavior was heightened by two additional conditions. First, elevated death rates on board attracted risk-tolerant seafarers, leading to adverse selection. Second, the mounting competition among European companies during the eighteenth century lowered seafarers' commitment to their employing organizations (Adams 1996; Bruijn 2011). Under these conditions, risk-tolerant seafarers were more likely to join other trading companies or seek out their own fortunes when their ships docked in port.

The literature on early modern companies highlights private trading as an incentive that may address principal-agent problems (Hejeebu 2005). By granting seafarers opportunities to legitimately engage in private trade, companies sought to align their agents' interests with those of company directors and shareholders. Historical examples illustrate the massive financial gains obtained by ships' officers. From 1757 to 1761, for instance, Jan Lubbert Baron van Eck shipped commodities worth an average of 18,527 rupees per ship over 14 different voyages, eventually appropriating about 10 percent of the VOC's trade from the Coast of Coromandel (Nierstrasz 2012). Private trading imposed few costs on a company as long as the trade was conducted outside its monopolies on restricted commodities (Hejeebu 2005). Companies set

limitations concerning both the type of goods and the quantities to be traded. The trial of Nicolaas Schaghen, involving an excessive amount of copper as well as trade in a type of silk (*armosijn*) covered under the VOC monopoly (McVay 1996), nicely illustrates these constraints. Outside those limitations, seafarers leaving for Asia were allowed to bring with them any non-monopolized items (e.g., alcohol) that fit into their chests (Boxer 1965). Private trading also generated externalities in the form of information needed to establish new commercial routes (Erikson 2014; Erikson and Bearman 2006). In the British East India Company, the voyages completed by Henry Kent between 1738 and 1752 show how entrepreneurial captains could reach new ports (e.g., Tamborneo), which opened up markets for the company in the process (Erikson and Bearman 2006).

Although serving as a powerful incentive, private trade privileges were not without their own problems. Economic and sociological theory suggests that the simultaneous pursuit of private activity and work in the interest of a company poses the risk of directing agents' attention away from the principal's goals (Adams 1996; Holmstrom and Milgrom 1991, 1994). To minimize this risk, agents' wages must be responsive to changes in firm profits, which was not the case in most of the early trading companies. The merits of combining private trade with other forms of control have been debated in the literature. Economists (Carlos and Nicholas 1990; Hejeebu 2005) emphasize the necessity of hierarchically enforcing contracts, with a credible threat of dismissal in case of illicit behavior. Economic sociologists underscore the unexpected benefits obtained by linking private trade to company infrastructure and to cohesive trading networks (Erikson and Bearman 2006).

Notwithstanding the progress made in understanding how early modern corporations managed their seafarers, several important questions remain unanswered. In particular, which dimensions of hierarchical control helped address principal-agent problems in the presence of private trade? How could principals rely on social bonds to maintain control over a geographically dispersed and diverse labor force? Before addressing these questions, we first provide a historical overview of the evolution of the Dutch East India Company during the eighteenth century. We link the discussion of opportunism to the risk of voluntary turnover among VOC seafarers, which represented a fundamental disjuncture in the interests of these agents from those of the company's directors and shareholders.

Turnover in the Dutch East India Company

Managing agents was a dominant concern for the directors of the Dutch East India Company. Located thousands of miles from their originating ports, seafarers were prone to a variety of opportunistic behaviors, ranging from desertion and indolence to fraudulence (Jones and Ville 1996). Even commanders who seemed competent and trustworthy on home turf were often less so once on the high seas and placed in charge of large numbers of men and the shipment of expensive commodities.

Considerable research on the VOC has been dedicated to company performance (e.g., Adams 1996; Sgourev and van Lent 2015), but much less is known about the factors that influenced voluntary turnover among seafarers. The drivers of turnover in the VOC are especially relevant when we consider that, during the eighteenth century, about 30 ships left for Asia every year, and 200 to 300 people (both soldiers and seamen) were needed to crew each ship. The magnitude of the endeavor was such that "for many years the VOC was the largest trade and shipping company in the world, with, in Asia alone, more than 20,000 European and Asiatic employees" (Mörzer Bruyns 1992:143). Given the duration and difficulty of the voyage, and the high death rates, only one out of three people set foot back in the Netherlands (Bruijn and van Eyck van Heslinga 1984). Voluntary turnover added further complications, contributing to a permanent shortage of European labor for the VOC.

Desertion was a form of turnover that represented a serious personnel concern for the

VOC.[2] The Governor of Malabar, Adrian Moens, complained that "desertion is an evil, which seems impossible to put a stop [to] in this place" (van Rossum and Kamp 2016:187). The prevention of desertion assumed particular importance because it reaffirmed "the sailor's power" (Rediker 1989:105). The economic consequences of desertion were also related to the difficulty of finding reliable replacements in Asia. The maintenance of the company's legitimacy and credibility thus called for special attention to this problem. Note that walking away from a job was illegal for contract wage workers like seafarers, and it was a punishable offence. As van Rossum and Kamp (2016:135) put it, "[D]esertion (*desertie*) was used as a concept not only for military labor but also for maritime and other workers. In the Court of Justice of Batavia it was used against European sailors, soldiers, boatswains, cooks, carpenters etc." Compared to mutiny, desertion did not imply an overt act of rebellion (cf. Hechter et al. 2016) but a voluntary decision to exit from the organization. Like mutiny, desertion represented an opportunistic behavior guided by the pursuit of self-interest, one that incurred substantial risks, including the possibility of corporal punishment, labor in chains, and, occasionally, execution. Moreover, agents who deserted were banned from the Netherlands and their earnings and belongings were confiscated. Yet, "despite the punishment against desertion," seafarers "did not mind [leaving] the service of the Company" (van Rossum and Kamp 2016:142).

In line with other authors (Adams 1996; Erickson and Bearman 2006), we assume that seafarers were rational agents who wished to advance their individual interests. Desertion is related to opportunism because historians suggest that this form of turnover was often driven by the pursuit of external opportunities (van Rossum and Kamp 2016). Jumping ships, whether with the goal of private trade or not, occurred with some regularity among VOC seafarers. Personnel who sought to exit the VOC had ample opportunity in ports like Cape Town, Galle, and Batavia, where foreign ships were eager to recruit new crew members and the settlements (and their hinterland) offered alternative sources of livelihood, including smuggling (Ward 2009). In those locations, seafarers and soldiers could "find work in the intra-Asian shipping trade of small private merchants" (van Rossum and Kamp 2016:129). To address these temptations, the company varied its policies over time. Private trading privileges were initially subordinated to hierarchy, but later they were elevated above hierarchy. We rely on this distinction to advance predictions about the dimensions of hierarchy and social bonds that may have been effective in reducing desertion during each historical period.

Turnover When Private Trade Is Subordinated to Hierarchy

The VOC had placed limited emphasis on market incentives for seafarers since its founding in 1602, but the company drastically changed course in the mid-eighteenth century. The radical shift was championed by Gustaaf van Imhoff, who was nominated Governor-General of Batavia in 1742. The most dramatic divergence between van Imhoff's organization and that of his predecessors involved his effort to combine market incentives with naval hierarchy. Among officers, van Imhoff increased salaries by roughly 20 percent and began to pay captains according to their experience with the company. He also doubled performance-based bonuses for officers who completed the outward journey to Asia more rapidly. Linking compensation to market conditions or performance was not common in early mercantile capitalism: the ordinary wages of commanders and officers had hardly changed since the origins of the VOC (Bruijn 2011). Moreover, van Imhoff was the first to open up the intra-Asian trade to officers and seafarers alike (Nierstrasz 2012). This "country trade" was not just tolerated by the company but was actively embraced. Under van Imhoff, the VOC also created the Bank of Lening in 1745 to provide loans that would stimulate private trade (Nierstrasz 2012). The company itself began to handle most of the remittances sent from

seafarers back to Europe, and van Imhoff endorsed the use of bills of exchange, whose amount grew substantially with the liberalization of private trading.

Despite these changes, private trade was not conceived as a substitute for hierarchical control within the VOC. On the contrary, van Imhoff simultaneously took steps to militarize the organization during his tenure. The drastic reorganization was partially motivated by his concerns about the quality of the VOC's top ranks and his hopes of recruiting naval officers (Bruijn 2011). Van Imhoff retained the existing emphasis on direct supervision in the VOC's lower ranks, while regulating officers' careers based on naval hierarchy. The East Indiamen were now sailed by captains, lieutenants, and cadets, rather than by commanders and mates. Van Imhoff established the *Académie de Marine* (a naval academy) in Batavia to train the new generation of officers. In Amsterdam and Rotterdam, *Zeemanscolleges* (Seaman's Colleges) were founded in 1749 to offer practical instruction to rank-and-file seafarers.

In theory, a combination of hierarchy and private trade can be effective in overcoming the perception of alienation often generated by hierarchical control. According to Weber (1968), meaningful dimensions of hierarchical control include professionalism, written rules, and employees' career prospects. A number of dysfunctions and unanticipated consequences may accompany these dimensions of hierarchy (Adler 2012; Haveman 2009; see also Hodson 1996; Merton 1957). The extent to which participants view hierarchy as a coercive institution negatively affects their degree of organizational commitment. For instance, Gouldner's (1954a, 1954b) studies of a gypsum plant showed how the strict enforcement of rules could backfire, in the form of employee resistance, resentment, and a debilitating worker strike. Alienation and voluntary turnover may thus depend on whether hierarchical control is also accompanied by autonomy and initiative (Adler and Borys 1996; Hodson 1996, 2001; Kacperczyk 2012).

