The Privatization of Bankruptcy:

Evidence from Financial Distress in the Shipping Industry*

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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 is no more than about 5 percent. The results inform the debate about the need for mandatory bankruptcy laws that are justified by coordination failures between creditors and large fire sale discounts.

"*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, when ships operate across different jurisdictions, or on the high seas outside any jurisdiction, and with a choice of ports, some notorious for their corruption and inefficiency. Advocates of legal activism might expect to find an industry plagued by coordination failures, costly seizure of assets and hurried sales of assets at fire sale prices. As a consequence, shipping provides an interesting laboratory that allows us to study how something akin to a freedom of contracting environment can operate, particularly when the industry is distressed.

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 to some extent private, decentralized, highly differentiated, competitive and adaptable. However, one exception to private contracting is maritime ports which have developed legal procedures for arresting a ship in the event a creditor can prove the owner of the ship has defaulted. Upon default and in the absence of an agreement with the debtor, a creditor has the right to have a vessel arrested in a port for unpaid debts, including for arrears on a mortgage, unpaid crew wages, and debts to a supplier. While some ports are corrupt and inefficient, there are a sufficient number that are not, and they compete on the basis of the speed of vessel arrest and speed of sale[1]. In addition, contracts have adapted so as to deliver more efficient procedures for creditors to enforce their rights. For example, crews, who physically control the vessel, are made senior to the mortgage, so as to discourage the crew from abandoning the vessel when wages are unpaid, thereby aligning their interests with the creditor rather than the distressed owner. In addition, shipping companies are frequently organized as holding companies, with each vessel owned separately by a different subsidiary. This organizational form allows the creditor to take two forms of security on an individual vessel: first, a mortgage on the physical vessel just like any other collateral contract, and a second collateral interest on the shares of the subsidiary owning the vessel. In the event of default by the creditor, the ownership of the shares in the subsidiary would revert to the creditor, who would then have the right to appoint new directors of the subsidiary company and, thereby have the option to sell the vessel. The advantage of such an arrangement, sometimes referred to as a 'double mortgage', is that it allows the creditor to take legal possession of a vessel when

[1]The Gibraltar Maritime Authority on its website describes itself as: "Widely recognised for its speed and efficiency in handling ship arrests, Gibraltar provides shipowners and mortgagors with a tried and tested maritime legal system based on English law conducted in English."

it is on the high seas and sell it, without the need or the associated costs of sailing it to a port, arresting and immobilizing it. We illustrate how this 'double mortgage' functions with a description of the Eastwind case, a large U.S. operator of ships that became distressed and eventually bankrupt in 2009. The main creditor, a bank, held a 'double mortgage' on thirteen ships and was able to take ownership of those vessels, while many were on the high seas, and sell them without recourse to arrest and immobilization. The sale of the ships was also completed prior to the company entering US bankruptcy procedures and as a result, thwarted the attempt of the trustee in bankruptcy to claim jurisdiction over the ships and impose an automatic stay.

Second, we take vessel arrests as a proxy for coordination failures. We estimate the direct costs of an arrest and auction of a vessel as 8% of its market value. This does not include any indirect costs from lost income while the vessel is immobilized in port. 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 largely originates with low valued ships, which are often close to their break up value, or with dysfunctional debtors, whose equity interest in the assets is "far out of the money", rather than with poorly coordinated creditors. This is not consistent with the important criticism often leveled against a freedom of contracting regime, that uncoordinated creditors precipitate a costly run, although one has to be careful about generalizing from shipping to other industries.[2]

Third, we examine a second cost that is discussed in the literature on financial distress and fire sales, relating to the quality of distressed assets that are repossessed and sold by creditors. In their paper on forced sales of houses, Campbell, Giglio and Pathak (2011) discuss the difficulties

[2]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.

