The Privatization of Bankruptcy:
Evidence from Financial Distress in the Shipping Industry*

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November 22, 2016

*We are grateful to many people in the shipping industry and in related industries who have provided valuable advice on our shipping research, particularly, Mathew Mazhuvanchery of Clarkson's, Paul Wilcox of Eggar Forrester Group, Idan Ofer, The Admiralty Marshall of the UK, Charles Buss (Watson, Farley and Williams), Nigel Hollyer (ICAP Shipping), Trevor Fairhurst (Fairwind Shipping Limited), Ivar Hansson Myklebust (Nordea Bank) and Sir Gavin Lightman. This paper has been presented at the GCGC conference at Stanford, University of Geneva, the Geerzensee Summer School, EBRD, Harvard Economics Department, the Hebrew University Law School, the NYU joint seminar in law and finance, the joint Oxford-LSE conference in law and finance, Bremen Maritime Cross Border Insolvency Conference, the University of Manheim, Koç University, the University of Sheffield and the University of Porto. We are grateful to the discussants and participants for helpful comments and suggestions including John Armour, Daniel Ferreira , Randall Morck, Andrei Shleifer, Alan Schwartz, Holger Spamann, David Yermack, Yishay Yafeh, and Kristin van Zwieten. Gur Aminadav, Bo Bian, and Raja Patnaik provided excellent research assistance for this project.

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Abstract

We study the resolution of financial distress in shipping, where the ex-territorial nature of assets has distanced the industry from on-shore bankruptcy legislation. We demonstrate how contracts and private institutions have adapted to the industry's special circumstances so as to deliver an effective resolution of financial distress. We investigate three costs of distress: coordination failures leading to the arrest of ships, the direct costs of arrest and auction, and the fire sale discount. We find that most arrests are not caused by coordination failures but rather are precipitated by debtors whose equity is far out of the money and where the ships are close to their break up values. The direct costs of arrest and auction are 8% of a vessel's value, and there is an average fire sale discount of 26%. However, when we control for the low quality of such ships (due to under-maintenance), their low value, and corrupt versus non corrupt ports, the discount virtually disappears. The results suggest that bankruptcy laws that are justified by coordination failures between creditors and large fire sale discounts, may not be necessary, at least for some industries.

"*There is only one law in shipping: there is no law in shipping*".

Sami Ofer (shipping magnate)

1 Introduction

The last thirty years have witnessed a significant expansion of judicial activism in corporate bankruptcy. Many countries have reformed their bankruptcy laws using Chapter 11 of the US Bankruptcy Code as a model, whereby the courts are given the authority to protect companies from creditors in order to assist their recovery. In particular, creditors can exercise their security interests only to the extent that these rights are not stayed by the court. No doubt, there are important cross-country differences in the discretion given to the courts, as well as in their willingness to exercise it (see Davydenko and Franks (2008) and Djankov, Hart and Shleifer (2008)). Even in the United States, the activist trend has not been entirely consistent: see Baird and Rasmussen (2002) and Ayotte and Morrison (2009). And yet, it is fair to say that the old English principle of *freedom of contracting* is all but forgotten. Namely, the idea that privately (re)negotiated debt contracts should be strictly enforced and serve as contingency plans in the eventuality of default is no longer considered a serious policy option. Jensen's (1997) call for the privatization of bankruptcy law is viewed as a somewhat idiosyncratic idea.

It seems that these developments have been driven by a strong conviction that in the absence of vigorous court involvement, freedom of contracting is destined to be plagued by coordination failures. According to Jackson (1986), bankruptcy, by its very nature, raises a common pool problem. Hence, debtors and creditors are unable to renegotiate existing contracts in order to resolve Myers's (1977) debt overhang problem to their mutual benefit. As a result, viable projects are discontinued, assets liquidated unnecessarily, and a company's value diminished by creditors runs, similar to Diamond-Dybvig (1984) bank runs. It follows that the common pool problem is essentially a failure of the contracting parties to allocate property rights on the pool of the company's assets among the stakeholders, so that they have the incentive to take value-enhancing actions. Moreover, these problems are exacerbated by insufficient market liquidity, so that forced sales of assets are not fairly priced. Shleifer and Vishny (1992) argue that part of the solution is in bankruptcy law: "assets in liquidation fetch prices below value in best use ...[Hence,] automatic auctions... , without the possibility of Chapter 11 protection, is not theoretically sound." Pulvino (1998) provides empirical estimates of a fire sale discount of up to 30% of the value of second-hand aircraft.

Remarkably little is known about the actual operation of freedom of contracting regimes, partly because law reforms have pushed them close to extinction. In this paper, we study the resolution of financial distress in shipping, where the ex-territorial nature of assets has loosened (although not completely eliminated) the grip of national bankruptcy laws. While enabling freedom of contracting, the ex-territoriality of assets also creates a major challenge: how to establish the rule of law, so that contracts, and property rights in general, are strictly enforced. Operating across many jurisdictions, much of the time on the high seas, sometimes in ports notorious for corruption and lawlessness, proponents of legal activism might expect to find an industry plagued by coordination failures. We find surprisingly little evidence to this effect.

We have four main findings. First, in spite of the potentially chaotic environment in which the industry operates, the rule of law has been established: it is largely private, decentralized, highly differentiated, competitive and adaptable. Upon default, a secured creditor has the right to repossess the vessel by arresting it in port. Though many ports are corrupt and inefficient, there is a sufficient number that are not. Ports, like flags, compete on the quality of service. Most importantly, contracts and institutions have adapted so as to deliver an efficient repossession process. For example, crews, who physically control the vessel, are made senior to the mortgage, to discourage the crew from abandoning the vessel when their wages are unpaid, thereby aligning their interests with the creditor rather than the distressed owner. In addition, operators are organized as holding companies, with each vessel owned separately by a different subsidiary. The creditor can thus take a security interest on the equity of the subsidiary as well as on the physical vessel. Such a contract, referred to as a “double mortgage”, allows the creditor to repossess and sell a vessel when it is on the high seas, without bearing the costs of arresting it in port. We illustrate the functioning of the system with a description of the Eastwind case, a large operator of ships that entered bankruptcy in 2009.

Second, we take vessel arrests as a proxy for coordination failures. In a Coasian world (with financial frictions), companies that run out of capital lose their assets to better capitalized ones, but this transfer of ownership should not disrupt the assets from operating and generating cash. Anecdotal evidence indicates that practitioners understand this implication of the Coase Theorem and act accordingly: upon default, and under threat of arrest, vessels are sold “voluntarily” and creditors are repaid. As a result, the amount of capacity under arrest as a proportion of total industry capacity is only 0.6% in recessions, and is close to zero in normal times. More significantly, we find that most of the arrests are caused by debtors who are in virtual liquidation. At the same time, we find that debtors who have gone through serious financial distress, characterized by very significant downsizing (sometimes by more than 50%) but which remain in operation, have largely avoided vessel arrests. It seems that the main economic cost of financial distress originates with dysfunctional debtors rather than with poorly coordinated creditors. This undermines an important criticism that is often leveled against a freedom of contracting regime, although one has to be careful about generalizing from shipping to other industries.[1]

Third, we estimate vessels' hazard rates, namely the probability of being "broken up" (the counterpart of "death" in the demographic use of the term) conditional on age and other vessel characteristics. We find that vessels both arrested and auctioned by creditors tend to have a higher hazard rate compared with other shipping transactions. This finding is consistent with Myers (1977)'s under-investment hypothesis, applied to investment in maintenance. Evidence from ship appraisers' reports contained in a hand-collected sample of arrested and auctioned ships in UK ports strongly confirms this under-maintenance effect. While the Myers (1977) debt overhang problem is very prominent in the literature empirical evidence is much scarcer.

Lastly, we quantify the effect of the higher hazard rate on vessels' value, and use it to demonstrate a statistical bias in the measurement of the fire-sale discount. We start by applying Pulvino's methodology to our data, which yields similar results: conditional on financial distress, a vessel is priced about 30% below a market benchmark. We call this the raw discount, which we then decompose into a quality component (due to the higher hazard rate and the implied shorter expected economic life) and the remainder which may be assigned to liquidity (the difficulty of finding a buyer at short notice). The results suggest that about half of the raw discount is due to low quality i.e. under-investment. Moreover, we show that a liquidity discount affects only the lower end of the value distribution: there is no evidence that high-valued vessels, arrested in ports with a high standard of enforcement are sold below the market benchmark.

Our paper is related to a large literature on the economic analysis of bankruptcy law. In particular, it relates to a new set of results that have demonstrated the unintended consequences of law reform: Vig (2013) for India, Serrano-Velarde and Tarantinoet (2015) for Italy, and Lilenfeld-Toal, Mookherjee and Visaria (2012) for India. Our paper is also related to a large legal literature on both the feasibility and the desirability of competition among legal systems: LoPucki and Kalin (2001), Kahan and Kamar (2002), Bebchuk and Cohen (2003) and Romano

[1] It should be noted that we are focusing here on the ex-post coordination failures often cited as market failures that justify statutory bankruptcy codes. However, it may still be the case that firms change their behavior ex-ante and this may generate inefficiencies. For example, the shipping industry might respond ex-ante with (sub-optimal) low levels of leverage or concentrated creditors. While the shipping industry is highly levered, we are aware that ex-post coordination failures may generate ex-ante inefficiencies. We are therefore very cautious about making any welfare claims, but simply wish to highlight that at least some of the justification used for Chapter 11 does not seem to be borne out by our data.

(2005). We see this debate in the more general context of the "spontaneous" generation of law and institutions through the decentralized interaction of traders within competitive markets: see Hayek (1979), Bernstein (1992) and Greif, and Milgrom and Weingast (1994).

Our fire-sale results are related to Campbell, Giglio and Pathak (2011), Coval and Stafford (2007), Stromberg (2000), and Eckbo and Thorburn (2008). Shleifer and Vishny (2011) provide an excellent survey of the fire sale discount literature in both finance and economics.

The rest of the paper is organized as follows. In section 2 we describe our data. In section 3 we discuss the institutional structure of the industry including how property rights are registered and enforced particularly in the case of an arrest of a ship. Section 4 tests whether coordination failures can explain vessel arrests and provides some evidence of the economic costs of arrest and immobilization. Section 5 estimates the fire sale discount for arrested and auctioned vessels and section 6 concludes the paper.