Within the VOC, legitimizing private trade delegated initiative to the company's seafarers. We thus expect that the beneficial effect of each dimension of hierarchical control, namely professionalism, rules, and expectations of career progression, was especially apparent in reducing turnover under van Imhoff and his successors. In that period, the advantages of rent extraction outweighed the potential costs of disobedience, and seafarers were more likely to accept hierarchy.[3] Consider first the effects of professionalism. Because top officers were the key professional figures on VOC ships, the greater their naval experience, the more likely they would display expertise in navigation and knowledge about trading opportunities (Lucassen and van Rossum 2015). Given allowances for private trade, every seafarer had a potential stake in the effective transport of commodities on the East Indiamen, and experienced leadership was likely valued as an indication of professionalism. Consequently, we expect that voluntary turnover was minimized under experienced officers.

> *Hypothesis 1a:* The experience of top officers in a unit decreases the hazard of voluntary turnover when private trade is subordinated to hierarchy.

Hierarchical control also relied on the application of rules and sanctions. For sailors on the Indiamen, "cursing, swearing, whoring, debauchery and murder [were] the merest trifles. There [was] therefore, always something brewing among these rascals, and if the officers did not crack down on them so quickly with punishments, their own lives would certainly not be safe for a moment among that unruly rabble" (Dash 2003:89–90). On board the VOC's ships, the code of discipline (Artikelbrief, or *Article-Letter*) identified crimes and meted out corporal punishment to seafarers. The written rules of naval discipline were specified by the company's directors, but enforcement of the *Article-Letter* on board was a responsibility of the master-at-arms, who enjoyed substantial leeway in establishing punishment (de Hullu, Bruijn, and Lucassen 1980). After

private trading was legitimized, the presence of these authorities on board ensured the safety of the seafarers' own goods, as well as the profits of the company. Insofar as the reliability of regulation increases with the number of individuals who are empowered to enforce the rules, voluntary turnover will decrease with the proliferation of authority roles.

Hypothesis 1b: The number of rule-enforcing authorities in a unit decreases the hazard of voluntary turnover when private trade is subordinated to hierarchy.

Finally, hierarchical control is often coupled with a clear pattern of promotion, in which vacancies in senior positions are filled by qualified personnel who are more junior in the chain of command. The chains with the narrowest span of authority (i.e., chains with a one-to-one match between superiors and subordinates) offer the most propitious possibilities for promotion and for training from superiors. Seafarers holding these positions are more likely to value them when superiors are a source of information regarding trading opportunities. If private trade is permitted and extends beyond top officials, working closely with a superior offers rewards that balance the intensive monitoring that typifies these junior positions. Consequently, positions that match a supervisor with a single subordinate will be less prone to turnover.

Hypothesis 1c: In positions with a one-to-one match between superiors and junior subordinates, there is a lower hazard of voluntary turnover when private trade is subordinated to hierarchy.

Turnover When Private Trade Is Elevated above Hierarchy

The VOC's hierarchical approach to the control of workers contrasted sharply with the English East India Company, which made greater allowances for administrative decentralization and private trade (Erikson 2014). The Dutch Republic's prolonged period of economic and political decline, which followed its Golden Age, forced the company to consider alternative ways of coordinating employment relations. An economic argument inspired this change in the second half of the eighteenth century: the high fixed costs faced by the company made the VOC directors realize that close control of seafarers was "prevent[ing] the company from harnessing the ascending and ultimately victorious forces of private traders" (Adams 2005:143). To stimulate the creation and discovery of new opportunities, an even less constraining and more open-ended employment relation was required. The solution drew inspiration from the EIC, reorienting seafarers toward more autonomy and elevating private trading above hierarchy (Sgourev and van Lent 2015). Most of the intra-Asian trade was thereafter left to seafarers' private initiative (Nierstrasz 2012).

Private trade became an integral part of the entrepreneurial nature of the VOC and was liberalized extensively during the second part of the eighteenth century. The provisions in favor of private trade increased dramatically (Sgourev and van Lent 2015), the constraints around intra-Asian trading were relaxed, and the types of goods being traded expanded. As of 1771, long-distance trade in products, including products close to the VOC monopoly, was no longer restricted (Nierstrasz 2012). Commanders and officers in the company had long been allowed to transport personal property to Asia, within sea chests that were regulated by size and contents. With these constraints in place, opportunities to earn extra income from the transport of private goods remained under the thumb of the VOC hierarchy, at least when official rules regarding contraband were adhered to. Following the Fourth Anglo-Dutch War, in the 1780s, all regulations and limitations governing private trade were abandoned and private entrepreneurship was encouraged among VOC seafarers (Bruijn 2011; Nierstrasz 2012).

During those decades, support for private trading was coupled with a significant weakening of hierarchical control. Seafarers were granted more autonomy and punishment became less systematic (van Rossum and

Kamp 2016). On ships to Asia, ranks with direct analogues to the Dutch military were abandoned in October 1755 (Bruijn 2011). An emphasis on written rules persisted, at least on the surface. Nevertheless, declines in the company's financial resources meant that enforcement was lax and the rules took on an increasingly ritual aura (Adams 1996). As the Dutch Republic and VOC entered the period of decline, "the remuneration of its servants continued to be tied to hierarchy, but an increasing personal responsibility was thrust on them to make their own fortune" (Nierstrasz 2012:144).

Under these conditions of weakened hierarchy, social bonds played a fundamental role in restraining seafarers' opportunism. Reputational concerns and community ties are arguably most salient in periods when interpersonal or patrimonial relationships no longer govern transactions exclusively and the impersonal exchanges typical of advanced capitalist systems are not yet in place (Silver 1990). For instance, Greif (2006a:223, italics in the original) suggests that in the Middle Ages, communal courts acted as mechanisms of control because they "held *all* the members of another commune legally liable for the default of *any* member in contracts with a member of the local community." In the absence of effective legal enforcement of contracts, subtler types of social bonds regulated transactions. For instance, in the community of Maghribi traders, reputational concerns were crucial to norm enforcement and to the prevention of agent opportunism (Greif 2006b). An agent's repetitive transactions with the community ensured he was held responsible toward any other merchant in the group. In other words, "a credible threat of collective, multilateral punishment supported the beliefs that the short-run gain from cheating today was less than the long-run benefit of being honest" (Greif 2006b:59). Respect for this community norm was facilitated by the fact that merchants and agents belonged to the same ethnic and religious group.

With respect to the VOC, we argue that the beneficial effects of reputational concerns and community ties were especially apparent when private trade became an activity elevated above hierarchy. The labor of seafarers during the eighteenth century was still "considered a duty . . . [and] all those who escaped from it were deemed fugitives" (Stanziani 2016:16). Moreover, in the face of increasing competition from an international workforce and economic problems in the Netherlands, labor "was considered . . . a resource for the whole community to which the individual belonged" (Stanziani 2016:22–23). Community norms thus played a key role in activating reputational concerns. In the eighteenth century, community norms were most likely to affect seafarers who originated from one of the VOC chambers, who had obligations to family members, or who worked among peers with strong community ties.

VOC seafarers' social identities were tied to their city of origin, especially in the case of agents who originated from a city that hosted a VOC chamber (i.e., Amsterdam, Middelburg, Delft, Rotterdam, Hoorn, and Enkuizen) (Gaastra 2003). Because the chambers were responsible for staffing their own ships, the company remained the largest employer in most of these cities, and local families were closely interrelated with its personnel (Bruijn 2011). Social ties played a major role in the hiring and management of seafarers. We expect that reputational concerns served to discipline the opportunism of seafarers who originated from the same city as the chamber that organized the focal voyage. In the second part of the eighteenth century, the scarcity of labor and harsh economic conditions at home amplified this effect.

Hypothesis 2a: Originating from the same city as a unit's headquarters lowers the hazard of voluntary turnover when private trade is elevated above hierarchy.

In the presence of increased worker autonomy, a second reputational concern that helped reduce voluntary turnover was the effort to preserve family ties. The enduring absence of seafarers from home exposed

wives to financial stress and parents to a lack of practical support from their sons (van der Heijden and van den Heuvel 2007). Historical sources indicate that a considerable percentage of seamen across all ranks left wives and children behind (e.g., van der Heijden 2004). Monthly letters (Maandbrieven) allowed family members to collect up to three months of a seaman's wages per year (van Bochove and van Velzen 2014) and held priority over other payments (e.g., letters of debt). The VOC also sought to support families in the absence of seafarers through the company's charity board, which provided extra jobs to meet financial needs; these benefits would stop upon a seafarer's return or desertion (see van der Heijden and van den Heuvel 2007). Because beneficiaries were most often family members, we expect seafarers who signed monthly certificates were less likely to desert. This was particularly true during times in which private trading was elevated above hierarchy.