of estimating the fire sale discount because the quality of houses repossessed by creditors is likely to be below that of houses sold outside distress, due to under-maintenance. Since the fire sale discount is based upon the difference in sales prices between equivalent distressed and non-distressed houses, the failure to control for the lower quality of distressed houses is likely to overstate the fire sale discount. One way of overcoming this problem is to estimate the remaining life of distressed and non-distressed assets, with any under-maintenance effect being reflected in a shorter life expectancy. However, houses usually do not die and therefore the quality discount cannot be be measured in this way. As a result, Campbell, Giglio and Pathak (2011) find it difficult to adjust their (raw) fire sale discount for differences in quality. In contrast, virtually all ships die and are eventually "broken up" at the end of their economic life. As a result, we can estimate a vessel's hazard rate, namely the probability of being "broken up" conditional on age and other vessel characteristics. We find that vessels arrested and auctioned by creditors tend to have a higher hazard rate compared with other sales of ships. Evidence from ship appraisers' reports, commissioned by the auctioneers of the ships, contained in a hand-collected sample of arrested and auctioned ships in UK ports, strongly confirms this under maintenance effect. This contributes to the very sparse empirical literature on the Myers (1977) debt overhang problem.

We quantify the effect of the higher hazard rate on a vessel's 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 28% 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-maintenance. Moreover, we show that a liquidity discount affects only the lower end of the value distribution of ship sales: there is no evidence that high-valued vessels are sold significantly below the market benchmark. The discount is also affected by the port of arrest: if the ship is sold in low corruption ports the value weighted fire sale discount is only 3-5% (after adjusting for under maintenance) compared with 13 percent in high corruption ports. Moreover, this adjusted discount of 3-5 percent is very similar to that for sales of distressed ships, which are sold without arrest and where there is likely to be more patience exercised in the sales process. This similarity of the adjusted discount suggests that an automatic stay that provided for a delay in the sale of arrested ships might not produce much improvement in prices. In this respect, mandatory bankruptcy procedures with automatic stay may not necessarily improve realised prices.

Our paper is related to the literature on freedom of contracting in bankruptcy, where scholars have hotly debated the need for mandatory bankruptcy procedures (see Rasmussen (1998) and Schwartz (1999)). Warren and Westbrook (2005) have argued that, Thus far, the debate over whether parties should be able to contract out of bankruptcy has been entirely theoretical (p1201). Our paper is also related to the broader literature on the debate between those advocating competition between jurisdictions and those advocating harmonization. Romano (2002, 2005) has argued for a system of competitive federalism for the US securities system so as to replace regulation by the SEC. In contrast, LoPucki and Kalin (2001) have responded that competition in the US between states in bankruptcy reorganizations has led to a race to the bottom, where certain states frame rules to attract parties who make the decision to file for Chapter 11, so as to maximize tax revenues. This debate between competition and harmonisation extends to laws between different sovereign jurisdictions. In response, the European Union has strongly supported harmonization, developing common standards in a wide range of financial activities including insolvency law and banking regulation.[3] We also 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). Another related literature, as discussed above, is that on fire sales of assets by creditors, for example, Campbell, Giglio and Pathak (2011), Coval and Stafford (2007), Pulvino (1998), 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 a simple analytical framework based upon a theoretical model of the literature. In section 3 we describe our data. In section 4 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 5 tests whether coordination failures can explain vessel arrests and provides some evidence of the economic costs of arrest and immobilization. Section 6 estimates the fire sale discount for arrested and auctioned vessels and section 7 concludes the paper.

[3] See for example, Regulation (EU) 2015/848 on insolvency law which will come into law in 2017, and The Single Rulebook, a phrase coined by the European Council in 2009 which seeks to provide a single regulatory framework for the EU financial sector that would complete the single market in financial services.

2 Analytical Framework

The notion that competitive markets generate an efficient allocation of resources has been a core argument in favor of laissez-faire economics and one of the guiding principles of modern capitalism. Nevertheless, while market failures provide an important justification for government intervention, it is widely agreed that the intervention needs to be based on an exact identification of the constraint that has triggered the market failure; they include information asymmetries, cash constraints or coordination failures that prevent parties from reaching a Coasian bargain.[4] A bankruptcy procedure that allows the court to, say, stay a creditor's repossession right (as in Chapter 11 of the US Bankruptcy Code) is one such intervention. According to Schwartz (1998), bankruptcy courts have a mandate to intervene only when the Coasian Bargain fails to materialize, a common incidence according to Warren and Westbrook (2005).