2 Data

Our main data source is Lloyd's List Intelligence (henceforth LLI) originally part of Lloyd's of London, the famous syndicate of insurance underwriters.[2] Lloyd's has been collecting vessels' technical information (type of vessel, size, construction date etc.) and ownership information for more than two hundred years, but the data have existed in electronic form only since the mid 1990s.[3] Our sampling window begins in 1995 and ends in 2010. We focus on merchant vessels (bulk, containers, reefers and tankers) excluding passenger ships and highly specialized technical vessels (e.g. oil exploration vessels). We also exclude small vessels below 10 deadweight tons (DWT). Effectively, this is a survey of the world fleet during the sample period. The data contains information about both active and scrapped vessels. Each vessel is identified by an International Maritime Organization (IMO) number, which is attached to the body of the vessel, and remains intact when the vessel changes owner or name. Another important source is Clarkson Research Services Limited (CRSL), a shipping broker, which supplies price information for secondary market transactions. The CRSL and LLI data sets can be matched through IMO numbers. LLI also has detailed information about vessel arrest: port of the arrest, length of arrest and in many cases a short narrative describing the circumstances of the arrest. We augment this source with records of the Admiralty Marshal, the officer who executes vessel

[2]The intelligence unit is currently owned by Informa, a publisher.

[3]Lloyd's list, an industry news bulletin, in existence since 1734 and Lloyd's vessel register in existence since 1764.

arrests in the UK. These records provide more detailed information about the direct costs of the arrest, including all the costs of keeping the vessel in port and auctioning it, as well as a description of the state and quality of the vessel, provided to all potential bidders in the auction, and all the bids submitted. Additional data sources are mentioned below.

With expanding international trade, the world's merchant fleet has grown steadily over the sample period, from 19,424 vessels in 1995 to 29,555 in 2010, an annualized growth rate of 2.8%; see Table 1. The table also reports the size of vessels (measured in deadweight tons, henceforth DWT) and their age, which are the main explanatory variables in our valuation estimates in Section 5 below. Vessel average size has increased through the sample period, but the fleet has aged slightly, increasing from 15.6 years to 16.1 years. Since the early 2000s the industry has seen an unprecedented boom, with the Baltic Dry Index (tracking world-wide charter rates in bulk carrying, mainly raw materials such as coal or iron ore), increasing more than four times before crashing to half its 2003 level shortly after the 2008 financial crisis. As Figure 1 shows, charter rates in the tanker business[4] have gone through a similar cycle, albeit of a less erratic nature. Figure 1 also plots a price index for vessels.

[**Table 1 about here.**]

[**Figure 1 about here.**]

3 Institutional Structure

As described above, the shipping industry has used the ex-territorial nature of its assets in order to distance itself from on-shore national bankruptcy laws. As a result, financial distress is largely resolved through the enforcement of debt contracts by a nexus of private, decentralized, differentiated and competitive market institutions. To achieve an acceptable standard of enforcement in a potentially chaotic and lawless environment, markets and contracts had to adapt. In this section we provide a detailed description of how the industry has adapted to this harsh environment. It is worth remembering that claims about poor adaptability played an important role in bringing about legal activism in the US, which provided the principal building blocks of Chapter 11 of the US bankruptcy Code. An understanding of the institutional structure is also important in the interpretation of the quantitative results that we derive in subsequent sections.

[4] We use the "Dirty tanker" index for crude oil.

3.1 Property rights

We begin with the industry's special ownership structure. A shipping operator is typically organized as a holding company with multiple subsidiaries, each one owning a single vessel. The legal separation of vessels within a holding company allows a lender to take collateral not only on the physical vessel but also on the shares of the company owning the particular vessel, referred to as a 'double mortgage'. We describe below how this double mortgage can, in the event of default, allow the lender to repossess a ship on the high seas without taking it into port and thereby incurring significant costs.

The registration of a vessel's property rights is made with a sovereign country and the vessel "flies" the flag of that sovereign. Though registration is a technicality, it is an important one since any mortgage on the vessel is recorded on the same register. It is not unknown for owners or lenders to find that their property rights have been tampered with in low-quality flags. As a result, lenders will often stipulate the country or flag of registration in the loan agreement.

So-called flags of convenience are countries providing an open registry of vessels for owners that have no other material connection. In many cases, they belong to nations too small to have any significant trading activity and which may be located far away from any maritime route.They charge an annual lump sum fee, which is often a significant source of income for such small economies. They also support a significant set of service providers, e.g. a domestic bar association. Effectively, flags of convenience are semi-private revenue-driven institutions that operate in a highly competitive environment. In 2010, 49% of vessels and 61% of the DWT capacity in our sample were registered with flags of convenience. For example, the Marshal Islands has a population of less than 100,000 people and an annual GDP/capita of about $9000. It is located in the Pacific Ocean (slightly north of the equator), away from any major maritime route. It has increased its registration from 66 vessels in 1995 to 1,378 vessels in 2010, constituting 5% of the world's fleet and 12% of the DWT capacity, which indicates the quality of these vessels.

3.2 Legal diversity

It is not uncommon for a vessel to be registered with a flag, for the ownership of the subsidiary to be incorporated in another country, and for the holding company to be incorporated in a third country. Sister vessels owned by the same holding company may fly a different flag, and their ownership may be incorporated elsewhere. More significantly, the loan agreement, where most of the contractual substance (e.g. repossession procedure) is specified, will typically submit to another law, often English or American. It may, however, specify that disputes are to be resolved by Singaporean arbitration. This may be done for reasons of expertise as well as expense. Then there are insurers, customers, bunkers (fuel suppliers), and other suppliers, whose contractual relationships with the operator are affected by the laws of their respective locations. Also, in the event of collision, salvage or arrest, the law of the port where the vessel is situated takes precedence. One might expect that such legal diversity would increase the incidence of coordination failures. We show, below, how the industry uses the choice of legal regimes, jurisdictions and means of enforcement to its own advantage, in order to resolve potential conflicts and obtain an effective resolution.

3.3 Arrest of vessels

An arrest followed by the repossession and sale of the vessel is the ultimate remedy that a creditor can use in order to obtain payment. Sometimes, the arrest is strategic, so as to improve the creditor's bargaining position or to deter the debtor from taking an action that would affect the creditor's rights on the vessel. We have much anecdotal evidence to indicate that banks avoid arrest whenever possible, so as to avoid direct costs and prevent vessel immobilization and thereby the loss of cash flows. The first course of action is for the bank to approach the distressed owner and use the threat of arrest in order to obtain payment. Typically, owners comply, and sell the vessel 'voluntarily', sometimes to a buyer found and even funded by the bank.

During the sample period, LLI reports 2,195 arrests. This is a small number relative to the $370,000$ vessel-years that are recorded in Table 1 above, a rate of about 0.6%. LLI narratives[5] reveal a variety of factors that provoke an arrest apart from financial distress: a drunken shipmaster, contraband, violation of international sanctions, fire, collision with another vessel, or disputes with suppliers. It is not always possible to distinguish financial from other factors that might trigger an arrest. For example, a client may have a vessel arrested on the grounds that the owner mishandled a cargo and caused damage. In such an event, it would be easy for a financially sound owner to find a bank that would guarantee payment, conditional on a ruling in favor of the client, and thereby quickly lift the arrest warrant. However, a distressed owner

[5]Based on a system of agents that Lloyd's has in major ports all over the world to report mainly insurance-related events.

may not be able to obtain such a guarantee, thereby prolonging the arrest and exacerbating its own distress.

Table 2 classifies arrests by trigger and resolution. The classification is made on the basis of LLI narratives in conjunction with other information such as a transfer of ownership. We can with confidence identify 538 arrests that are not directly related to debt collection, and another 803 arrests as being unlikely to be related, leaving 474 arrests as being definitely related to the failure to repay secured debt, as well as the wages of the crew. Of these 474 cases, 30% of the ships are auctioned and the proceeds distributed to the creditors. About 17% of all vessels arrested and auctioned end with the vessel being sold for scrap[6]. This indicates the low quality of the vessels under arrest, a matter on which we shall provide much elaboration below.

[**Table 2 about here.**]

3.4 Ports of arrest

To initiate an arrest, port authorities need to verify that the creditor has a valid contractual right to seize the vessel, execute a sale (if no settlement between debtor and creditor is reached) and distribute the proceeds among the creditors according to their priority. There are some material differences in procedures across ports. For example, some ports, such as Gibraltar, allow a sale by private treaty whereby the creditor identifies a buyer and the sale is executed without a public auction, at a price that the Admiralty Court considers fair on the basis of expert opinion. A sale by private treaty can be resolved in a matter of days. Other ports, such those in the Netherlands, accept only a public auction. There are also important differences in the speed of implementing the procedure, with some ports being more sensitive to the costs imposed by the immobilization of the vessel. Other ports are hopelessly corrupt and inefficient and are to be avoided by creditors at all costs. We are aware of a case where it took the creditor ten years to receive the proceeds arising from an arrest and auction in a particular port in Asia.

Six countries stand out for the effectiveness of their arrest procedure: Gibraltar, Hong Kong, Singapore, South Africa, the Netherlands and the UK. As a result, there are more arrests initiated by secured creditors[7] in these specialized ports, relative to the volume of traffic.[8]

[6] Most of vessel breakups are undertaken in poor countries like Pakistan or Bangladesh, often distant from the main maritime ports. As a result, owners may abandon a vessel under arrest, rather than bearing the costs of sailing it to a distant destination with the result of an extremely long resolution.

[7] The 474 cases identified above.

[8] Traffic data are taken from the Institute of Shipping and Economics Logistics (ISL), Bremen, for the years 2005-2008.

While their share in the world's cargo traffic is only 12%, these six ports have a 39% share in the arrest activity; see Table 3 which is based on our sample of 474 arrests identified as 'definitely related to the failure to repay debt'. In contrast, in some of the world's busiest ports, such as Japan, China or the USA, the arrest volume is small relative to the volume of traffic. The following cross-county regression provides a formal test:

$$N\_arrest_i = c + \underset{(2.34)}{0.30} \times volume_i + \underset{(8.46)}{2.97} \times D\_specialized_i + \varepsilon_i,$$

where i is a country index, N_arrest is the number of arrests, *volume* measures the volume of traffic and $D\_specialized$ is a dummy variable for the six ports above. $N = 55$, $R^2 = 0.59$ and t-statistics are in brackets below the estimators.

[**Table 3 about here.**]

Figure 2 plots a Kaplan-Meier (non-parametric) estimate of the duration of arrest, for the six specialized ports and the other remaining ports. A log-rank test is consistent with the hypothesis that the two groups differ significantly, at the 1% level (with a chi-squared statistic of 42.92), in the way they function. Clearly, arrest at a specialized port imposes significantly lower deadweight losses. Noticeably, both distribution functions are affected by a long tail; even at a specialized port an arrest can, in some extreme cases, drag on for up to three years. From the LLI narrative, the impression is that such prolonged arrests may be a result of technical problems, for example, a shipyard places a vessel under arrest so as to facilitate repossession in case the owner defaults on the repair bill. In other cases, a bankrupt owner disappeared and abandoned a vessel in port that had reached the end of its economic life rather than bear the cost of sailing it to a yard where it would be broken up and sold for scrap.