Hypothesis 2b: Commitments to family members lead to a lower hazard of voluntary turnover when private trade is elevated above hierarchy.

In other historical instances, such as the Maghribi traders studied by Greif (2006b), community identity was promoted by homogeneity and cohesion. A similar degree of social and ethnic homogeneity was atypical within the VOC, especially during the second part of the eighteenth century (Sgourev and van Lent forthcoming). In those decades, the VOC relied increasingly on a global workforce and recruited seafarers from more diverse geographic origins. Community norms became increasingly disjointed from labor markets, but they continued to be applied by fellow crew members who came from the same place of origin (which, in turn, could reflect similarities in ethnicity, religion, or culture). Because communities of origin represent natural reference points for individuals confronted with uncertainty (Portes 1995), we argue that seafarers were less likely to desert when other seafarers on their ships originated from the same city.

Hypothesis 2c: The larger the number of seafarers in a unit originating from the same city as the focal individual, the lower the hazard of voluntary turnover when private trade is elevated above hierarchy.

DATA, MEASURES, AND METHOD

Data

We test our hypotheses using systematic data on VOC sea-voyagers compiled by the Dutch National Archives (Nationaal Archief 2008). This database provides information about virtually every seafarer involved in outbound voyages to Asia from 1700 to 1796 (see Bruijn, Gaastra, and Schöffer 1979). The database was compiled from two sources of information. First, the logbooks provide information concerning each voyage, from the name of the ship and captain to the year of the voyage and chamber that managed it. Second, information about individual seafarers was obtained from the ship's pay-registers. Nearly 95 percent of all pay-registers from the eighteenth century have been preserved, so the database provides access to a unique and comprehensive catalogue of VOC seafarers hired in Europe and sent to Asia. After careful data cleaning and name reconciliation, 628,768 seafarers, accounting for a total of 561,454 individual-trip observations, were obtained for the period 1700 to 1796.

Life On Board VOC Ships

Like most formal organizations, the functioning of a ship hinged on a clear division of labor. Responsibility for navigation and oversight of the ship rested with the master and his mates. The operational activities of the ship revolved around labor, food, order, and maintenance and were coordinated by the petty officers (or non-commissioned officers [NCOs]). Every sailor and soldier was allocated to shifts of seven men (called quarters),

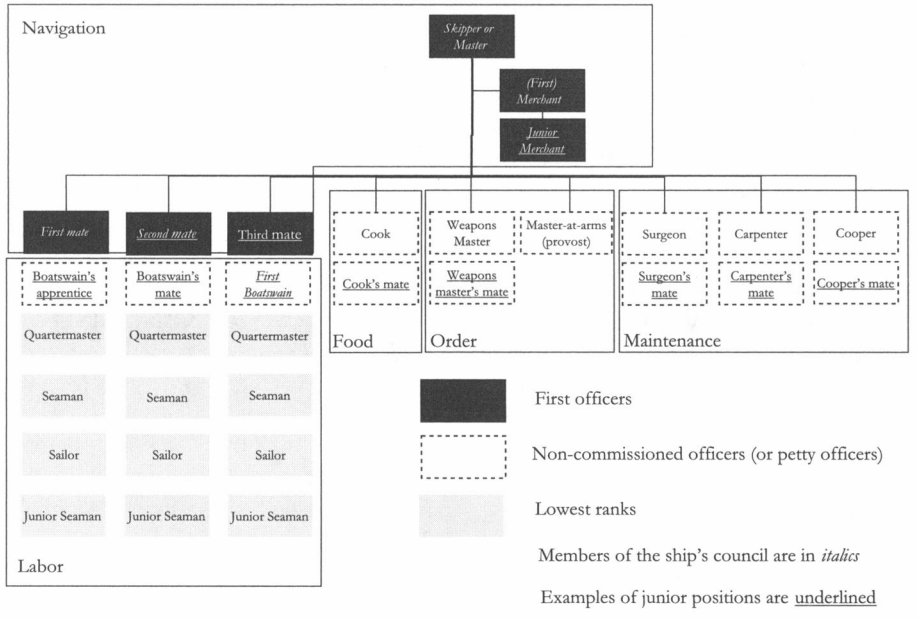

Figure 1. Typical Organizational Structure on a VOC Ship

and quarters were assigned to watches lasting four hours each. Each quarter was managed by a boatswain (or one of his mates, basically the foremen of the ship), the quartermaster (who provided help to the mates and had direct control over the crew), and three seamen (knowledgeable of the rigging and the sails). The master-at-arms was in charge of order and punishments. Maintenance was in the hands of several specialists, such as the cooper, the carpenter, and the master of weapons.

The division of labor was reinforced by differences in status among seafarers. Status differences were justified by diverse competencies and affected seafarers' salary and the resources available to them. First, a great divide existed between seafarers who knew the principles of navigation (master and mates) and manual workers. The master held the highest authority on board (*de facto* from the origins of the VOC, but officially only after 1742), followed by his mates and the petty officers. Second, salaries varied considerably across classes of seafarers, especially between officers and mates versus ordinary seamen. For most of the eighteenth century, a master earned 70 to 80 florins per month, a first mate earned 50, an experienced seaman was paid 11 florins per month, and a novice 7 florins (Bruijn et al. 1979). Until the reforms initiated by van Imhoff, salaries and status on board strongly affected opportunities outside the ship's confines: for instance, marriages and smuggling opportunities were correlated with ranks (Lucassen and van Rossum 2015).

Figure 1 provides a visual illustration of the organizational structure on board a typical VOC ship. The figure also identifies the members of the council responsible for handling disputes regarding navigation and other matters (Pearson 2009).

Measures

Dependent variable. The pay-registers identify how each employee terminated his contract with the VOC. Terminations related to voluntary turnover are the most relevant for our study. Instances of *desertion* occurred in 2.1 percent of all cases and were coded as a dichotomous variable.[4] Note that desertion represented an instance of opportunistic behavior, because it was typically driven by the pursuit of self-interest (van Rossum and Kamp

2016) and involved a willful violation of a legal obligation. Desertion was considered "one of the most chronic and severe problems faced by merchant capitalists of the shipping industry" (Rediker 1989:100). Because our database contains only seafarers who were recruited by the VOC in the Netherlands and boarded a ship to Asia, this is a conservative measure of the extent of desertion faced by the company.[5] The rare occurrence of mutiny in the VOC (Bruijn and van Eyck van Heslinga 1982) led us away from considering it as an alternative dependent variable.

Period effects. The test of our hypotheses hinges on the definition of time periods during which the VOC managed the employment relation as (1) one in which private trade was restricted (1700 to 1741), (2) one in which private trade was subordinated to hierarchy (1742 to 1755) (Hypotheses 1a, 1b, and 1c), and (3) one in which private trade was elevated above hierarchy (1756 to 1796) (Hypotheses 2a, 2b, and 2c). The theory section hinted at these time periods; here, we specify them more precisely and provide evidence in support of construct validity.[6]

The period 1700 to 1741 serves as the baseline for our study. During this era, private trade was in principle confined to the sea chests allowed on board, which varied significantly in size across ranks. For instance, the chests of first mates were proportionally two-thirds the size of those of the masters (Bruijn 2011). In reality, private trade was widespread and firmly in the hands of high officials (Lucassen and van Rossum 2015; McVay 1996). As van Imhoff himself put it, "[R]ecently the company trade [has become] a sideline and private trade the main work" (cited in Bruijn 2011:206). In response to this and other concerns, stringent regulations and punishments were imposed on board. A punishment implied "work for the company while earnings were confiscated with a declaration of the pay forfeited" (Nationaal Archief 2008). Consistent with our narrative, the *highest* frequency of punishment was observed during this period, occurring at a per capita rate 26 percent higher than during 1742 to 1755 and three times higher than the per capita rate from 1756 on.[7]

Between 1742 and 1755, the VOC increased the professionalization and militarization of its officers by imposing multiple qualifying exams (Boxer 1965). Training programs and examinations were accompanied by an ongoing focus on rule-following: in 1742, the *Article-Letter* (i.e., the code of discipline on board) was revised to 121 ship regulations (Bruijn 2011). Several incentives were also activated during this period. Salaries were increased in 1742, and bonuses were doubled in 1744. Most importantly, the VOC's efforts to focus on its most profitable monopolistic trades allowed private initiative among its servants in the intra-Asian trade (Nierstrasz 2012). This change opened up new opportunities for less experienced and lower ranking seafarers. A seafarer at the rank of carpenter, for instance, could take a substantial amount of liquor to be sold in Asia in exchange for payment of a tax (Bruijn 2011). On the home voyage, goods purchased in Asia were exchanged for a monetary equivalent so that "everybody on board would make as much profits" as their private trading activities allowed (cited in Bruijn 2011:213). For these reasons, we label this era as *private trade subordinated to hierarchy*. We end this period in 1755, because the regulations proposed by van Imhoff concerning military ranks and increased salaries were rescinded by the end of that year.