To clarify these ideas, we summarize the existing theory using a simple numerical example based on Shleifer and Vishny (1992), who use the analysis of Hart (1991). Consider a 3 period setting, $t = 1, 2, 3$. A penniless entrepreneur (E) has a project that requires an initial investment, $I = 30$, at $t = 0$. A financier (F) can provide funding. Both E and F are risk neutral. The project generates stochastic cash flows:

- $t = 1$ cash flow is either 100 or 0 with equal probabilities. We interpret a 0 outcome as financial distress.
- $t = 2$ cash flow is either 100 or 0, with equal probabilities, independently of $t = 1$ outcome.
- Cash flows are nonverifiable and, therefore, can be diverted away by E.[5]
- At $t = 1$, the project can be liquidated for $L = 30$. The liquidation value is determined by the cash flows that another operator, less effective than E, can generate by using the asset.
- For simplicity, we assume that E has all the bargaining power.

[4]A Coasian bargain is a transaction, bilateral or multilateral, to the mutual benefit of *all* stakeholders. It is important to distinguish between a Coasian bargain and an action that can benefit some stakeholders but not all, even if he action generates value on aggregate, as the winners gain more than the losers lose. Technically, an implementation of a Coasian bargain constitutes a Pareto improvement while a value-generating action is a Kaldor-Hicks improvement.

[5]Non-verifiability is a staple assumption of theories of incomplete contracting. Asymmetry of information can be used as a substitute.

Since nonverifiability excludes debt contingent upon cash flows,[6] the only funding instrument is secured debt with a face value of 30, granting F in period 1 the right to liquidate the project in case of default. The contract is implemented as follows: if period 1 cash flow is 100, it is in E's best interest to repay the debt. If, however, period 1's cash flow is 0 (financial distress) E has no choice but to default, in which case it is in F's best interest to exercise his liquidation right. Notice that the non pledgeability of period 2's cash flows prevents E from rescheduling the debt, thereby "buying back" F's liquidation right.

It follows that financial distress destroys value, for an asset with a continuation value of 50 is sold off for 30, to a less efficient operator. Nevertheless, no Coasian bargain could ameliorate the situation. Indeed, a bankruptcy procedure that stayed the liquidation rights of the creditor would avoid the value destruction of $20 = 50 - 30$ by leaving the project in the hands of its most effective operator, but it would not be to F's advantage because ex ante F would not finance the project in the first place. Such a stay of liquidation rights can only increase value if the judge has a better technology than the private parties for verifying the cash flows. It is not obvious why the judge should have a better technology and if he did, then the parties to the debt contract would wish to employ it voluntarily as part of the debt contract.[7] According to the Schwartz's (1998) criterion, bankruptcy courts should have no power to execute such a stay. Possibly, other state organs, c.f. the Treasury, who operate under a less restrictive mandate could consider measures such as a bailout funded by taxation. We ignore the (non trivial) question of how the Treasury would identify financial distress, for it, too, is likely to be affected by the nonverifiability of cash flows, as well as E's incentive to strategically default when he is not financially distressed. Notice also that the economics of a stay is akin to a bailout with the cost imposed on F alone, rather than on the tax-paying population. Most important, a stay would affect F's incentive to lend in the first place.

While a Coasian bargain could not avoid the destruction of value described above, it should avoid any additional loss of value associated with a "disorderly" liquidation. The shipping industry provides an excellent example of such additional costs, as well as the opportunity to identify and measure them empirically: a vessel arrest generates additional fees (to lawyers, brokers, port authorities etc.) as well as disrupting the cash flows of the vessel while it is immobilized. Under the Coase theorem, the threat of liquidation should be sufficient for E and F to coordinate a "voluntary" sale of the vessel so as to repay the debt. While one may expect

[6] In particular, an equity contract is ruled out as F would have no power to enforce dividend repayments on E.