[**Figure 2 about here.**]

3.5 Contract adaptability

The results of Section 3.4 are consistent with the view that creditors frequently direct vessels to be arrested at an efficient port. Two contractual innovations (crew seniority and the double mortgage) play an important role in achieving this result. It is worth noting that the word innovation does not imply a recent introduction of the instrument; the maritime lien was introduced well before the twentieth century in some ports. Our focus here is not on the history and timing of the innovation, but on its specialized use in the shipping industry as a means of improving contract enforcement.

Crews have physical control of the vessel. If distressed owners refuse to cooperate with the bank, the collaboration of the crew is paramount. Since default is typically accompanied by wage arrears, the crew may no longer be loyal to the owner. The bank can thus contact the crew and direct them to sail the vessel to an efficient port for arrest and, if necessary, sale, promising to pay the wage arrears immediately once the vessel is in port. In addition, the lender frequently offers to pay the crew's flight to their home country. Though the arrangement benefits both bank and crew, there is a commitment problem: once in port, the bank can renege on its commitment. The problem is resolved by a maritime lien, a security interest that the crew has on the vessel. Since the maritime lien is senior to the mortgage, a port with a high standard of contract enforcement would prioritize wage arrears over loan repayment. To the best of our knowledge, shipping is the only industry where labor is senior to capital for commercial considerations. It is an interesting twist on theories of control, which predict that the party in control should be junior and hold a residual claim: see Klein, Crawford and Alchian (1978) and Grossman and Hart (1986). When the residual claim is out of the money the senior claimant has to write down some of the debt so as to bring the party in control back into the money to restore value-maximizing actions. Such renegotiation may be hard to implement when the physical communication between the bank and crew is imperfect. The alternative is to grant the crew seniority, at a time when the crew's contribution to the asset value becomes pivotal.

A second contractual innovation is the double mortgage. In this case, the bank holds both a mortgage on the vessel and a security interest in the shares of the registered owner. The first security is on the physical asset, i.e. the vessel, and the second is on the title to the vessel i.e. the shares of the company that owns the vessel. The procedure through which the bank can repossess the shares is specified in the loan agreement. We illustrate how the arrangement works using the case of Eastwind Maritime Inc., a New York based company owning, at the time of the loan agreement, some 90 vessels. The company went into bankruptcy on June 22, 2009. Nordea, a Scandinavian bank with an extensive portfolio of maritime loans, took security interests in 12 Eastwind subsidiaries each of which owned one vessel. To facilitate repossession, the board members of these subsidiaries pledged signed but undated resignation letters. When Eastwind failed to repay interest on their loans, Nordea declared them in default, signed the resignation letters, and appointed new directors, who promptly sold the shares in the twelve subsidiaries to Samama's Draften Shipping, a company controlled by the Ofer family. We are informed that the value of the proceeds of sale was more than $50 million dollars. The sale took only a few hours to execute and some of the vessels were on the high seas at the time. Crucially, the creditor did not have to instruct the crews to sail the vessels to a port to have them arrested and sold. The latter procedure would have taken more than one month, and the company's eventual entry into Chapter 7 of the U.S. Bankruptcy Code would likely have forestalled or delayed the sale of the ships.

3.6 Conflicts of jurisdictions

The structure of debt in the shipping industry, and the fact that ships sail the high seas both mitigate the effects of judicial activism of on-shore bankruptcy procedures. However, the separation is imperfect, and the friction between the contract and national bankruptcy law may be a source of conflict and contractual failure. The Eastwind case highlights these frictions.

Nordea's repossession of the twelve vessels took place just hours before Eastwind's subsidiaries filed for bankruptcy under Chapter 7 of the US code in the Southern District of New York. Almost certainly, Nordea heard rumors that such filing was imminent.[9] The events that followed make clear how essential the early repossession of the ships was for Nordea. Upon filing for Chapter 7, a trustee was appointed by the court and a stay was imposed on all of Eastwind's assets. The trustee challenged the repossession of the vessels by Nordea and the subsequent sale, and claimed that the ships belonged to the bankruptcy estate. The dispute was settled in favor of Nordea although they had to pay $750k to the trustee. In return, the trustee acknowledged the validity of the repossession and accepted that the Eastwind subsidiaries "lacked appropriate authority" to file for bankruptcy.[10] Had Nordea delayed the sale, the automatic stay would have applied and the bank's collateral would have been weakened. This is clear from another decision in the Eastwind case. Some vessels were insured in the UK and those contracts were written under English law, with clauses stating that the insurance would terminate in the event of the bankruptcy of the insured. The trustee in Chapter 7 litigated against the insurers, arguing that under US law they were obliged to extend the insurance until the bankruptcy procedures were completed. His reasoning was that without insurance the vessels could not leave port and those on the high seas would have had to terminate their voyages. While recognizing that an English court would be likely to rule in favor of the insurer, the US court ruled in favor of the trustee.

[9]The fact that Eastwind was an American company is not relevant. Any debtor with assets in the US can file for US bankruptcy. In re Theresa McTague, Debtor, 198 B.R. 428. July 15, 1996, a precedent was established to the effect that a non-US company holding a US bank account with $194 qualifies.

[10]The court's decision (case No. 09-14014-ALG, US bankruptcy court, Southern District of NY) is limited to confirming the settlement and, thus, has no detail on the substantial arguments for or against the legality of the repossession.

The judge also dismissed the insurers' claim that "they did not anticipate such a result" on the grounds that with "more than 30 years experience with US bankruptcy law" they should have been aware of such an event and accounted for the consequences.[11] The insurer could have ignored the court's decision, except for the fact that it had other business interests in the US and these would have been at risk if the judge found the insurer in contempt of the court.

4 Coordination failures and the deadweight loss of vessel arrest

In a world that operates according to Coase's Theorem, a company that exhausts its capital might be forced to de-leverage and sell assets to a better capitalized one. However, such sales and de-leveraging should be accomplished without any disruption to operating performance. In this respect, any arrest is a coordination failure, since the vessel is immobilized and ceases to earn income. In this section we provide more systematic evidence that tests Jackson's (1986) common-pool hypothesis. We document the magnitude of vessel arrests and examine the hypothesis that a creditors run explains the state of financially distressed companies. To motivate our quantitative analysis, we re-examine Eastwind's decline and bankruptcy.

4.1 Eastwind's cycle of distress

Our data provide precise dates when ownership and arrests started and ended allowing us to track Eastwind's cycle of distress on a daily frequency. The top line in Figure 3 tracks the company's total capacity (in millions of DWTs) while the bottom line tracks capacity that is immobilized due to arrest. The two time series are plotted against "bankruptcy time", with zero being the day of the Chapter 7 filing. Several points merit discussion. Firstly, vessels were arrested during Eastwind's distress and bust episode, although the magnitude of the deadweight loss seems to be quite limited. Secondly, there is evidence that a substantial amount of vessel sales (i.e. downsizing) was achieved without any arrest: Eastwind started divesting capacity a year before it filed for bankruptcy, with very little arrest activity. Over the entire cycle, Eastwind divested some 1.5 million DWT, while the capacity under arrest amounted to some 0.2 million DWT-years. Hence, on average, 13% of the downsized capacity was immobilized for one year. Thirdly, throughout Eastwind's decline, capacity under arrest was well below total capacity. Even at its peak, a few months after the Chapter 7 filing, the arrest to total capacity ratio was well below 100%. This finding is not consistent with standard theories of a creditors

[11] Re Probulk Inc., Bankruptcy Court, Southern District of NY, Bankruptcy No. 09–14014–ALG.

run, whereby creditors driven by a first-mover advantage would grab any asset that has not already been seized by another creditor. It is consistent, however, with the view that once property rights are efficiently allocated to different mortgages and properly prioritizing all other creditors, runs do not occur because no creditor can "jump the queue" by grabbing an asset.

[**Figure 3 about here.**]

4.2 Immobilization across the industry

We extend the previous analysis to the entire sample of distressed firms. On an industry level, the magnitude of vessel arrests is very small. Figure 4 plots the amount of immobilized capacity as a percentage of total industry capacity, measured in DWT. We exclude from the measure non-financial arrests, namely those with an "other" trigger (see Table 2 above). The bottom (red) line also excludes the bankruptcy of Adriatic Tankers, a sizable Greek operator that went bust following a labor dispute, and some ex-soviet companies that went bankrupt with old and sub-standard fleets following the break-up of the Soviet Union. Even at times of severe slowdown, barely 0.4% of industry capacity is immobilized. Over the entire sample period, the immobilization to capacity ratio is about 0.2% on average; see table 4 below. This compares with annual levels of corporate defaults and formal bankruptcies of 1.9-2.2% in the UK and France (see Davydenko and Franks (2008)).

[**Figure 4 about here.**]

We now examine the extent to which industry arrests are triggered as a result of financial distress and co-ordination failures. Traditionally, bond default is used as a proxy for financial distress. However, many shipping companies rely on mortgages rather than publicly traded bonds; mortgages are not rated and the status of default is at the discretion of the lender, usually a bank. Often the bank will restructure a distressed company's debt without declaring it in default. As a result, we provide another proxy to measure a company's financial distress, based on two indicators. First, a company is defined as distressed if there is a reduction of 50% in its DWT fleet capacity measured over a five-year period; we refer to this as a "downsizing". Second, we impose a stricter measure, when "downsizing" is accompanied by at least one arrest.

Formally, company i is classified as distressed, in year y, if it has downsized by 50% (or more) relative to peak capacity during the previous five years:[12]

$$\frac{capacity_{i,y}}{max\left\{capacity_{i,y-5},...capacity_{i,y-1}\right\}}\begin{cases} \leq 0.5 : \text{distress year} \\ \\ > 0.5 : \text{ non-distress year} \end{cases}. \tag{1}$$

where $capacity_{i,y}$ denotes the capacity of company i in year y, measured in DWT. Once year y is defined as distressed, all of the previous five years are also defined as distressed. The denominator, $max\left\{capacity_{i,y-5},...capacity_{i,y-1}\right\}$, is termed $peak\_capacity_i$, namely the maximum capacity of the company i over the previous five years. The variable $trough\_capacity_i$ is defined similarly, that is, the lowest capacity over the previous five years.[13] For a given company, a distressed episode is defined as a sequence of all distressed years.[14] We define company i as "bust" if the distressed episode ends with the firm disappearing from the ownership register. If the company disappears from the ownership register without being in financial distress beforehand, it is not considered "bust". Rather, we consider it as having disappeared due to a merger or a voluntary liquidation, unrelated to distress. We also apply an additional test to a bust company: that it should have experienced at least one arrest. The definition of bust, deliberately, ignores the legal mechanism through which the company ceases to exist, whether it enters a formal bankruptcy procedure or undertakes a restructuring outside formal procedures, i.e. a workout.