Between 1756 and 1796, the VOC was characterized by lower hierarchical control and stronger incentives for private trade. We label this era as *private trade elevated above hierarchy*. The freedom granted by van Imhoff to seafarers to pursue their own trading became a "virtually irreversible policy" (Bruijn 2011:215), the number of provisions for private trade increased sharply (Sgourev and van Lent 2015), and restrictions on long-distance exchange were removed in 1771. The Fourth Anglo-Dutch Sea War (1780 to 1784) and increasing competitive pressure from British rivals pushed the company to

remove any remaining restrictions on private trading (Nierstrasz 2012). Hierarchical control receded during the last decades of the company's existence (Adams 1996), and attempts at militarization were revoked in 1755 (Bruijn 2011). Regulation did not necessarily diminish, but its enforcement became milder: the lowest per capita rates of punishment and death sentences were observed in this period. In light of a scarce labor force, the sentence for desertion was changed to lifelong labor, and authorities often chose to reduce punishment even further (van Rossum and Kamp 2016).

To account for the possibility that transitions between these eras generated considerable disruption within the organization—and may have contributed directly to desertion—we supplemented the period effects with a clock, assessing how many years had elapsed since the beginning of each era. This modeling strategy follows theories of organizational inertia (e.g., Barnett and Carroll 1995), which predict that change processes may adversely affect the viability of an organization in the short-run, even if the content of the changes allows for more flexibility and retention of the organization's workforce in the long-run.

Independent variables. To capture the experience of top officers (Hypothesis 1a), we counted the number of trips to Asia made by each ship's master (*master's experience*). Other measures could be used (e.g., average experience of the first officers or of the ship's council), but our approach stresses the authority of the master on board. The master set the working climate and decided whether a more rigid or lenient enforcement of sanctions was to be observed.

The master had supreme authority in the ship, but his daily activities mostly concerned navigation. The master-at-arms was the executor of justice on board and enforced the *Article-Letter*. The role of the master-at-arms in maintaining discipline is well described by Mentzel (1919:31), who reports the experience of a soldier embarking on a VOC ship in 1732. In his recollection, the master-at-arms is described as "armed with a piece of rope 18 inches long, as thick as one's finger, and with its end boiled in tar, go[ing] among the soldiers; [he] hit out blindly, striking those who are whole-heartedly tackling their work as well as the shirkers." His responsibilities ashore were to ensure that no crew member was left behind at departure and to forbid the use of violence. We measured the number of authority figures on board with the count of master-at-arms on each ship (Hypothesis 1b) (*number of master-at-arms*).

We captured one-to-one matching between superiors and subordinates (Hypothesis 1c) by coding as 1 the cases in which a direct relation of training and apprenticeship was observed, and 0 otherwise. Extensive practical knowledge was required for most activities on board, and on-the-job training was gathered by serving as mates, juniors, or assistants in a given function. Consider the case of mates, as illustrated in Figure 1. The carpenter was a highly skilled worker who learned his job via apprenticeship. A carpenter's mate was assigned to him to be trained (Rediker 1989). The same holds true for the cooper, the weapon master, the cook, and the surgeon: in each case, there was close supervision between a supervisor and a subordinate. But close supervision and one-to-one matching was also observed across first, second, and third officers: even the first mate, while being a supervisor himself, "remained a worker perpetually supervised by the captain" (Rediker 1989:210). Thus, we also coded as subordinates (*junior position*) the instances of first, second, and third in line (e.g., second boatswain, third mate).[8]

Hypothesis 2a concerns the reputational effect on seafarers who originated from the city of the chamber that organized their voyage, coded as a dichotomous variable (*from same city as chamber*). Monthly certificates (maandbrief) were designed to provide incentives for married men to work for the VOC. To compensate for the loss of a seafarer's income, he could sign a maandbrief, which allowed a member of his family (most often his wife) to collect three months of his salary

every year (van Bochove and van Velzen 2014). The monthly certificate was not transferable but was prioritized over other types of payments. To test for the potential effects of this incentive on desertion (Hypothesis 2b), we coded as 1 the instances in which the focal seafarer signed a *monthly* certificate, and 0 otherwise. Given the difficulty of socialization on board, fellow seafarers who originated from the same geographic origin provided an important source of social bonds. Hypothesis 2c argues that the number of seafarers originating from the same city as the focal seafarer (*number of seafarers from same city*) reduced desertion.

Controls. Desertion may be driven by several alternative motivations. First, desertion may be related to social and labor conditions (van Rossum and Kamp 2016). Seafarers could have been more likely to desert when criminal activities occurred on board. We used the supplemental text available in the VOC database (particulars) to create a dummy variable, coded as 1 when instances of murder, conspiracy, or criminality were reported (*conspiracy, murder, criminals on board*). The size of the crew and crowded conditions could also make the voyage to Asia more unpleasant. We created a variable labeled *number of seafarers on board* to rule out this effect. To proxy the possibility of social contagion, we also counted the number of other deserters who embarked on a ship, excluding the focal seafarer (*number of deserters from same ship*). Opportunities within the VOC were most likely to be exploited at the top of the hierarchy, whereas the presence of private trade incentives alongside limited bureaucratic control could produce turnover at the bottom. Thus, we created a variable (*lowest rank*) coded as 1 for quartermasters, sailors, seamen, and junior seaman (see Figure 1). We used the same rationale in classifying the military ranks, with simple soldiers positioned at the lowest rank. Because the lowest ranks represent the majority of seafarers, we benchmark them against any alternative rank, including first officers (the master and his mates) and NCOs (e.g., the boatswain, surgeon, carpenter, and their mates).[9]

Second, economic conditions, in particular debt, triggered desertion. The *debenture* was a letter of debt granted to *volkshouders*—namely third parties, often called "soul buyers"—who recruited manpower for the company. *Volkshouders* offered (poor) housing, food, and clothing, and in turn received a tradable letter of debt. Insofar as signatories to *debentures* had greater levels of economic desperation than others (or were more likely to have been pressed into service), we expect these seafarers were also less fit for hardships in the VOC and more inclined to desert. To measure the effects of compensation on desertion (*monthly pay*), we used figures reported by Bruijn and colleagues (1979: Appendix 1), who updated existing sources (Boxer 1965) with the various regulations (*Reglement*) provided by the VOC's directors to the chambers. The minimum salary for each position is often missing, so we used the maximum reported value. Using the maximum value of the salary is consistent with a conception of compensation as aspirational, capturing the top earnings for a job position. Levels of pay remained constant for the whole eighteenth century, with the sole exception of 1742 to 1755 (Bruijn et al. 1979). Because a few job titles are not reported in this source, we had to impute the pay of administrative employees (e.g., lawyers), which we set to that of bookkeepers (18 florins); and the pay of various craftsmen (e.g., blacksmith), which we set to that of sail makers (20 florins).

Third, desertion could result from fear of anticipated hardship or mortality linked to a ship's voyage. For instance, desertion was likely to increase during geopolitical conflict (van Rossum and Kamp 2016). To isolate the effect of war on desertion, we created four dummy variables for the War of the Spanish Succession (1702 to 1713), War of the Austrian Succession (1747 to 1748), Seven Years War (1756 to 1763), and Fourth Anglo-Dutch War (1780 to 1784). These time periods were defined according to Boxer (1965). Similarly, journeys in which regiments were on board

were different from others, as a colonial spirit dominated on the ship and tensions with soldiers could escalate (*regiment on board*). Desertion is also expected to increase with the length of the voyage. We thus created a variable that counts the (logged) number of days taken between departure and arrival in Asia (*duration of voyage*). Fear of anticipated hardship varied across career phases and experience, so we controlled for the number of trips made to Asia (*number of trips made*) and the span of employment with the company (*length of current employment span*).

The test of our theoretical arguments requires us to hold constant the external opportunities available to VOC seafarers. We approached this issue in three ways. First, we recognized that opportunities vary across career types and origin. We created a set of dummy variables to isolate unobserved propensities to desert due to career tracks and diverse hiring practices across chambers (*Amsterdam, Zeeland, Rotterdam, Delft, Hoorn, Enkhuizen*).[10] Second, we addressed variation in opportunities across routes by adding dummy variables that capture unobserved differences in destinations.[11] Finally, we measured time-varying differences in external opportunities for seafarers by the price of the two most important goods traded by the company: pepper and tea (*price of pepper* and *price of tea*). We obtained the information to code these variables from the standardized measures provided by Allen (2007). In addition, we proxied the intensity of private trading activities of VOC seafarers in Asia with the value (in thousands of guilders) of bills of exchange paid out in the Netherlands to seafarers (*bills of exchange*). We obtained this variable from Bruijn and colleagues (1979). We have only decade-by-decade information, so we held the value constant for each decade.

Method

Our dataset is organized at the seafarer-trip level. Each observation in our data is an individual voyage of a given seafarer. Our aim is to model whether desertion is the reason why a focal seafarer's tenure ended. Because of the relative rarity of the outcome under study, we used a complementary log-log regression to model this binary variable. The complementary log-log model also suits our dependent variable, because desertion can happen at any time in theory, but is only observed in discrete intervals (Allison 2012). We report robust standard errors clustered by seafarer. This cluster adjustment takes into consideration the dependence among observations in the case of seafarers engaged in multiple voyages (about 10 percent of the observations) and corrects for correlation among error terms.