[7] Namely, this is a Kaldor-Hicks but not a Pareto improvement; see footnote 6 above. It follows that the contract is *constrained* Pareto efficient, subject to the cash and and non-verifiability constraints.

that such arrests would be rare in a "normal" environment, no such presumption should be made in the potentially chaotic environment of the shipping industry where the vessel may be on the high seas outside any jurisdiction, or may be subject to the laws of conflicting jurisdictions, either of which may undermine the debt contract. For example, E may try to avoid repossession by diverting the vessel into a "friendly" port where F's liquidation right may not be recognized.

The prospect for coordination failures increases when there are multiple lenders. Suppose that the start-up cost, 30, is equally split between fixed capital funded by a bank, and working capital funded by a supplier, each secured on the firm's assets. That may lead to a creditors run akin to a Diamond and Dybvig (1984) bank run where one creditor seeks to be repaid first at the expense of other. By reference to the bank-run literature one can construct an example that even a viable, non-distressed company can be brought down by a creditors run. It is important to emphasize that the problem results not from the multiplicity of creditors per se, but from the absence of suitable priority arrangements, that could remove the advantage of moving first. In that respect, the Jackson's (1986) "common pool" problem and the "asset grabbing" problem that it generates is a failure of contracting. As such, it also has a contractual solution: to partition and prioritize, so that the company's assets are no longer a common pool that each stakeholder is incentivised to over-exploit but, rather, provides for an association of stakeholders, each with his own, well defined, contingent property rights. Hence, our analysis contains, not only a quantitative test of a creditors run on the company, but also a detailed description of the institutional arrangements that the industry has developed to define and enforce these property rights so as to mitigate coordination failures.

There is a growing recognition that financial distress has a systemic dimension as collateral values feed back to the amount of asset liquidation and amplify the effect of the original financial distress. Leverage and the ease of repossession are clearly a part of the causal chain. Government policies can affect the amount of value destruction: see Kiyotaki and Moore 1997, Lorenzoni (2008)and Guembel and Sussman (2015). Yet, the effect of the credit cycle on the analysis of bankruptcy law may be constrained by the following considerations. First, given collateral values, it is not clear that *forcing* a dilution of rights upon the creditor is a Coasian bargain that would, ultimately, be to his own advantage. Indeed, much of the welfare analysis above uses weaker measures of welfare. Second, the effect of the policy may be ambiguous: Suarez and Sussman (2007) provide examples where a "soft" bankruptcy law amplifies the credit cycle. Finally, other state agencies such as central banks and treasuries may have an advantage in comparison to courts, for example additional policy tools and a better understanding of macroeconomic data. Also, fixed legal principles and historic precedent may limit the ability of the courts to condition their policies on the state of the credit cycle.[8]

For these reasons we maintain the focus of this paper on potential failures of the Coasian bargain, which, in practice, are the main drivers behind bankruptcy legislation. Specifically, we examine instances of potential coordination failures in our analysis and examine the fire sale discount in the shipping industry. As will be seen later in Section 5, our analysis raises methodological concerns about potential biases in Pulvino's estimates of the fire sale discount.[9]

3 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.[10] 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.[11] 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 contain 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 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

[8] Yet, Bolton and Rosenthal (2002) and Krozner (1998) do argue that a restriction on liquidation could be used in some exceptional circumstances.

[9] It is important to note that the fire sale discount should be measured relative to the market valuation of the collateral, not relative to the owner's valuation, that is relative to 30 rather than 50 in our numerical example.

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

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

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 6 below. Vessel average size has increased through the sample period, but the fleet has aged slightly, increasing from 15.6 years in 1995 to 16.1 years in 2010. 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[12] 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.**]

4 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.

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

4.1 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. Loans on a particular vessel maybe recourse or non recourse. In the case of recourse (often called "sister ship" clauses), creditors of one company may try to grab assets in another company. Where the debts are non-recourse, the creditors of one company are prevented from pursuing claims against another company. While creditors may have recourse clauses in the debt contract, most of the lending tends to be on a non-recourse basis.[13]

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.

[13] There are a few jurisdictions that allow particular creditors to pursue claims against other ships in other companies even where the debts are non recourse.