Our procedure yields $3,063$ distress episodes, of which $1,103$ constitute a bust (see Table 4). The probability of bust conditional on distress is about 13.4% (273 divided by 2,040) compared with 36% (1,103 divided by 3,063) when calculated on DWT capacity rather than on distress episodes (see Table 4)[15]. DWT gives a higher probability of distress because bust companies

[12]Missing values are replaced by zeros.

[13]Only a very small number of companies have two episodes of distress.

[14]As an example, assume capacity for a series of years is 100, 90, 80, 70, 40, 40, 40; the first distressed year is year 5 (since 40/100 is <50%). The two subsequent years are also distressed years because in each case that year's capacity is less than 50% of the maximum capacity of the previous 5 years (40/100 and 40/90, respectively). Thus, the distressed episode includes seven years. The maximum capacity is 100 and the trough capacity is 40. The number of arrests is summed over all 7 years.

[15]If we restrict the analyses to arrest events triggered by financial reasons, the corresponding probability of arrest in the non-distressed population, is extremely small: 0.03% (0.05%) when capacity is measured in DWT-years (vessel years). Conditional on financial distress, the corresponding probabilities increase to 0.65% (0.95%). Conditional on bust, the corresponding probabilities increase further to 2.07% (3.26%). The patterns are similar to those using data on all arrests. We use the full set of arrests since most of them (more than 60%) do not have a clearly identified trigger in our data.

tend to own smaller vessels and therefore have lower DWT capacities than the average vessel involved in distress episodes. Arrested vessels have a capacity of one half of the population's average DWT. We shall return to this point in the fire-sale analysis, below.

The arrest statistics in Table 4 include all arrests in the sample, regardless of the triggers identified in Table 2 above. Panel A describes the probability of arrest based on all the vessels in the sample. As reported earlier, the unconditional probability of an arrest is very low (only 0.21% using DWT). Panel B reports the probability of arrest for the population of vessels partitioned by the occurrence of distress. As can be seen, the probability of distress in the non-distressed population is extremely small: 0.13% (0.25%) when capacity is measured in DWT-years (vessel years). Conditional on financial distress, the corresponding probabilities increase more than five-fold to 0.69% (1.29%). Panel C further partitions the distressed sample into companies that went bust and those that did not. Conditional on bust, the corresponding probabilities increase further to 3.29% (6.19%). There are no significant differences in the average duration of arrest and the average size of vessels arrested for the two samples of "bust" and "no bust" companies reported in Panel C.

[**Table 4 about here.**]

The main insight from the previous analysis is that arrest is a proxy for a coordination failure, it is a relatively unusual event, with its likelihood increasing modestly upon distress, and then dramatically upon bust. To further analyse this issue, we estimate $\Delta capacity_i$ which denotes the difference between $peak\_capacity_i$ and $trough\_capacity_i$, while $imob_i$ is the aggregate amount of capacity under arrest over the entire duration of an arrest episode i (same definition as in Table 4). Notice that $\Delta capacity$ is measured in DWT while $imob$ is measured in DWT years. *Dbust* is a dummy variable that receives a value of 1 if the distress episode ends in a bust and 0 otherwise. We normalize the population by deflating both sides of the equation by $peak\_capacity_i$, so that the main explanatory variable is the percentage of the company's fleet downsized. Since, by definition, downsizing in bust is 100%, γ has the interpretation of a dummy slope.

$$\frac{imob_i}{peak\_capacity_i} = \alpha + \beta \frac{\Delta capacity_i}{peak\_capacity_i} + \gamma Dbust_i \frac{\Delta capacity_i}{peak\_capacity_i} + \varepsilon_i. \quad (2)$$

Results are reported in Table 5 below. The first and the second columns report, respectively, the results without and with *Dbust* as explanatory variable.

[**Table 5 about here.**]

In column 2 of Table 5, we find that the $\Delta capacity$ coefficient is not statistically different from zero, and that arrests are largely driven by companies which are bust. This finding is consistent with the hypothesis that surviving companies, even when in financial distress, have an incentive to cooperate with their secured creditors. On average, 24.8% of vessels sold under distress are arrested for one year. This evidence is consistent with the hypothesis that bust companies have a weaker incentive to cooperate with their creditors in minimizing the loss of value in financial distress.

Though the high incidence of arrest is consistent with the dysfunctional-owner hypothesis, it is also consistent with the creditors-run hypothesis. We apply the same test that we have used in the Eastwind case to rule out a creditors run, that is a run should be accompanied by an arrest rate of 100% of remaining capacity; if the arrest rate is consistently below total capacity throughout the cycle of distress we can rule out a run. Hence, denote the daily capacity (under arrest) on day d of episode i by $capacity_{d,i}$ ($imob_{d,i}$) and further denote the ratio of the latter over the former by $daily\_arrest\_rate_{d,i}$. For each company that went bust, we scan the entire distress episode to identify the maximum daily arrest rate, $max\left\{daily\_arrest\_rate_{d,i}\right\}_d$. Arguably, we are less interested in high arrest rates that took place close to the end of the cycle of distress, when virtually the entire fleet is likely to have been sold off. To mitigate this concern, we truncate the series $\{daily\_arrest\_rate_{d,t}\}$ at the point where $capacity_{d,i}$ is 25% of $peak\_capacity_i$. The results are reported in Table 6 below. We also report the $mean\{daily\_arrest\_rate_{d,t}\}$ averaged over a 91 day window around the maximum, to avoid the problem where the arrest rate is very high for a very short period. Of 1176 bust episodes[16], 870 had no arrests at all. For another 97 we can reject the hypothesis of a creditors run on the grounds that the arrest rate peaked below 100%. That number increases to 167 once we tighten the test for a run requiring a 100% daily arrest rate averaged over an extended period of 91 days. That leaves us 209 suspected runs for a maximum daily arrest rate and 139 for the one averaged over 91 days. A closer look, however, reveals that in 189 cases out of the 209 cases the companies had, at that stage of their decline, only one vessel left. Excluding these cases, we conclude that there is sufficient evidence to exclude a creditor's run for 98% or 99% of all bust episodes. Only in $1\% - 2\%$ of bust episodes can we conclude that a creditors run can explain the level of arrests; in all other cases it is likely to be caused by disfunctional owners.

[Table 6 about here.]

[16]In this process, we lose a few observations where capacity dropped so fast that we could not identify the point where the company crossed the threshold.

4.3 Direct costs of arrests

While the loss of income is the main cost of immobilization, it is not the only one. There are additional direct costs due to port fees, crew wages and supplies, court costs, brokerage fees etc. The existence of these additional fees does not change the analysis: in a perfect Coasian world there would be no arrests and, therefore, no additional costs of arrest. For the sake of completeness, however, we used the files of the Admiralty Marshall (the agency responsible for executing arrest warrants) in London to hand collect data for 22 vessel arrests in England over the 1995-2010 period. The results are described in Table 7: the median period for which the vessel was immobilized for was 71 days or about two months (much lower than the sample mean). The median direct costs of arrest are 8% of the sale price. Consistent with the observation that arrested vessels tend to be small, the average sale value of a vessel is only $1 million, compared with an average value of ships sold of $9 million dollars. The costs of immobilization are not small particularly when account is taken that they do not include the loss of any income forgone during arrest.

[**Table 7 about here.**]

5 Estimating the Fire Sale Discount

LLI's arrest narratives, which we have used in order to classify arrests by trigger and resolution (see Table 2 above), make frequent references to the poor technical condition of arrested vessels: "auxiliary engines and boiler trouble", "ingress of water into engine-room; hull in bad condition; cargo holds water contaminated", "cracks in hull", "survey revealed unseaworthiness", "bottom damage requiring considerable steel renewal" etc. These descriptions suggest that one aspect of Myers (1977) underinvestment problem is poor maintenance of assets. They also suggest that the standard technique of measuring the fire sale discount, developed by Pulvino (1998) may be biased as it does not take into account the poor quality assets in fire sales, a concern that has already been raised by Campbell, Giglio and Pathak (2011): "this confirms the suspicion that much of the estimated price effect is not directly related to the urgency of the sale, but results from unobserved poor maintenance" (p. 2119). In this section, we develop a formal econometric technique that allows us to decompose the "raw" fire sale discount, as measured by Pulvino, into a quality (maintenance) component and a liquidity component.

We identify the quality of a vessel through a duration analysis that measures the vessel's "life expectancy", that is the expected number of years of service until it is scrapped (or "broken up" in industry jargon), conditional on its "registered age", that is the number of years since it started service. We first demonstrate that the remaining life of vessels under arrest is shorter than that for equivalent non-arrested vessels. Put differently, the effective age of an arrested vessel is roughly 1.7 years older than its registered age. Using a hedonic price regression, we convert this higher effective age into a price discount.[17] It turns out that about half of the raw fire sale discount is due to poor maintenance. We will refer to this issue in the next sub section.

5.1 Hedonic Regression

To calculate the fire-sale discount, we need the counterfactual sales price of a given arrested ship, i.e., assuming it has not been involved in a forced sale. We apply our technique in two stages. In the first stage, we estimate a hedonic model (characteristics-based approach) to calculate a ship's benchmark price. The equation is given by:

$$log(Price)_{ijt} = \beta_j + \beta_t + \sum \beta_i X_{it} + \epsilon_{ijt} \qquad (3)$$

where $Price_{ijt}$ denotes the price of vessel i of type j transacted in period t. β_j and β_t denotes ship-type and year fixed effects. X_{it} denotes a vector of both technical characteristics (such as DWT, vessel length, breadth, freeboard and draft) and transaction characteristics (such as whether the transaction was part of a block sale of several vessels and the age of the vessel at sale). Definitions of vessel-related variables are provided in the appendix. The results are reported in column 1 of Table 8. An R^2 of 88% indicates that the predicted ship price from the hedonic model can serve as a good benchmark.

A key innovation of this study is that it controls for the quality of the ship at the time of sale, by including the imputed life expectancy of the ship in the hedonic regression. We can only make this correction because ships have a finite life and are eventually broken up[18]. The

[17] Hedonic prices are estimated using some 20,000 vessel transactions, controlling for a large number of technical characteristics such as vessel type, size, age etc. Commercial vessels are relatively homogeneous, which allows for a reliable estimate.

[18] Such a correction would be difficult in housing because houses do not usually die.

expected future life expectancy given that the ship has survived until t_0 is defined as:

$$\frac{1}{S(t_0)} \sum_{t=t_0}^{T} S(t)$$

where $S(t)$ is the Kaplan-Meier Survival function. Therefore, the values of the life expectancy characterize how many years the ship will remain alive given the age at sale. The survival function is defined as:

$$S(t) = Pt(T > t) = \int_t^{\infty} f(u)du = 1 - F(t)$$

The corresponding hazard rate is

$$hazard(t) = \frac{f(t)}{1 - F(t)}$$

where $f(t)$ is the probability density function and $F(t)$ is the corresponding cumulative density function at the time of vessel death. Using the above method, we calculate the life expectancy and hazard rate separately for both the arrested and non-arrested groups. It should be noted that in calculating the hazard rate, we pool all ships together irrespective of their type. We find that for a ship at any given age, the probability of a breakup, i.e. hazard rate, is higher for arrested ships relative to non-arrested ships, as plotted in Figure 5. In robustness tests, we estimate a cox proportional hazard model that allows us to partially control for the characteristics of ships. We find that the life expectancy correction is virtually unaffected when we include the new life expectancy calculated from the predicted hazard rate after running the cox regression. The relevant methodology is described briefly in the appendix.