RESULTS

Descriptive Statistics

Table 1 reports summary statistics and bivariate correlations among the variables included in our models. The average number of seafarers on each ship (275) matches that observed by other authors. Out of this total, each seafarer could count on an average of about 14 fellow seafarers originating from the same city. In roughly 17 percent of observations, seafarers originated from the same city as the chamber that organized the voyage. *Debentures* were widely diffused among seafarers (83 percent, higher among the lowest ranks), but the opposite held true for monthly certificates, which were quite rare (8 percent). Experience on board was limited; most seafarers (about 83 percent) traveled to Asia only once, although the maximum was 12 trips and the average was higher for masters (about two trips). In 12 percent of observations, seafarers occupied a junior position with one-to-one supervision. One master-at-arms was most often observed on board, but in many instances, zero, two, or three officers were assigned to this position. Contagion was a reasonable concern: a mean of six deserters could be found on each ship averaging 275 seafarers. The mean salary of seafarers was relatively low (13 florins) but came with substantial variance, ranging from 7 to 100 florins.

Table 1. Descriptive Statistics and Correlations

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1	Desertion	.02	.14	1.00																																		
2	Duration of voyage (days)	243.26	56.77	.03	1.00																																	
3	Conspiracy, murder, criminals on board	.38	.48	.02	.29	1.00																																
4	Regiment on board	.02	.12	.00	−.02	−.04	1.00																															
5	Number of seafarers on board	274.66	80.98	.03	.01	.02	.08	1.00																														
6	Baseline era, 1700 to 1741	.41	.49	−.02	.09	−.01	−.10	−.53	1.00																													
7	Era of subordinated private trade, 1742 to 1755	.17	.38	.02	.00	.16	−.06	.10	−.38	1.00																												
8	Era of elevated private trade, 1756 to 1796	.42	.49	.01	−.09	−.11	.15	.45	−.71	−.39	1.00																											
9	Seven Years War	.10	.30	.02	−.08	.04	−.04	.22	−.28	−.15	.40	1.00																										
10	Fourth Anglo-Dutch War	.03	.18	.02	.06	−.07	.01	.08	−.16	−.08	.22	−.06	1.00																									
11	War of Austrian Succession	.02	.14	.01	.07	.02	−.02	.04	−.12	.31	−.12	−.05	−.03	1.00																								
12	War of Spanish Succession	.09	.28	.00	.06	−.03	−.04	−.21	.37	−.14	−.26	−.10	−.06	−.04	1.00																							
13	Number of deserters from same ship	5.77	10.39	.19	.13	.09	.00	.27	−.14	.08	.07	.09	.09	.04	−.03	1.00																						
14	Number of seafarers from same city	14.39	26.59	−.03	.00	−.01	−.04	−.07	.19	−.08	−.13	−.06	−.04	−.02	.15	−.05	1.00																					
15	From same city as chamber	.17	.38	−.03	.00	−.01	−.06	−.12	.14	−.05	−.11	−.04	−.03	−.01	.10	−.05	.88	1.00																				
16	Monthly pay	13.13	10.31	−.02	.00	.02	−.04	−.08	.04	.05	−.08	.03	−.03	.01	.03	−.02	.06	.08	1.00																			
17	Monthly certificate	.08	.27	−.01	.03	.00	−.03	−.14	.19	−.02	−.18	−.05	−.05	−.01	.14	−.03	.14	.13	.18	1.00																		
18	Debenture	.83	.37	.05	−.01	.01	−.04	.09	−.14	.06	.09	.05	−.03	.02	−.06	.04	−.15	−.14	−.12	−.01	1.00																	
19	Length of current employment span (years)	3.59	4.68	−.04	−.01	.00	−.04	−.06	.12	.01	−.12	−.01	−.03	−.01	.07	−.03	.00	−.01	−.05	−.01	.05	1.00															
20	Number of trips made	1.19	.65	−.02	−.01	.00	−.01	−.02	.00	−.01	.01	.01	−.01	−.01	−.04	−.01	.11	.14	.25	.06	−.12	−.05	1.00														
21	Medical and spiritual care	.01	.12	−.02	.00	.00	.00	−.03	.02	−.01	−.01	−.01	.00	.00	.01	−.01	.03	.04	.28	.06	−.08	.00	.05	1.00													
22	Naval career	.55	.50	.01	−.01	−.02	.03	−.03	−.01	−.06	.05	−.02	.04	−.03	−.01	.00	.10	.10	−.06	−.03	−.04	−.15	.09	−.14	1.00												
23	Craftsmen, artisans	.05	.23	−.01	.00	.00	.00	−.02	−.01	.00	.01	−.01	−.01	.00	−.01	−.01	.01	.01	.42	.11	.05	−.02	−.03	−.03	−.26	1.00											
24	Other careers and administrators	.04	.18	−.02	.01	.01	.00	−.03	.03	−.01	−.02	−.02	.00	.00	.02	−.01	.09	.12	.02	.05	−.10	−.02	.09	−.02	−.21	−.05	1.00										
25	Merchants and traders	.00	.06	−.01	.00	.00	.00	−.02	.02	.00	−.02	−.01	.00	.00	.01	.00	.01	.02	.13	.00	−.11	.05	.00	−.01	−.07	−.01	−.01	1.00									
26	Specialists	.01	.08	.00	.00	.00	−.01	−.01	.01	.00	−.02	.00	−.01	.00	.00	.00	−.01	−.01	.02	.00	.02	.02	−.01	−.01	−.09	−.02	−.01	.00	1.00								

(continued)

Table 1. *(continued)*

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
27	Food and drink	.03	.18	−.01	.00	.00	.00	−.04	.03	−.01	−.02	−.01	−.01	−.01	.02	−.01	.07	.08	.05	.04	−.06	−.04	.08	−.02	−.21	−.04	−.04	−.01	−.01	1.00								
28	Lowest rank	.60	.49	.03	.00	−.02	.03	.09	−.05	−.05	.09	−.02	.04	−.01	−.03	.02	−.13	−.15	−.66	−.11	.14	.07	−.17	−.15	−.09	−.29	−.23	−.08	−.10	−.06	1.00							
29	Junior position	.12	.32	−.02	.00	.00	−.01	.01	−.04	−.02	.06	.01	−.01	−.01	−.04	−.01	.08	.10	.11	.04	−.06	−.03	.04	.11	.07	.11	.16	.06	−.03	.00	−.10	1.00							
30	Number of master-at-arms	.90	.35	.01	.00	.04	.03	.35	−.24	.11	.16	.08	−.01	.03	−.09	.09	−.03	−.08	−.04	−.03	.04	−.04	.00	−.01	−.01	.01	.00	−.01	.00	−.01	.04	.01	1.00						
31	Experience of the master	1.94	1.20	−.01	−.05	.00	.00	.15	−.13	.01	.13	.05	.04	−.02	−.11	−.02	−.01	−.01	−.01	−.04	.02	−.02	.01	−.01	.01	.00	−.01	.00	.00	−.01	.01	.01	.11	1.00					
32	Years since last era	17.32	11.65	−.04	−.06	.17	−.21	.38	−.41	−.07	−.40	.15	−.15	−.25	−.07	−.01	.01	−.02	−.02	−.08	−.03	.03	.01	.01	.07	.01	.02	.00	.00	.01	−.01	.03	−.07	.01	1.00				
33	Pepper price	23.36	5.05	−.01	−.01	−.09	.07	−.1	.18	−.19	−.03	−.13	−.02	−.04	−.07	−.05	.11	.06	−.04	.03	−.05	.01	−.01	.01	.03	−.01	.00	.00	.00	.01	.05	−.01	−.13	−.01	.09	1.00			
34	Tea price	160.86	74.17	−.02	.09	−.04	−.14	−.43	.76	−.11	−.67	−.31	−.13	−.06	.49	−.13	.22	.15	.02	.19	−.11	.12	−.02	.01	−.03	−.02	.02	.01	.01	.02	−.01	−.06	−.25	−.14	−.05	.42	1.00	
35	Bills of exchange (in millions)	22.00	12.10	.01	−.09	−.07	.04	.48	−.74	−.14	.85	.25	.28	−.10	−.35	.10	−.17	−.12	−.07	−.19	.11	−.11	.01	−.01	.04	.01	−.03	−.02	−.01	−.02	.08	.05	.18	.14	−.05	−.19	−.70	1.00

Multivariate Regression

The results reported in Table 2 are not meant for hypothesis testing but represent the average coefficient estimates across the three historical eras. Model 1 suggests that the length of the voyage, the existence of a regiment on board, and the manifestation of criminal activities were positively related to the hazard of desertion. As expected, the hazard of desertion for a seafarer increased with the number of deserters on his ship. At one standard deviation above the mean (16 deserters on board), the hazard of desertion was 35 percent higher than the mean for this variable (6). Not surprisingly, as time passed in the current employment span, the hazard of desertion was reduced: seafarers in their second voyage to Asia were about 18 percent less prone to desert compared to novices. The *lower ranks* exhibited a significantly higher hazard of desertion (about 24 percent) compared to other ranks. *Monthly pay* exhibits a negative effect on desertion. The estimate of the *debenture* variable is positive and suggests that seafarers who signed this letter of debt were almost three times more likely to desert compared to those who did not.