4.2 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.

4.3 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[14] reveal a variety of factors that provoke an arrest apart from financial distress: a drunken ship-master, 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

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

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 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[15]. This indicates the low quality of the vessels under arrest, a matter on which we shall provide much elaboration below.

[**Table 2 about here.**]

4.4 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. In one case, it took the creditor ten years to receive the proceeds arising from an arrest and auction in a particular port in Asia.

[15]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.

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[16] in these specialized ports, relative to the volume of traffic.[17] 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.**]

[16] The 474 cases identified above.

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

4.5 Contract adaptability

The results of Section 4.4 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[18]. To the best of our knowledge, shipping is the only industry where labor is senior to capital for commercial considerations. Bankruptcy law often gives the junior claimholder significant control in bankruptcy, because they are the residual claimholder. For example, Chapter 11 in the US gives substantial control to the equityholders through debtor-in-possession provisions[19]. 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 senior creditor and the crew is imperfect. If the relationship were to break down, the crew might abandon the vessel and cause collision and damage to other vessels. 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

[18]In England the maritime lien is part of admiralty law which does not use the common law of England but uses civil law. Many other countries, including the US, have a maritime lien.

[19]See Klein, Crawford and Alchian (1978) and Grossman and Hart (1986).

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 had pledged signed but undated resignation letters, at the time of loan origination. When Eastwind failed to repay interest on their loans, Nordea declared them in default, dated the resignation letters, and appointed new directors of each of the companies, 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 subsequent entry into Chapter 7 of the U.S. Bankruptcy Code would likely have forestalled or delayed the sale of the ships; see Bris, Welch and Zhu (2006) for evidence that Chapter 7 is lengthy, costly and dilutes secured creditors' claims .

4.6 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.[20] 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

[20] 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.

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.[21] 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. 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.[22] 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.

4.7 Leverage in the Shipping Industry

It might be thought that jurisdictional conflicts in the shipping industry would reduce ex-ante the supply of debt financing and that we would observe a relatively low leveraged industry. In fact, the opposite is the case. In a study by Drobetz et al. (2012) they describe shipping as an industry where 'debt has traditionally been the most important source of external financing in the maritime industry...More than 80 % of all external funding needs in the shipping industry were traditionally covered by debt finance.' They report leverage ratios of large listed shipping companies as being twice as high as a sample of other industrial firms. For a sample spanning a period from 1992 to 2010, they report leverage ratios of 41 percent compared with 25 percent for other firms. Debt financing at the individual ship level is even higher. For a sample of twenty eight ships made available to us by a shipping consultant, the average loan to value ratio, at the inception of the loan, was 65 percent (median 70 percent). The loans had original maturities of between 4 and 12 years, required quarterly payments of interest and principal, although many

[21] 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.

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

also had balloon loan payments. The average interest rate spread (above LIBOR) on the loans was 2.35 percent. [23]

5 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 and any resulting coordination failure. We document the magnitude of vessel arrests and examine the extent to which arrests are associated with a coordination failure and a creditors run. In this test of runs and coordination failures, we distinguish between companies that are financial distressed, defined as those that have sold off at least 50% of their capacity, and those companies that have liquidated themselves and ceased to exist as corporate entities, which we denote as 'bust' companies. We might expect to find evidence of coordination failures in 'bust' companies, whereas for those that are financially distressed we would expect to find far fewer arrests and little or no evidence of or coordination failures. To motivate our quantitative analysis, we re-examine Eastwind's decline and bankruptcy. We compare the rate of arrests before and after bankruptcy and compare the level of arrests with the total capacity of the company and the rate at which the company reduced capacity through voluntary sale of its ships.

5.1 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

[23] The data is available on request.

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 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, coordination failures do not occur because no creditor can "jump the queue" by grabbing an asset.

[**Figure 3 about here.**]

5.2 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[24].