[**Figure 5 about here.**]

In column 2 of Table 8 we add the derived "Life expectancy" variable to the hedonic price regression. It shows that an extra year of life expectancy commands a 7.5% higher price and is significant at the 1% level, confirming the importance of imposing a quality correction.

[**Table 8 about here.**]

In the second stage, the dependent variable is calculated using the following equation:

$$e^{\hat{\epsilon}_{ijt}} - 1 = e^{log(Price_{ijt}) - log(\hat{Price})_{ijt}} - 1 = Price_{ijt}/\hat{Price}_{ijt} - 1 \tag{4}$$

where $log(\hat{Price})_{ijt}$ is the predicted benchmark price and is equal to $\hat{\beta}_j + \hat{\beta}_t + \sum \hat{\beta}_i X_{it}$ (equation 3), and $\hat{\epsilon}_{ijt}$ is the residual from the first stage regression using equation 3. In this way, the dependent variable is simply the price discount of a ship based on its benchmark value, as shown in equation 4. We further regress this variable on a dummy indicating whether a ship is arrested, to derive the fire sale discount on arrested ships.

In Table 9, we report the price discount on various categories of ship transactions. In column 1 we examine the fire sale on arrested ships and find that, on average, arrested ships are sold at a discount of 25.9% relative to normal ship transactions. These estimates are quite similar to those that have been reported in Pulvino (1998). In column 2, where we control for the quality of the ship by adding life expectancy of ships (with QC), this discount reduces to 13.4%, suggesting that roughly half of the fire sale discount is driven by differences in quality of ships, which we interpret as maintenance-related. In terms of life expectancy this roughly corresponds to an average difference of 1.7 years[19] in life expectancy, with arrested ships having a lower life expectancy. [20]

In columns 3 and 4, we calculate the fire sale discount on ships that are all sold by distressed owners, whether they have gone bust or not. The variable "Distressed" is an indicator variable that takes on a value of 1 if the firm has undergone a 50% decline in capacity in the last 5 years and is 0 otherwise (same definition as in section 4). We find the raw fire sale discount for distressed owners to be 4.1% and it slightly drop to 3.5% when we control for quality.

The small quality discount suggests that under-maintenance does not seem to be a significant issue for ships which belong to distressed owners but which are not arrested. In columns 5 and 6, we include both the arrest and the distress indicator variables in our regressions and find that virtually the entire quality discount is driven by arrested ships. The overall discount for arrested ships decreases from 26.1% to 12.1% when one controls for the quality of ships. The fire sale discount for distressed ships is around 3.3% and is mostly unaffected by any quality correction. The implication is that distressed owners do not skimp on maintenance, possibly because they believe more in the potential for recovery and they plan to sell their ships in an orderly fashion.

[**Table 9 about here.**]

[19]This can be calculated by $(25.9\% - 13.4\%)/7.5\% \simeq 1.7$.

[20]It is important to note that the difference in quality is not correlated with the length of a vessel's immobilization period in port, suggesting that the under-maintenance effect does not occur post arrest.

In summary, we find that arrested ships generate a raw fire sale discount of roughly 25%, which is similar to what has been documented in prior studies. Interestingly, however, we find that as much as half of this discount is due to the unobserved quality of arrested ships. Moreover, the fire sale discount with or without quality correction, is not significant for vessels that are sold by distressed owners, but are not arrested. In the next sub section, we explore some other determinants of the fire sale discount.

5.2 Other determinants of the fire sale discount

In the previous sub section, we documented that roughly half of the discount was driven by quality differences between arrested and non-arrested sales. Even after controlling for quality the discount is quite large at between 10 and 13%. The analysis above gives equal weight to all vessel sale transactions. In other words, a fire sale discount on a 100 million dollar LNG (liquefied natural gas) tanker is treated similarly to a fire sale discount on a 10,000 USD bulk carrier. So if the fire sale discount on the 100 million dollar vessel is 0% and the fire sale discount on the 10,000 USD is 40%, the average discount (equally weighted) would be 20%. The value weighted discount, however, is very close to 0%. Thus, while an equally weighted discount provides us with a useful metric to gauge the extent of loss, a value weighted fire sale discount provides a better indication of the extent of overall economic loss. Before we report the price weighted results it is important to note that the median price of the arrested ship is significantly lower than the median price of a transacted ship (3.3 million USD vs. 9.0 million USD). In Figure 6, we show the distribution of values of ships sold under arrest and those sold privately. Obviously the ships sold under arrest command a much lower average value.

[**Figure 6 about here.**]

In Table 10, we report the price weighted fire sale discount. In columns 1 and 2, the price weighting reduces the entire fire sale discount to only 5.1% and it is not statistically significant. In columns 3 and 4, we conduct additional cross-sectional tests to investigate the heterogeneity in the fire-sale discount documented above. This test examines how the fire-sale discount varies with institutional differences such as the quality of the ports. We expect that the low quality of a country's jurisdiction will add some additional costs that the buyer of the vessel might face following the sale, such as higher port charges, payments to suppliers and crew, and any side payments (bribes) to officials. An arrested ship can be sold within six weeks of the arrest in an efficient port while the period of immobilization may take years in an inefficient port (average days of arrest are 213 for corrupt ports and 142 for less corrupt ports). For this purpose, we use a country corruption index described below. We would expect the fire sale discount of the arrested ship to be positively correlated with the corruption index. For a corruption index, we use the one devised by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1999) which has a range from 0 to 10.

We split the data regarding arrested ships into two sub samples, depending on whether they were arrested in high or low corruption countries. A cutoff of 7.9 was used to separate the two samples, and provides the following two groups of countries. The high corruption countries include: the Bahamas, Chile, Cyprus, Greece, India, Italy, Malaysia, Malta, Mexico, Panama, Sri Lanka, Trinidad and Tobago, Turkey and Venezuela. The low corruption countries include: Australia, Belgium, Canada, Denmark, France, Germany, Gibraltar, Holland, Hong Kong, Israel, Japan, Montenegro, the Netherlands, the Antilles, South Africa, Singapore, Tahiti, the UK and the US. As can be seen in Table 10, ships arrested in countries with less corruption (above the average of 7.9 for the corruption index), incur a smaller fire sale discount: 11% in low corruption countries compared with 21.4% in high corruption countries; this difference is statistically significant (at the 10% level) and economically significant (columns 3 and 4). In columns 5 and 6, we redo the analysis, but this time we run a price weighted regression instead. We find that while there is a fire sale discount in the high corruption ports, the firm sale discount virtually disappears (3.1% and not statistically significant) in low corruption ports.

[**Table 10 about here.**]

Another interesting observation is how the fire-sale discount varies with business cycles in the shipping industry. As argued by Shleifer and Vishny (1992), due to a decrease in the number of potential buyers when the industry environment is unfavorable, the fire-sale discount can be higher than that in the boom years. To test this hypothesis, we split the data of all ship sales into two sub-samples (good and bad), depending on whether the Baltic Dry Index (BDI) in the year of ship sale is above or below the median during 1995 and 2010. The results are displayed in Table 11. We can see from column 1 that in the relative boom years, the fire-sale discount for arrested ships is 16.7% without a quality correction in the first stage. If we add in quality correction, the discount disappears and is insignificant, as reported in column 4. In contrast, when the industry struggles, the discount is significantly higher, reaching 28.1% in column 2. Even if we control for quality of the ship in the first stage, it is still as high as 16.5%, as shown in column 5. Results in columns 3 and 6 confirm the statistical significance of the difference in fire-sale discount during the booms and recessions. It should be noted that the analysis presented above is based on a small sample size, which explains some weak statistical significance in columns 3 and 6.

[**Table 11 about here.**]

In summary, the raw fire sale discount in our paper is very similar to the fire sale discount that has been documented in Pulvino (1998). On decomposing the fire sale discount, we find that about half of this discount is due to quality differences between arrested and non-arrested ships. Furthermore, the discount seems to be concentrated in lower valued ships. A value weighted regression estimate further reduces the discount to roughly 5%. A cross-sectional analysis reveals that higher valued ships arrested in less corrupt ports carry a very small discount.

5.3 Auctions

An important result in this paper is that auctions of arrested ships result in low fire sale discounts after corrections for under-maintenance and for low quality ports. A key issue here is how efficient the auction process is in high quality ports. One aspect of efficiency is the number of bidders for a vessel that is being auctioned. Using the same hand-collected sample of UK auctions used in Table 7, Table 12 shows that the average number of bidders is high at 8, which is consistent with the view that the second-hand vessel market is liquid. In one case, the number of bidders reached 23. The bids come from all over the world. This may reflect the small sample. However, the spread between the top two bidders is quite significant: 24% on average.

[**Table 12 about here.**]

6 Conclusion

Shipping provides an important laboratory for testing Hayek's natural experiment in "spontaneous order". Because ships move from one jurisdiction to another, and may "go bust" on the high seas outside any country's territorial waters and jurisdiction, the creditor (with or without the debtor's assistance) can arrest and auction a ship at a maritime port. Ideally, they will wish to choose the port of arrest to minimize costs. The proceeds from the auction will then be used to repay creditors, according to the laws of that jurisdiction.

There are two important qualifications. First, creditors of shipping companies rely on maritime courts to arrest ships, in the event of default, and auction them in a timely and cost efficient manner. Thus, enforcement plays an important role for the courts. Second, the courts of some countries, for example the US, may sometimes try to thwart the arrest or auction of ships in foreign ports, where the debtor is in some way connected with the US and seeks protection under Chapter 7 or Chapter 11 of the 1978 Bankruptcy Code. However, the exercise of US "imperium" in shipping bankruptcies can and has been mitigated by contractual innovations, as illustrated in the case of Eastwind.

This paper has addressed the question of how costly bankruptcy procedures are. These procedures have largely evolved out of private commercial contracts, with the courts playing little more than the role of contractual enforcer. There are three measures of costs. First, how frequently do creditors of distressed and defaulting shipping companies resort to the bankruptcy procedure of arrest and auction in maritime ports? We find a relatively low proportion of arrests, with the debtor frequently resorting to the private sale of ships. Only when the debtor seems to have run out of cash, or when the ships are of such a low value that the debtor or owner's equity is far out of the money, do we find arrests and forced sales taking place. This is evidenced by the value of arrested ships which is far below the median value of ships sold by non-distressed companies. The value of those forced sales is frequently close to, or at, "break up" value.