Model 2 adds variables that capture various aspects of hierarchical control. No statistically significant effect of *master experience* is detectable in these unperiodized models. Seafarers traveling on ships in which the enforcement of discipline was carried out by multiple *master-at-arms* exhibited a lower hazard of desertion (about 9 percent lower for every officer added on board). Seafarers assigned to one-on-one supervision (*junior* roles) were, on average, less likely to desert. Their hazard of desertion was 17 percent lower than seafarers not in this role.

Model 3 adds the community and reputational variables, and Model 4 adds the three eras of theoretical interest. Identification, proxied by correspondence between the city of origin of the focal seafarer and the chamber having organized the voyage (*seafarer from same city as chamber*), reduced the hazard of desertion by about 22 percent. The coefficient estimate of the *monthly certificate* variable fails to reach statistical significance. We see a negative effect on desertion with increasing *numbers of seafarers from the same city*.

The results of Model 4 suggest a couple of considerations. We see significant variation in the desertion rate across the three periods, but there is no indication that private trade allowances—in and of themselves—reduced desertion. To the contrary, desertion rates appear significantly higher with van Imhoff's reforms in the mid-eighteenth century. In alignment with our arguments, this set of results calls for further exploration of the moderating role of the three historical eras on the effects induced by hierarchical control and social bonding.

Hypothesis Tests

The previous set of models assumes that effects of the independent variables are time-invariant. Our theoretical argument suggests, however, that effects will vary across historical periods, as each approach to private trading carries its own distinct measures against desertion. Table 3 reports estimates that test our hypotheses. These estimates come from the interaction of each variable with the three periods under consideration, namely the *baseline era*, the *era of subordinated private trade*, and the *era of elevated private trade*.[12]

Once moderating effects are accounted for, the coefficient estimates for the *bills of exchange* variable confirm that trading opportunities during the periods of subordinated and elevated private trade contributed to increased opportunistic behaviors among seafarers, as inferred from desertion. Considering the baseline period, desertion rates were low in well-compensated positions, which were most likely to grant access to the limited opportunities for private trading (see *monthly pay*). Owing to the widespread use of coercion against lower-ranked seafarers, there was a distrust of experienced top officers (*experience of the master*) and close monitoring (*junior*) during this era. For instance, each additional trip experienced by the commander increased the average hazard of desertion

Table 2. Baseline Models of the Hazard of Seafarer Desertion

	Model 1	Model 2	Model 3	Model 4
Duration of the voyage	.001**	.001**	.001**	.001**
	(.000)	(.000)	(.000)	(.000)
Conspiracy, murder, criminals on board	.118**	.119**	.120**	.099**
	(.021)	(.021)	(.021)	(.021)
Regiment on board	.213**	.188*	.197*	.204*
	(.077)	(.077)	(.077)	(.079)
Number of seafarers on board	−.003**	−.002**	−.002**	−.002**
	(.000)	(.000)	(.000)	(.000)
Pepper price	−.009**	−.009**	−.008**	−.002
	(.003)	(.003)	(.003)	(.003)
Tea price	−.002**	−.002**	−.001**	−.001**
	(.000)	(.000)	(.000)	(.000)
Bills of exchange	−.003**	−.004**	−.004**	.002
	(.001)	(.001)	(.001)	(.002)
Years since last era	−.006**	−.006**	−.006**	.001
	(.001)	(.001)	(.001)	(.002)
Number of deserters from same ship	.026**	.026**	.026**	.026**
	(.000)	(.000)	(.000)	(.000)
Length of current employment span	−.088**	−.087**	−.086**	−.086**
	(.003)	(.003)	(.003)	(.003)
Number of trips made	−.265**	−.269**	−.236**	−.235**
	(.026)	(.026)	(.026)	(.026)
Lowest rank	.215**	.248**	.226**	.243**
	(.029)	(.030)	(.030)	(.031)
Monthly pay	−.003*	−.003	−.004*	−.004*
	(.002)	(.002)	(.002)	(.002)
Debenture	1.154**	1.155**	1.113**	1.110**
	(.042)	(.042)	(.042)	(.042)
Experience of the master		−.008	−.009	−.010
		(.008)	(.008)	(.008)
Number of master-at-arms		−.102**	−.099**	−.114**
		(.029)	(.029)	(.029)
Junior position		−.184**	−.160**	−.170**
		(.036)	(.036)	(.036)
Seafarer from same city as chamber			−.244**	−.260**
			(.062)	(.062)
Monthly certificate			−.053	−.048
			(.041)	(.041)
Number of seafarers from same city			−.004**	−.004**
			(.001)	(.001)
Era of subordinated private trade, 1742 to 1755				.307**
				(.061)
Era elevated private trade, 1756 to 1796				−.076
				(.069)
Constant	−3.106**	−3.055**	−3.050**	−3.590**
	(.107)	(.109)	(.110)	(.135)
Observations	558,404	558,404	558,404	558,404
Log-likelihood	−54121	−54100	−53979	−53940
−2 Change in log-likelihood		42(3)**	242(3)**	78(2)**

Note: Destination, chamber, career, and war fixed effects are included in all models.
*$p < .05$; **$p < .01$ (two-tailed tests).

Table 3. Periodized Models of the Hazard of Seafarer Desertion

	Baseline Era (P1)	χ^2 P2 vs. P1	Era of Subordinated Private Trade (P2)	χ^2 P3 vs. P1	Era of Elevated Private Trade (P3)
Controls (selected)					
Period effect			−.649	**	−1.677**
			(.407)		(.312)
Bills of exchange	−.018**	**	.030**	**	.004
	(.006)		(.005)		(.003)
Number of deserters from same ship	.025**	**	.031**	**	.073**
	(.001)		(.001)		(.001)
Number of trips made	−.215**		−.223**		−.235**
	(.049)		(.060)		(.035)
Monthly pay	−.020**	**	−.005	**	.006*
	(.003)		(.004)		(.002)
Debenture	1.078**		1.162**		1.204**
	(.062)		(.111)		(.066)
Hypotheses 1a, 1b, and 1c					
Experience of the master	.062**	**	−.076**	**	−.014
	(.017)		(.019)		(.011)
Number of master-at-arms	−.009	**	−.543**		−.110*
	(.046)		(.087)		(.047)
Junior position	.137*	**	−.171*	**	−.288**
	(.065)		(.082)		(.051)
Hypotheses 2a, 2b, and 2c					
From same city as chamber	−.208*		−.237		−.229*
	(.089)		(.163)		(.109)
Monthly certificate	.015		−.170	**	−.353**
	(.047)		(.101)		(.132)
Number of seafarers from same city (in tens)	−.023		−.058	*	−.078**
	(.012)		(.030)		(.019)
Chamber fixed effects	YES		YES		YES
Destination fixed effects	YES		YES		YES
Career fixed effects	YES		YES		YES
War fixed effects	YES		YES		YES
Time since last era	YES		YES		YES
Observations	226,245		95,885		236,274
Log-likelihood (df)			−53265 (83)		

Note: Robust standard errors are in parentheses. Besides variables mentioned in the table, other controls include duration of voyage; conspiracy, murder, or criminals on board; regiment on board; number of seafarers on board; price of tea; price of pepper; length of current employment span; and lowest rank. *$p < .05$; **$p < .01$ (two-tailed tests).

among his seafarers by 6 percent. A similar interpretation can be attached to the positive effect of the junior variable: net of differences in career, seafarers assigned to junior roles exhibited a 15 percent higher hazard of desertion compared to personnel not assigned to roles with such intensive supervision.

Under Governor-General van Imhoff, new opportunities for private trading emerged at the bottom of the hierarchy. The first set of hypotheses concerns the effects associated with the VOC's focus on private trade subordinated to hierarchy. These estimates suggest support for Hypothesis 1a: the coefficient for the

experience of the master is negative during this era and is statistically different from that obtained during the baseline period, as revealed by the χ^2 test reported in Table 3. Consistent with Hypothesis 1b, the estimate of the *master-at-arms* coefficient is negative and statistically significant during this era (and again, different from that obtained in the baseline period). A second master-at-arms added to a ship in this period reduces the hazard of desertion by an additional 25 percent. The coefficient of the *junior position* variable is also negative and significantly contributes to reducing the hazard of turnover. Therefore, Hypothesis 1c also appears fully supported by our data.

The second set of hypotheses proposes that social mechanisms of control became paramount for reducing desertion during the era in which private trade was elevated above hierarchy. The coefficient estimates reported in Table 3 lend some support to these propositions. The effect of originating from the same chamber is negative but not significant during the era of subordinated private trade, but it becomes significant in the last period. However, we find no statistical difference in the effect of this variable compared to the baseline era (providing little support for Hypothesis 2a). Consistent with Hypothesis 2b, holding a monthly certificate during the era in which private trading was elevated above hierarchy lowers the hazard of desertion by about 30 percent. The effect of this variable in the last period is significantly different from that detected during the baseline period. Earlier eras witnessed an effect of having seafarers from common origins on VOC ships, but this effect was largest when private trade was elevated above hierarchy. In the last era, the coefficient estimate suggests the hazard of desertion was 17 percent lower when the *number of seafarers from the same city* increased by one standard deviation. This effect is significantly different from that generated by this variable in the baseline era, in support of Hypothesis 2c.