[**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,

[24] If arrest is a good proxy for formal default then it is interesting to compare the rate of arrests defaults with annual defaults in other sectors of the economy. Davydenko and Franks (2008) report annual levels of corporate defaults and formal bankruptcies of 1.9%-2.2% in the UK and France.

usually a bank. Often the bank will restructure a distressed company's debt without declaring it in default or placing it in bankruptcy. As a result, we collect data on vessel arrests, regardless of whether the company is in bankruptcy or not. Our measure of a company's financial distress is 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:[25]

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

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.[26] For a given company, a distressed episode is defined as a sequence of all distressed years.[27] 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 sale, unrelated to distress. The definition of bust, recognizes that companies cease to exist, sometimes through a formal bankruptcy procedure or through a voluntary liquidation or restructuring outside formal procedures.

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), based on

[25] Missing values are replaced by zeros.

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

[27] 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.

DWT capacity, compared with 36% (1,103 divided by 3,063) when calculated only on distress episodes (see Table 4). DWT gives a higher probability of distress because bust companies 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.

$$\frac{imob_i}{peak\_capacity_i} = \alpha + \beta \frac{\Delta capacity_i}{peak\_capacity_i} \times (1 - Dbust_i) + \gamma Dbust_i + \varepsilon_i. \tag{2}$$

Results are reported in column 4 of Table 5 below. The first column reports the simple regression with $\frac{\Delta capacity_i}{peak\_capacity_i}$, but without $Dbust$. The second and the third columns report, respectively, the results using the non-bust companies subsample and bust companies subsample.

[**Table 5 about here.**]

In column 4 of Table 5, we find that the $\frac{\Delta capacity_i}{peak\_capacity_i} \times (1 - Dbust_i)$ coefficient is not statistically different from zero, and that arrests are largely driven by companies which are bust. The same conclusion can also be drawn from the subsample regression results in column 2 and 3. 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, around 24% 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, because the debtor is often very far out of the money in terms of the value of their equity interest.

5.3 Vessel Arrests: Dysfunctional owners or coordination failures?

In this section, we provide evidence on the extent to which arrests are associated with companies that are in economic distress. We distinguish two types of distress. In one case a distressed company is shrinking or downsizing significantly but continues to operate. In itself, we might not expect such downsizing to give rise to coordination failures and arrests of its vessels. We would expect such companies to strike a bargain with creditors and voluntarily sell vessels, with minimal or no arrests. In the second case, some of those distressed companies are not only downsizing but the downsizing is on such a scale that the company is in virtual liquidation, and it ceases to exist as a corporate entity. We might expect a much higher level of arrests in these 'bust' companies since the owner's equity is far out of the money and they have less incentive, or less ability, to prevent coordination failures and the subsequent arrests of their ships. We believe this distinction is important because in the latter case the arrests are the result more of a dysfunctional borrower rather than lenders or creditors being unable or unwilling to renegotiate. With such an interpretation, such companies may be viewed as economically distressed and their sale or liquidation is efficient.[28]

[28] An arrest of a vessel even leading to a fire sale discount may not be economically inefficient. Consider a supplier who is unpaid and triggers an arrest and auction, and the auction price is at a large fire sale discount because of industry distress; providing the vessel is kept in its existing use, the sale of the ship leads to a wealth

There is, however, an alternative explanation for 'bust' companies other than the dysfunctional borrower described above. It maybe that coordination failures precipitated a creditors run, and that as a result the vessels were arrested and sold to buyers who are less efficient and operate the vessels with a lower set of cash flows; in this respect financial distress triggered a coordination failure among creditors and resulted in an inefficient liquidation. [29]