Second, using a hand-collected sample of ships arrested and auctioned in UK ports, we find that the direct costs of arrest and sale are around 8% of the proceeds of auction. The arrests are triggered by the mortgage holder, crews (who are owed wages) and unsecured creditors including suppliers to the ships. The costs vary with the value of the ship, suggesting a fixed element.

The third cost is the "fire sale discount". Following Pulvino (1998) we might expect a significant discount from the arrest and forced sale of ships due to the illiquidity of the market for second-hand ships. We find a discount of 26% on average compared with ships of similar age and use. This is very similar to the discount estimated by Pulvino. However, we also find that ships which are arrested and sold are of lower quality than comparable ships sold outside distress. In forced sales, ships tend to be under-maintained and are therefore of lower quality. In effect this lower quality is equivalent to an age premium of 1.7 years compared with sales by non-distressed companies. Adjusting for this factor reduces the discount from 26% to 13%. This average discount is for ships sold in both inefficient and efficient ports. As a proxy for efficiency, we have used La Porta et al's (1999) corruption index. When we re-estimate the index for arrests and sales at low corruption ports we find the discount is 11%, compared with 21% for high corruption ports.

Finally, we explore how the discount varies with the price of ships. Our results suggest that where the price is above the median value of arrested ships, the discount virtually disappears. The fire sale discount of 11% is almost wholly concentrated in ships with values well below the median. The evidence is that these low valued ships are frequently close to the end of their economic life and are frequently purchased by "breakers" who will tow the ship to Pakistan or India to be sold for scrap. The overall conclusion from this evidence suggests that in terms of distress and bankruptcy the shipping industry passes Hayeck's test of "spontaneous order".

The question remains, however, of the extent to which these results might extend to other industries. Do we need Chapter 11 type reorganizations to mitigate the risk of fire sale discounts (one of the motivations for the original legislation)? There are several important features of the shipping industry that may contribute to an efficient resolution of distress without the aid of complex bankruptcy procedures: the fact that ships consist of discrete assets which allow them to be separated from each other for the purposes of limited liability and collateral, the fact that assets can be marketed to potential buyers around the world thereby increasing the liquidity of the market for second-hand ships, and that the intangible value of a ship may be relatively low compared with other assets. There may be other industries which exhibit similar characteristics to shipping, such as real estate, oil and gas, and mining companies. However, there are many industries where asset complementaries make the segregation of assets more difficult. In this respect, we would be cautious in generalizing our results to other industries. Nevertheless, even here we might speculate that contractual innovations and well-developed capital markets might mitigate many of the costs claimed as justifying a highly active bankruptcy code.

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A Appendix: Vessel-related Variables

Age: Year since year of build at sale.
Block: Indicator which equals to 1 if the vessel is part of a block sale of several vessels, and zero otherwise.
Special Unit: Types of container units, including dry storage container, tanks, drums, car carriers, etc.
DWT: Deadweight tonnage of a vessel.
Gross Weight: The weightof the cargo plus theweightof the container, trailer,shipmentor packaging.
Length: The maximum length of a vessel's hull measured parallel to the waterline Breadth extreme The maximum breadth including all side plating, straps, etc.
Depth: The vertical distance between the moulded base line and the top of the beams of the uppermost continuous deck measured at the side amidships.
Draft: The vertical distance between the waterline and the bottom of the hull (keel), with the thickness of the hull included.
Freeboard: The vertical distance from the waterline to the upper deck level.

B Appendix: Life Expectancy Estimates from Cox Regression

In the main specification, life expectancy is calculated separately for the arrested and the non-arrested group, based on the distribution of vessels' age at death, regardless of their characteristics. We can also calculate the ship-specific life expectancy after using Cox regression. Cox relative hazard regression yields estimation for coefficients ($\hat{\beta}$) on ship characteristics (X) and baseline hazard rate ($h_0(t)$). Therefore, $h_0(t) \times e^{\hat{\beta}' X}$ gives the predicted hazard rate for each ship, taken into effects of ship-specific characteristics. We can further calculate ship-specific life expectancy based on the post-Cox predicted hazard rate. Concerned about the fact that there may be too much noise in the above predicted hazard rate and hence the new ship-specific life expectancy measure, we group vessels according to their vessel type (bulk carrier, fully cellular container, reefer, general cargo tramp, etc). Because of this grouping procedure, we state in the paper that we "partially" control for the characteristics of ships. We use several methods to group the vessels in order to reduce the noise in the estimation, and the main findings are robust to those different specifications.

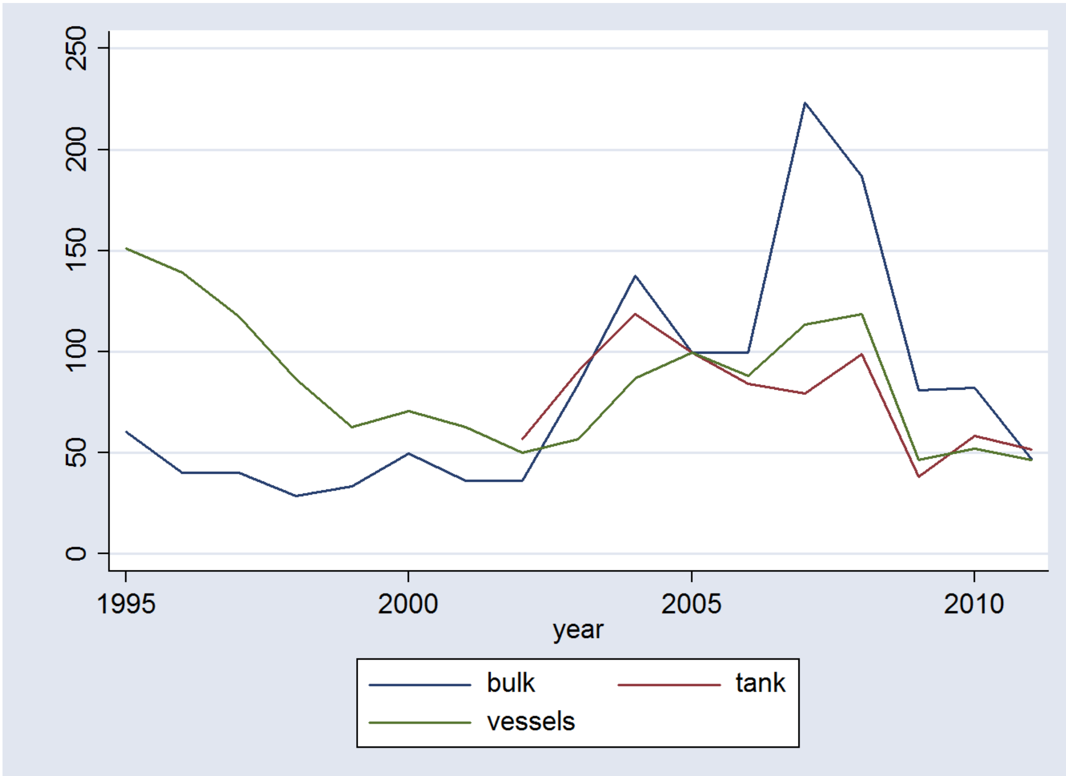

Figure 1: Charter Rates and Vessel Price Indexes, $P_{2005} = 100$. In this figure, we show the charter rates in the tanker business and the price indexes of vessels from 1995 to 2011.

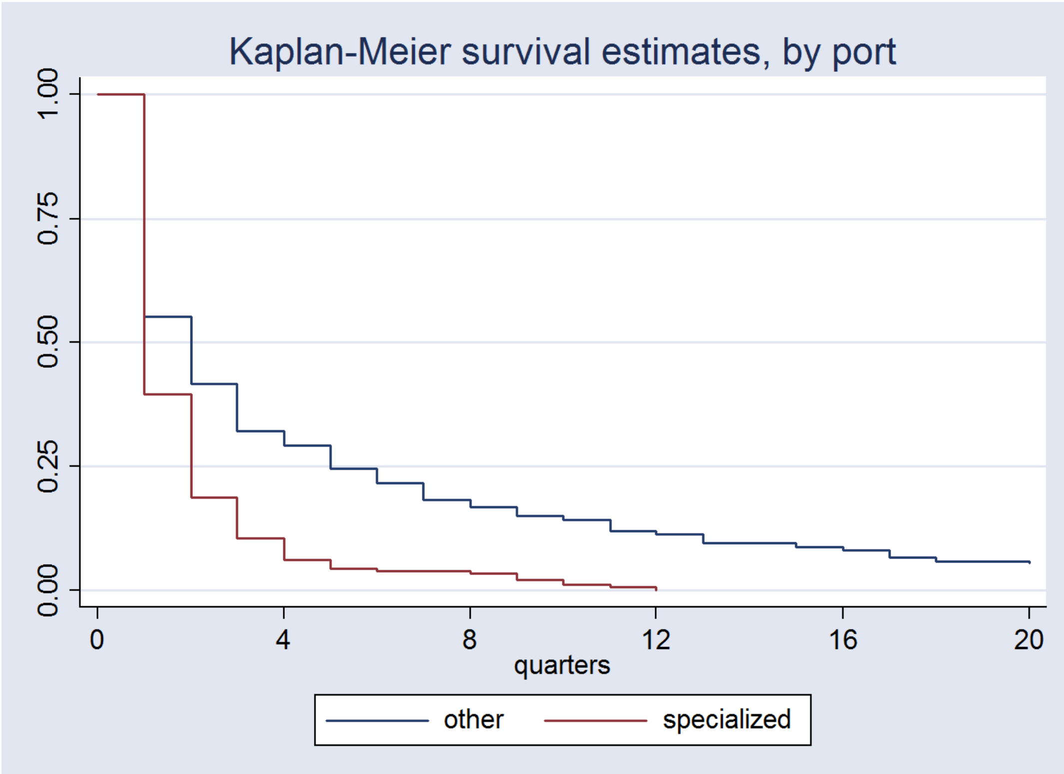

Figure 2: Duration of Arrest in Specialized and Other Ports. In this figure, we plot a Kaplan-Meier (non-parametric) estimate of the duration of arrest, for the six specialized ports and the other remaining ports.