Table 4 facilitates interpretation of the results by focusing on seamen; that is, excluding individuals with careers not directly related to naval activities. Because the characteristics detailed in our hypotheses coexisted rather than occurring independently, Table 4 reports the predicted probabilities of desertion after combining several characteristics.[13] Three aspects are worth highlighting. First, the beneficial effect of each variable on the probability of desertion can be seen from reading the results reported in the columns for *era of subordinated private trade* (see Hypotheses 1a, 1b, and 1c) and *era of elevated private trade* (see Hypotheses 2a, 2b, and 2c). Second, the beneficial effect of captain's experience, increasing number of master-at-arms, and being involved in a junior role is strongest in magnitude when private trade is subordinated to hierarchy (compare columns of Hypotheses 1a, 1b, and 1c). For instance, seafarers in junior roles who were subject to masters with extensive experience and a large number of rule-enforcing authorities were almost one-fifth as likely to desert under van Imhoff's organization compared to seafarers exposed to the same conditions during the baseline period. Finally, a similar reasoning holds true for the effects induced by the social bonds. As predicted by Hypotheses 2a, 2b, and 2c, these variables exhibit stronger effects in reducing desertion when private trade is elevated above hierarchy. During this period, the predicted probability of desertion for a seafarer from the same city as the chamber organizing the trip, who held a monthly certificate, and who was surrounded by peers from his city of origin was half of that observed during the baseline period.

Additional Analyses Using Length of Tenure

Our theory hinges on the claim that desertion represents an instance of opportunistic behavior on the part of seafarers and an act of deviance from the goals of their principals. However, the limited information available concerning the activities carried out by deserters impedes a direct validation of this claim (van Rossum and Kamp 2016). Our reasoning and hypotheses should nonetheless hold when

Table 4. Predicted Probabilities of Desertion for Seamen (Based on Estimates in Table 3)

		Baseline Era	Era of Subordinated Private Trade	Era of Elevated Private Trade
Baseline	Average position, average conditions	.018	.018	.017
Hypothesis 1a	High master experience	.020	.015	.017
Hypothesis 1b	High master experience, high number of master-at-arms	.020	.006	.014
Hypothesis 1c	High master experience, high number of master-at-arms, junior	.023	.005	.011
Hypothesis 2a	Originating from same city as chamber	.015	.015	.014
Hypothesis 2b	Originating from same city as chamber, monthly certificate	.015	.012	.010
Hypothesis 2c	Originating from same city as chamber, monthly certificate, high number of seafarers from same city	.014	.010	.007

Note: High master experience = 3 trips; high number of master-at-arms = 2; high number of seafarers from same city = 41.

considering an alternative but conceptually related outcome: length of tenure (LOT) of the current employment span. Seafarers signed with the VOC for a fixed number of years, but their employment span could be reduced or extended beyond the original limit during their stay in Asia.

Our dataset does not report information about contract renewals, but it does report the date when each employment span ended. The length of tenure therefore represents a plausible complement to desertion. We used event history techniques to model this outcome upon considering death events as censored cases. Table 5 reports the accelerated failure time estimates obtained from this procedure. Because we model a positive outcome (i.e., a proxy of loyalty), we expect opposite coefficients compared to those obtained when analyzing desertion. Indeed, the estimates reported in Table 5 provide ample support in favor of the second set of hypotheses (Hypotheses 2a, 2b, and 2c) and Hypothesis 1c. These results suggest that our predictions regarding social bonds and one-on-one supervision are generalizable beyond desertion. For Hypothesis 1b, the magnitude of the estimate for the presence of master-at-arms is highest during the era of subordinate private trade, but it is not significantly different from that observed in the baseline era. Hypothesis 1a fails to find support for this dependent variable. An inspection of the predicted median LOT confirms our general interpretation. Seamen who operated in a highly hierarchical context were most likely to stay with the company under subordinated private trade relative to seamen who operated under average conditions (+20 percent median LOT).[14] Seamen who had strong social bonds with their chamber of origin, family, and shipmates were most likely to stay with the company under elevated private trade compared to seamen who operated under average conditions (+16 percent median LOT).

Robustness Checks

Four potential problems may affect the estimates reported in Table 3. The first one relates to the possibility that effects of social bonds may be confounded with those induced by an increasing internationalization of the workforce (see, e.g., Sgourev and van Lent

Table 5. Periodized Models of the Length of Tenure of Seafarers

	Baseline Era (P1)	χ^2 P2 vs. P1	Era of Subordinated Private Trade (P2)	χ^2 P3 vs. P1	Era of Elevated Private Trade (P3)
Hypotheses 1a, 1b, and 1c					
Experience of the master	.001		−.005	**	−.006**
	(.002)		(.003)		(.002)
Number of master-at-arms	.018**		.041	**	−.015
	(.005)		(.023)		(.008)
Junior position	.087**	**	.166**	**	.144**
	(.007)		(.012)		(.007)
Hypotheses 2a, 2b, and 2c					
From same city as chamber	.004	**	.082**	**	.079**
	(.010)		(.023)		(.015)
Monthly certificate	−.028**	**	.029*	**	.036*
	(.006)		(.014)		(.016)
Number of seafarers from same city (in tens)	−.010**		−.002	**	.006**
	(.001)		(.004)		(.002)
Chamber fixed effects	YES		YES		YES
Destination fixed effects	YES		YES		YES
Career fixed effects	YES		YES		YES
War fixed effects	YES		YES		YES
Time since last era	YES		YES		YES
Observations			558,404		
Log-likelihood			−420454 (75)		

Note: Robust standard errors are in parentheses. Besides variables mentioned in the table, other controls include period effects; bills of exchange; pepper price; number of deserters from same ship; monthly pay; debenture; duration of voyage; conspiracy, murder, or criminals on board; regiment on board; number of seafarers on board; price of tea; and lowest rank.
*$p < .05$; **$p < .01$ (two-tailed tests).

forthcoming). Addressing this alternative explanation calls for a cleaner separation between compositional changes (i.e., how many seafarers from diverse origins worked for the VOC over time) and effect sizes (i.e., how did common origins on a ship affect desertion rates). To obtain pools of seafarers that are statistically equivalent across nationalities over the three historical eras, we applied entropy balancing (Hainmueller 2012). We first assigned every city of origin included in our dataset to a region (Netherlands, Germany, Scandinavia, France, England, and others). Of the observations in the dataset, 82 percent were unambiguously assigned to a given region. Then, we estimated the model reported in Table 3 upon requiring that the distribution of origins in the periods of *subordinated private trade* and *elevated private trade* be identical to that observed in the baseline era. Estimates obtained from this reweighting procedure were similar to those reported here (see Table 3A in the online supplement), therefore ruling out internationalization as an alternative explanation for our results.

The second problem relates to variation in the location of desertion. Most desertion events (about 60 percent) happened in Asia; other locations (e.g., England, Scotland, and the Cape of Good Hope) were common too. Desertion in locations other than Asia may indicate instances of turnover that were weakly correlated with experiences on board.

To rule out this concern, we re-ran the analyses upon restricting our sample to seafarers who ended their tenure in Asia. We also added the *number of employees working for the VOC in Batavia* as a further control. We obtained data for 1700 to 1789 from Lequin (1982: Table A26). While the estimates obtained from these models appear weaker, they remain consistent with our predictions in this restricted and smaller sample (see Table 3B in the online supplement).

A third concern involves issues of unobserved heterogeneity with respect to seafarers. Because we do not observe enough instances of seafarers who were employed by the VOC during more than one of the eras under study, the use of individual seafarer fixed effects is not an option. However, the experience of the voyage and its lasting consequences likely varied across career trajectories. For instance, some effects related to the master's experience were more salient for mariners than for soldiers on VOC ships. Although we added career fixed effects to our models, we also assessed the magnitude of this potential bias by re-running the analyses on a sample restricted solely to seafarers assigned to a naval career. Results obtained from this procedure were similar to those reported in Table 3 (see Table 3C in the online supplement). An exception relates to the weak effect of the chamber of origin variable, which was stronger in the earlier era. Conversely, the effect of holding a monthly certificate and of the number of fellow seafarers originating from the same city appears greater in this sample during the last period.

A final, and related, issue may be raised with respect to the non-random allocation of seafarers on board. For instance, endogeneity biases may occur insofar as masters varied in the care with which they selected their crew. This potential concern is tempered by the fact that it was not the master himself who was primarily responsible for recruiting the crew, but rather the chambers (Gaastra 2003).[15] Because quality differences in the profile of applicants, as well as in the hiring process, may have existed across chambers, we added the chamber-specific dummy variables to our models to rule out this source of unobserved variation. We addressed additional historical variation in hiring policy or in employment opportunities for seafarers (both in the Netherlands and abroad) by adding annual fixed effects to our models. Results obtained from this procedure again turned out to be similar to those discussed in the Results section.

DISCUSSION

Lacking modern tools of communication and governance, early trading enterprises struggled to manage their agents across vast colonial empires. Existing studies have tackled this dilemma and contributed to our understanding of the mechanisms through which the principal-agent problem was alleviated, with a particular focus on kinship ties, patrimonial relationships, and networks (Adams 1996; Carlos and Nicholas 1990; Jones and Ville 1996). The increasing scale of operations in the eighteenth century made these traditional solutions less effective in managing principal-agent problems and rendered private trading a reasonable alternative (Erikson and Bearman 2006; Hejeebu 2005). However, the beneficial effects of private trading alone could not be taken-for-granted, given its capacity to induce opportunism among agents (Adams 1996; Holmstrom and Milgrom 1991). To prevent seafarers from pursuing their own interests rather than those of their employers, private trading had to be coupled with other mechanisms of control.

We investigated the role played by hierarchy and social bonds in the context of the Dutch East India Company (VOC), the largest corporation in early modern capitalism. Our study leverages the different ways the company approached private trading over the course of the eighteenth century, particularly with respect to the primacy given to private trading over hierarchical control. The empirical analyses focus on a specific type of opportunistic behavior relevant to our historical context: desertion. Our research design uses this within-firm variation to explore the

effects of hierarchy and social control on the hazard of desertion among seafarers.

The results of our work speak to the young but growing literature in sociology on agency theory (e.g., Adams 1996; Erikson and Bearman 2006; Kiser and Cai 2003; Shapiro 2005). Two main contributions are worth highlighting. First, by placing agents in the context of hierarchical structures and social ties, we move beyond the assumption of organizations as "legal fictions which serve as nexus for a set of contracting relationships among individuals" (Jensen and Meckling 1976:310). In particular, a sociologically rich understanding of agent opportunism requires careful consideration of the trade-off between the pursuit of self-interest and adherence to normative principles internalized via hierarchical or social relationships. Second, our historical case study provides further evidence that organizations may rely on different types of agency relations in the face of changing contextual conditions (Kiser and Cai 2003).

As expected by a Weberian approach to agency theory (Kiser 1999), bureaucratization, through professionalism, rule enforcement, and employees' career prospects, was effective in reducing opportunism, but mostly when such hierarchical control was coupled with regulations that enabled personal initiative (cf. Adler and Borys 1996; Hodson 2001). The value of coupling hierarchy and private trade is especially apparent when compared to the effects generated by similar dimensions of hierarchy during times in which private trade was not yet legitimized. In that earlier era, seafarers assigned to close monitoring or more experienced leadership were especially likely to desert the organization. Once hierarchy served to further their own interests, seafarers were less likely to leave the VOC under conditions of intensive bureaucratic regulation.

The increasing scale of operations and the deregulation of private trade nonetheless made it harder to control employees via hierarchy, as they increasingly "evaded the ruler's influence" (Weber 1968:1051). Such contextual conditions made social bonds and collegiate organizing—that is, keeping "one expert in check by others" (Weber 1968:995, cited in Kiser 1999)—a more successful form of monitoring. The effects of social bonds described in this article are interesting for at least two theoretical reasons. First, social bonds are routinely considered an evolutionary step before structured and formal means of control. Our case illustrates their role even in the presence of a reversed transition from *Gemeinschaft* to *Gesellschaft*. Second, the effect of social bonds became more relevant in preventing turnover when the internationalization of the VOC's workforce increased. In this diverse and disruptive context, seafarers who abandoned peers from the same city of origin or families who relied on cash transfers faced severe damage to their reputations at home. Taken together, these considerations suggest a generalization of the reputational mechanism advanced by Greif (2006b) within a homogeneous social group. Community norms and reputation were especially relevant to our context because labor was still considered an obligation and a resource to the community to which the worker belonged. Nonetheless, community norms and reputation likely play a role in modern firms characterized by a globalized workforce and reduced hierarchical control in comparison to traditional corporations (Cappelli 1999; Davis 2016).

We interpret our results as also reinforcing emerging understandings of the management of workers in early modern corporations in sociology. Adams (1996) and Erikson and Bearman (2006) highlight the pitfalls and possible advantages of social networks for the functioning and performance of these trading enterprises. Our article extends their reasoning and the definition of opportunism to a novel outcome (desertion) and to reputational mechanisms that have not yet been studied in this context. The within-firm variation leveraged by our study allows us to compare the effects induced by social and hierarchical mechanisms of control in preventing the opportunism engendered by private trading. One reason why the company's reliance on social bonds may have been more persistent

than hierarchy is that the combination of private trading and hierarchy led to a structure animated by incompatible norms and ambiguous work roles (Adler 2012; Merton 1976). Within the Dutch East India Company, this form emerged as a fragile organizational configuration that was challenged by centrifugal forces and only survived for a few years, mostly through the stewardship of Baron van Imhoff. Officers may have resisted his reforms because they perceived them to be a challenge to their power; and the lowest ranking seafarers became cynical about an organization that touted market opportunities yet continued to appropriate the returns of their initiatives via hierarchical control.

Three limitations of our work are worth noting and may offer additional avenues for research. First, by focusing on desertion, we avoided any discussion of the broader consequences of hierarchical and social control for early capitalist enterprise. One implicit assumption is that such turnover represents a form of opportunism on the part of agents that damages organizational performance and runs against the interest of principals. Desertion was clearly a challenge that the Dutch East India Company sought to minimize. However, we cannot claim that it contributed to the decline of the company, particularly when considered alongside factors such as geopolitical conflict, competition from other trading companies, or shifts in European demand for commodities from the East Indies. Second, we have limited information regarding the motivations seafarers had for deserting. Additional archival research would be needed to corroborate our claims about the functioning of each mechanism of control. Finally, the conclusions that can be drawn from this study may be limited by the idiosyncratic characteristics of our historical context. The forced nature of the contracts signed by seafarers and the monopolistic position of the VOC invite particular care in generalizing these results. However, such potential disadvantages should be weighed against the rare opportunity to study the principal-agent problem in the context of a mobile workforce that did not take bureaucratic practices for granted and which was highly calculative in its decision-making because the lives of seafarers were very much at risk.

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Notes

1. Desertion generally reflected opportunistic behavior on the part of seafarers (Bruijn and van Eyck van Heslinga 1982; van Rossum and Kamp 2016). It was far more common than mutinies in the VOC, especially when compared to other enterprises during mercantile capitalism (see Hechter, Pfaff, and Underwood 2016; Rao and Dutta 2012).
2. The forced nature of the contract impeded voluntary turnover as we know it. Nevertheless, desertion was a form of turnover because it implied an intention on the part of seafarers not to return to the company. Equating desertion to turnover is not uncommon in the academic literature involving similar historical contexts (Perrings 1979) and in mass media accounts (e.g., Amani and MacAskill 2016).
3. We thank one of the reviewers for suggesting this formulation.
4. Although 2.1 percent may seem like a relatively rare event to a U.S. reader, note that (1) this is a conservative estimate (see end of the paragraph); and (2) even today, certain countries (e.g., Germany) and sectors (e.g., utilities) exhibit similar levels of voluntary turnover (see Elkjaer and Filmer 2015).
5. The database does not include Asian and European workers recruited in Asia, who were arguably at greater risk of desertion.

6. Analyses of baseline models including no other controls (available upon request) demonstrate that the periodization described in this section provides a better fit to the data compared to alternative specifications that either reorganize the first period (i.e., 1700–1722; 1723–1755; 1756–) or refine the last one (i.e., 1700–1741; 1742–1755; 1756–1771; 1772–1795).
7. We obtained these figures from an analysis of instances of individual punishment involving our sample of seafarers during the same time window as this study. A shift toward more regulation and increased punishment had already started in the last decade of the seventeenth century, but data limitations lead us to begin in 1700. Our decision concerning the years to be included in this period is consistent with Israel (1989).
8. In supplemental analyses, we experimented with a different coding of this variable that included only juniors, mates, and apprentices and, therefore, excluded first, second, and third ranks from the coding. Alternatively, we also coded first mates as junior in additional analyses (compare to Figure 1). The results obtained when using these variables in our models are either weaker or stronger but remain consistent with those presented here.
9. Another category of seafarers may be defined as unspecified with respect to rank. For instance, ship gunners, drummers, and trumpeters fit into this category.
10. These dummies include medical and spiritual care, naval, military, craftsmen and artisans, merchants and traders, food and drinks, specialists, and administrators. Military career is the omitted category in these analyses.
11. Several destinations are reported in the dataset, but Batavia appears as the place of arrival in 88 percent of cases. Because a common reason for desertion was a move to another European company (e.g., the French, British, Danish, and Portuguese India companies), the destination fixed effects isolate the unobserved differences among locations in terms of employment opportunities.
12. As the note with Table 3 indicates, several control variables are not reported in the table but included in the models. The full set of results is available upon request.
13. We used the prvalue routine in Stata to obtain these estimates, based on the coefficients reported in Table 3. We chose a value of one standard deviation above the mean for the continuous variables used for hypothesis testing. The other variables included in our models are set to their mean value.
14. We obtained these estimates by considering only the hierarchical variables that are statistically significant in Table 5.
15. Because captains vary with respect to unobserved differences, we also contemplated the use of fixed effects at that level. Using a captain fixed effect estimator, however, is infeasible in our models, primarily because of the large number of captains who have only a single voyage. We nonetheless estimated models that clustered the standard errors at the captain level and obtained results consistent with those reported in the article.

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