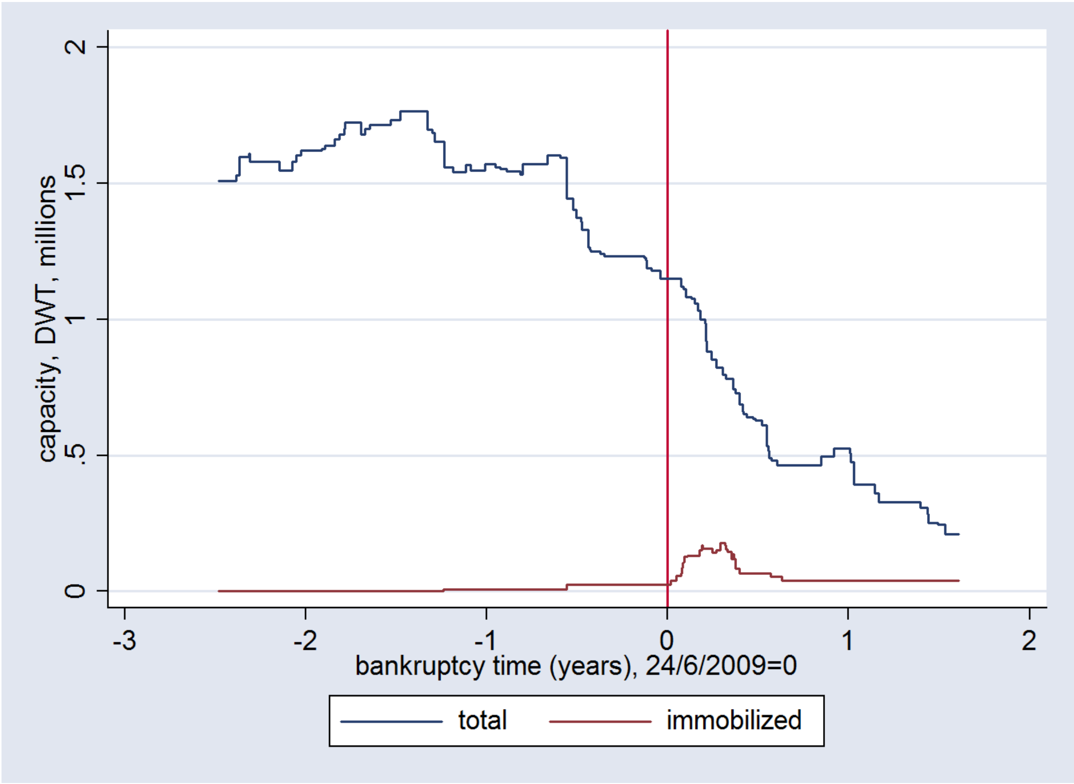

Figure 3: Eastwind's Cycle of Distress. In this figure, we track Eastwind's cycle of distress on a daily frequency. The top (blue) line tracks the company's total capacity (in millions of DWTs) while the bottom (red) line tracks capacity that is immobilized due to arrest.

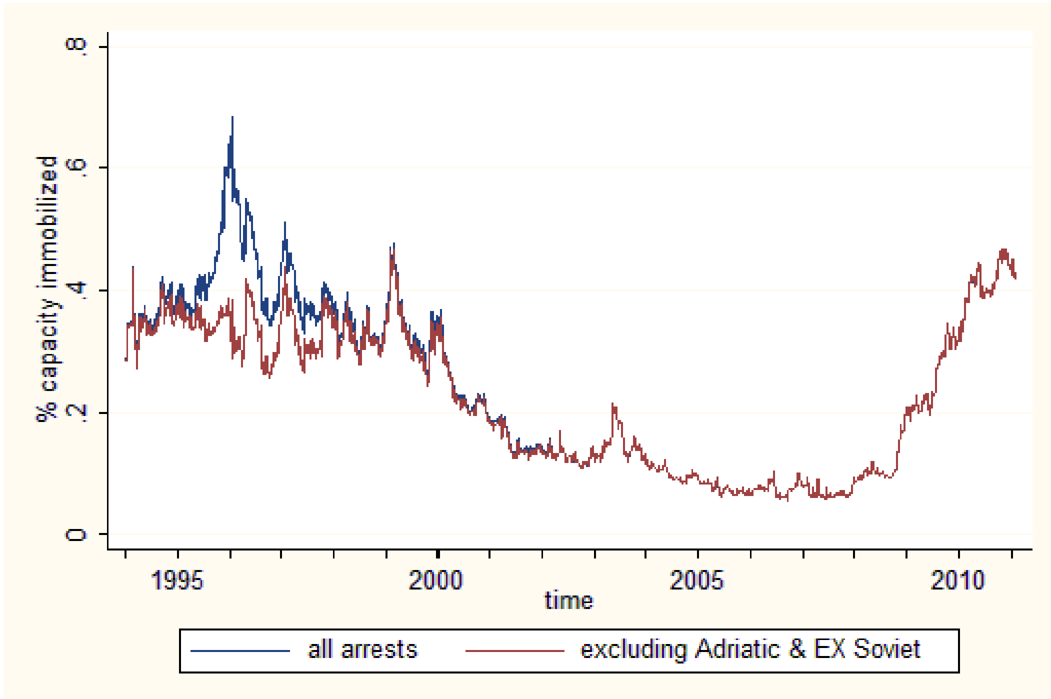

Figure 4: Immobilized Capacity as a Percentage of Total Capacity. In this figure, we track the amount of immobilized capacity as a percentage of total industry capacity, measured in DWT. The bottom (red) line also excludes the bankruptcy of Adriatic Tankers and some ex-soviet companies that went bankrupt with old and sub-standard fleets following the break-up of the Soviet Union.

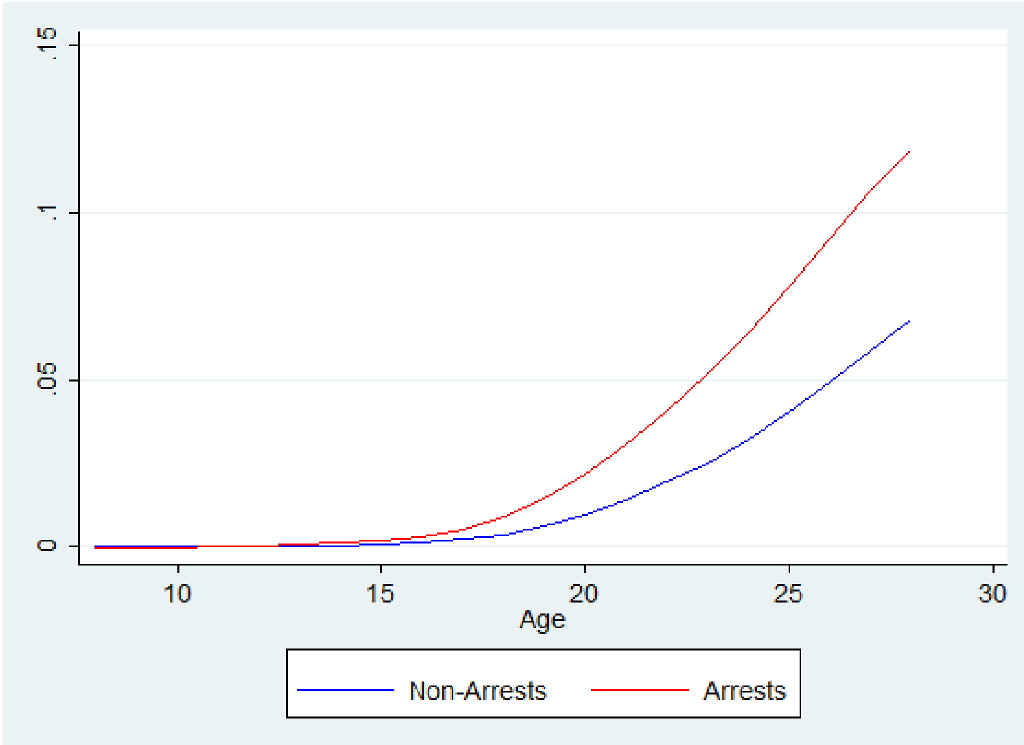

Figure 5: Hazard Rate for Arrested and Non-arrested Vessels. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the arrested (red/top line) and non-arrested (blue/bottom) vessels at any given age.

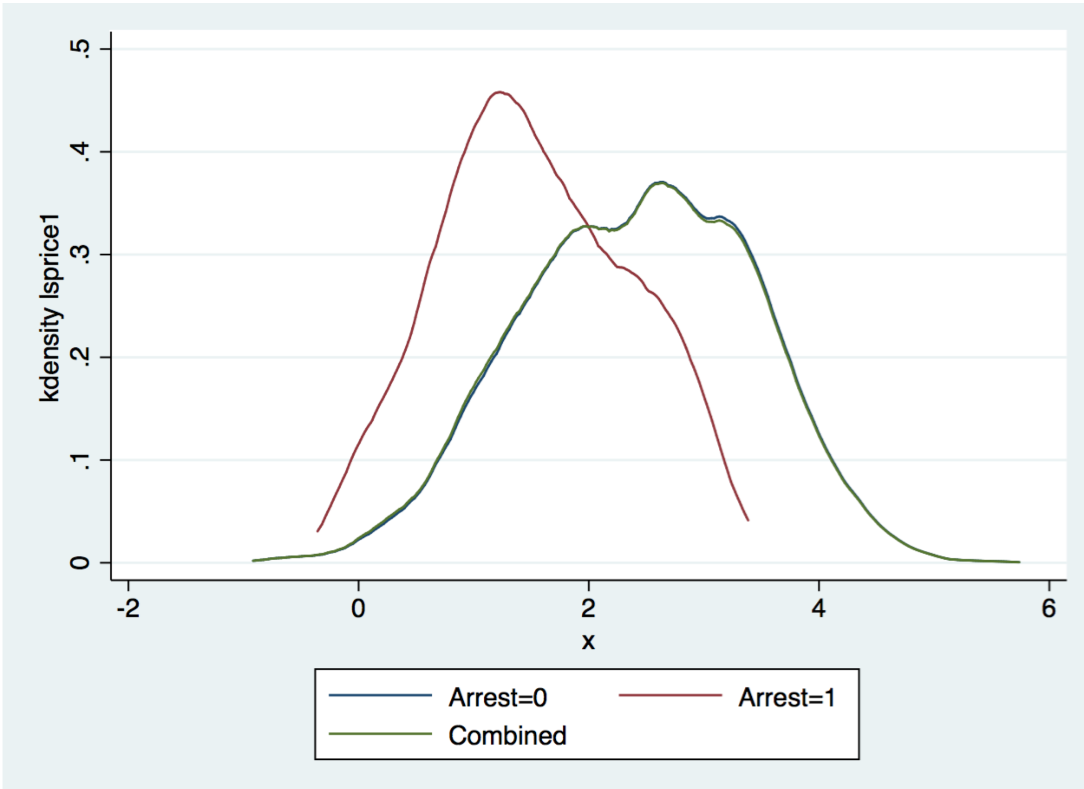

Figure 6: Value Distribution of Arrested and Non-arrested Ships. In this figure, we plot distribution of values of ships sold under arrest and those sold privately. The value distribution for the combined sample of arrested and non-arrested ships is also plotted.

Table 1: The evolution of the fleet over the sample period

This table reports the evolution of fleet number, total deadweight tonnage and age of four representative years over the sample period. The sample period is from 1995 to 2010. Mean, median and standard deviation of total deadweight and age of vessels are reported.

year	1995	2000	2005	2010
Number of vessels	19,424	21,312	23,840	29,555
Size of vessels (DWT)				
mean	32,027	33,664	37,808	44,460
median	13,466	14,519	18,835	25,160
SD	52,971	53,632	55,282	59,254
Age of vessels (years)				
mean	15.6	16.8	17.4	16.1
median	15.6	16.6	16.6	13.6
SD	9.8	11.0	12.2	13.4

Table 2: Arrests, by trigger and resolution

This table reports the number of arrests triggered by various reasons and resolved in different ways. The classification is made on the basis of LLI narratives in conjunction with other information such as a transfer of ownership.

		Trigger					
		crew	mortgage	other	unknown	unsecured	total
Resolution	auction	11	131	10	50	32	234
	break-up	11	59	39	38	21	168
	sale	20	123	57	126	42	368
	same owner	35	83	428	402	283	1231
	unknown	1		4	187	2	194
	total	78	396	538	803	380	2,195

Table 3: Arrest and traffic activity in some specialized and high volume ports

This table reports the arrest and traffic activity in some arrest specialized ports and high volume ports. Six countries stand out for the effectiveness of their arrest procedure: Gibraltar, Hong Kong, Singapore, South Africa, the Netherlands and the UK. This table considers the 474 arrest cases triggered by failure to repay secured debt and the wages of the crew.

	N arrests	arrest (%)	traffic (%)
Arrest specialized ports			
Gibraltar	33	7	0
Hong Kong	19	4	1.7
Netherlands	37	7.8	3.5
Singapore	37	7.8	3.3
South Africa	19	4	1.2
UK	42	8.9	2.8
other	287	60.5	87.6
High volume ports			
Australia	9	1.9	5.1
China	5	1.1	15.8
Germany	6	1.3	2.3
Japan	2	0.4	6.6
South Korea	4	0.8	5.8
USA	23	4.9	11.9
other	425	89.7	52.5

Table 4: Capacity under arrest, by outcome

This table reports the capacity under arrest for all the arrested ships identified in Table 2. Panel A describes the probability of arrest based on all the vessels in the sample. Panel B reports the probability of arrest for the population of vessels partitioned by the occurrence of distress. Panel C further partitions the distressed sample into companies that went bust and those that did not. Capacity is measured both in vessel years and DWT years.

Panel A	entire industry	
	vessel years	DWT years, 10^6
total capacity	384,137	14,300
arrests	1,580	30
No. of arrest events	2,105	
prob. arrest (unconditional)	0.41%	0.21%
average duration of arrest (years)	0.75	
average vessel size (DWT)	37,226	
average vessel size in arrest (DWT)	18,861	

Panel B	no distress		distress	
	vessel years	DWT years, 10^6	vessel years	DWT years, 10^6
No. of episodes			3,063	
total capacity	324,214	12,300	59,923	2040
capacity under arrest	805	16	775	14
No. of arrest events	992		1,113	
prob. arrest (conditional)	0.25%	0.13%	1.29%	0.69%
average duration of arrest (years)	0.81		0.70	
average size in arrest (DWT)	19,501		18,066	

Panel C	no bust		bust	
	vessel years	DWT years, 10^6	vessel years	DWT years, 10^6
No. of episodes	1,960		1,103	
total capacity	51,925	1,770	7,998	273
capacity under arrest	280.23	5	494.71	9
No. of arrest events	417		696	
prob. arrest (conditional)	0.54%	0.29%	6.19%	3.29%
average duration of arrest (years)	0.67		0.71	
average size in arrest (DWT)	18,020		18,173	

Table 5: The determinants of arrested capacity

This table reports the regression results from equation (2), linking capacity under arrest ($imob_i$) with the scale of the downsizing ($\Delta capacity$) for the sample of distressed companies. Columns 2 and 3 report respectively the results without and with Dbust as explanatory variable. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	$imob_i$	$imob_i$
$\Delta capacity_i$	-0.245***	0.007
	(0.048)	(0.056)
$Dbust_i$		-0.248***
		(0.027)
$constant$	-0.098**	0.025
	(0.042)	(0.044)
Adjusted R^2	0.008	0.034
Observations	3,061	3,061

Table 6: The distribution of the maximum daily arrest rate

This table reports the frequency and the percentage of bust episodes featuring 7 different categories of maximum daily arrest rate (or mean daily arrest rate over 90 days).

	$max\{daily\_arrest\_rate_{d,i}\}_d$		$mean\{daily\_arrest\_rate_{d,i}\}_{max\pm45d}$	
	frequency	percentage	frequency	percentage
0	870	74	870	74
(0,20%)	18	1.5	55	4.7
[20%,40%)	23	2	25	2.1
[40%,60%)	35	3	40	3.4
[60%,80%)	12	1	22	1.9
[80%,100%)	9	0.8	25	2.1
100%	209	17.8	139	11.8
excluding single vessels	20	1.7	12	1

Table 7: Direct costs of arrests

This table reports the direct costs of arrests for 22 vessel arrests in England over the period 1995-2010. Column 2 shows the number of immobilization days, column 3 shows the sales price and column 4 shows the total cost as a percentage of sales price.

	Immobilization (days)	Sales price (USD, millions)	Total costs as % of sales price
mean	111	3.25	18%
median	71	1.09	8%
st.dev	165	8.16	30%
min	19	0.04	2%
max	835	38.65	105%
Observations	22	22	21

Table 8: Hedonic Model, with and without quality correction

This table reports the results from the first stage hedonic regression as in equation 3. The dependent variable is log of the sales price of ships. Column 1 includes a range of characteristics of ships. Column 2 further includes remaining life expectancy of ships. The regression also includes ship type fixed effects and year fixed effects. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	Without quality correction	With quality correction
Block	0.033***	0.024**
	(0.010)	(0.009)
Age	-0.001	0.145*
	(0.081)	(0.081)
Age x Age	0.001***	-0.001***
	(0.000)	(0.000)
Special unit	0.007**	-0.002
	(0.004)	(0.004)
DWT	-0.000	-0.000
	(0.000)	(0.000)
Gross weight	-0.000***	-0.000***
	(0.000)	(0.000)
Length	0.005***	0.005***
	(0.000)	(0.000)
Breadth extreme	0.034***	0.035***
	(0.003)	(0.003)
Depth	0.042***	0.046***
	(0.005)	(0.005)
Draft	0.012***	0.014***
	(0.005)	(0.005)
Freeboard	-0.000	-0.000
	(0.000)	(0.000)
Life Expectancy		0.075***
		(0.011)
Observations	10,893	9,479
Adjusted R^2	0.877	0.873
FE (year & type)	Yes	Yes

Table 9: Second Stage: Difference between the actual price and the imputed price

This table reports the results from the second stage which regresses the price discount calculated using equation 4 on a dummy indicating whether the ship is arrested (*Arrested*) or whether the owner is distressed (*Distressed*). Columns 1 and 2 use *Arrested* as the explanatory variable, without and with quality correction (QC) respectively. Quality correction means including life expectancy as an explanatory variable in the first stage hedonic regression. Columns 3 and 4 use *Distressed* as the explanatory variable, without and with quality correction (QC) respectively. Columns 5 and 6 include both *Arrested* and *Distressed* as the explanatory variables, without and with quality correction (QC) respectively. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
	W/O QC	With QC	W/O QC	With QC	W/O QC	With QC
Arrested	-0.259***	-0.134***			-0.261***	-0.121***
	(0.035)	(0.035)			(0.037)	(0.038)
Distressed			-0.041***	-0.035***	-0.033***	-0.032***
			(0.008)	(0.008)	(0.008)	(0.008)
Constant	-0.000	0.000	-0.000	0.000	0.000	0.000
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	9,673	9,673	9,673	9,673	9,673	9,673
Adjusted R^2	0.011	0.003	0.003	0.002	0.014	0.005

Table 10: Fire-sale Discount Decomposition Analysis: Second Stage Regression Results

This table reports the results from the second stage which regresses the price discount calculated using equation 4 on an indicator variable that takes on a value of 1 if the ship is arrested and 0 otherwise. Columns 2, 5 and 6 shows results from price weighted regressions while columns 1, 3 and 4 impose no weighting. Columns 1 and 2 represent the full sample. Columns 3 and 4 (or 5 and 6) split the sample into high corruption and low corruption ports. All the regressions in this table include quality correction (With QC) in the first stage. Quality correction means including life expectancy as an explanatory variable in the first stage hedonic regression. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1) All No Weighting	(2) All Price Weighted	(3) High Corruption No Weighting	(4) Low Corruption No Weighting	(5) High Corruption Price Weighted	(6) Low Corruption Price Weighted
Arrested	-0.134***	-0.051	-0.214***	-0.110***	-0.139**	-0.037
	(0.035)	(0.034)	(0.060)	(0.040)	(0.063)	(0.038)
Constant	0.000	0.044***	0.000	0.000	0.044***	0.044***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	9,673	9,623	9,550	9,627	9,503	9,578
Adjusted R^2	0.003	0.000	0.003	0.002	0.001	0.000

Table 11: Fire-sale Discount and Business Cycles: Second Stage Regression Results

This table reports the results from the second stage which regresses the price discount calculated using equation 4 on an indicator variable that takes on a value of 1 if the ship is arrested and 0 otherwise. The sample is divided into two subsamples based on industry cycles (annual Baltic Dry Index): good and bad. *Bad* is a dummy variable indicating whether the year of sale is considered a bad year for the shipping industry, i.e. the Baltic Dry Index (BDI) in the year of ship sale is below the median. Columns 1 and 2 show the results without quality correction (W/O QC) for the good and bad time subsamples, respectively. Column 3 uses the full sample and includes the interaction term between *Arrested* and *Bad*. Columns 4 to 6 are the corresponding specifications of columns 1 to 3, but with quality correction (With QC). Quality correction means including life expectancy as an explanatory variable in the first stage hedonic regression. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1) W/O QC Good Time	(2) W/O QC Bad Time	(3) W/O QC Interaction	(4) With QC Good Time	(5) With QC Bad Time	(6) With QC Interaction
Arrested	-0.167***	-0.281***	-0.167***	-0.045	-0.165***	-0.045
	(0.057)	(0.041)	(0.057)	(0.056)	(0.042)	(0.056)
Arrest*Bad			-0.114*			-0.12*
			(0.069)			(0.069)
Observations	5373	4054	9427	5373	4054	9427
Adjusted R^2	0.002	0.022	0.012	0.000	0.008	0.004

Table 12: Auction data from UK ports

This table describes the number of bidders for a vessel arrested and sold in UK ports.

	No. of bids	Spread between Top 2	Spread between Top 3
mean	8.5	24%	30%
median	8	22%	31%
st. dev.	4.9	20%	10%
min	1	1%	10%
max	23	79%	60%