To distinguish between a dysfunctional borrower and a coordination failure, we apply the same test that we have used in the Eastwind case to test for a creditors run, that is a run should be accompanied by an arrest rate of of something like 100% of remaining capacity; if the arrest rate is consistently below total capacity throughout the cycle of distress we can rule out a run. Denote the daily capacity (under arrest) on day d of episode i by $capacity_{d,i}$ ($imob_{d,i}$) and further denote as $daily\_arrest\_rate_{d,i}$ the ratio of $imob_{d,i}$ over $capacity_{d,i}$. 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. For example, if only one ship is remaining in a fleet and is arrested, then 100% of the fleet would be recorded as being under arrest. However, we would not describe the arrest as a coordination failure. To ensure that we do not classify the arrest of a very small number of ships as a coordination failure, we truncate the series $\{daily\_arrest\_rate_{d,t}\}$ at the point where $capacity_{d,i}$ is 25% of $peak\_capacity_i$. We also truncate the series at 15%, instead of 25%, of peak capacity as a robustness check. 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 only a very short period. Of 1176 bust episodes[30], 870 had no arrests at all; therefore this is consistent with an absence of coordination failures. For another 97 (18 + 23 + 35 + 12 + 0) we can reject the hypothesis of a creditors run on the grounds that the arrest rate peaked below 100%. That rejection rate increases to 167 once we tighten the test for a run requiring a 100% daily arrest rate averaged over an extended period

transfer from the seller to the buyer, but there is no deadweight loss or economic inefficiency. We will discuss the issue of fire sale discounts in Section 5.

[29]This is akin to the common pool problem defined by Baird (1986): "A creditor whose opt-out right has ripened may reduce the total value of the assets of the firm if he acts alone. If he sues the firm and reduces his claim to judgement, the sheriff may seize a $10 machine to satisfy a $10 debt. The sheriff may leave behind the custom-designed dies that with the machine are worth $10 but that without are worthless. When firm defaults to several investors and triggers opt-out rights, a race to assets may begin that ultimately could leave the creditors as a group worse off than they would have been if they had acted in concert."

[30]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.

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; we exclude a run in these cases.[31] 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 may explain the level of arrests; in all other cases it is likely to be caused by dysfunctional owners. Notwithstanding our definition of a run, we examine the average number of ships owned by companies with an arrest rate below 100%. For example, companies with an arrest rate between 40%-60%, have on average 3 vessels. We suspect that arrest rates averaging 1.5 vessels are more likely to be associated with companies that are in virtual liquidation than with coordination failures. This result is likely to be a direct consequence of the fact that contractual rights on individual ships are well defined, with a mortgage holder on a particular ship, and a maritime liens for claims by the crew.

[**Table 6 about here.**]

5.4 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

[31] In principle it is possible to have a coordination failure or a run on an individual ship. The likelihood of such a run is mitigated by a well defined priority structure of claims on the ship. It is possible that suppliers such as those providing bunker fuel would try to arrest a ship for non-payment. However, the amounts would be relatively small and it is unlikely to result in a coordination failure among creditors and an inefficient liquidation of the vessel.

small particularly when account is taken that they do not include the loss of any income forgone during arrest.

[Table 7 about here.]

6 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 adequate account of the poor quality assets in fire sales, a concern that has already been raised by Pulvino (1998). It might be thought that under maintenance is not as great a problem for aircraft as it is for ships because there is stricter monitoring of aircraft safety by the FAA. That ignores two issues. First, a large part of the cost of an aircraft is the fitting out of the aircraft and little to do with safety. Second, there is the issue of discretionary maintenance which has the effect, not of endangering the aircraft, but rather of increasing downtime, thereby making the aircraft unavailable for use. In an analysis of discretionary maintenance on days lost for aircraft of different ages Decker (2000) states: 'As aircraft age, the increase in unscheduled maintenance associated with scheduled inspections also requires a great deal more maintenance downtime. Both detract from the availability of the aircraft for flight operations. Available data shows that availability drops from the 95% range for aircraft up to 15-20 years of age to an average of 70% at age 25 and 55% at age 30'.[32] Pulvino acknowledges the issue of quality differences in aircraft values and the challenge of controlling for it because of lack of data availability (page 968). Using a very small sample of just eleven aircraft, he compares the appraised values (generated by an appraisal firm) with the actual sales prices, with the difference being designated as a fire sale discount. The magnitudes of the discount are no smaller than those from his hedonic regression. Pulvino interprets this as evidence that quality differences are not driving his estimates of the fire sale discount. While

[32]This information is obtained from an Aviation article written by Bill de Decker in Conklin & de Decker, March 2000.

these estimates are informative, it is difficult to place much reliance on them because of the small sample; moreover, appraiser's values are likely to be noisy estimates of sales prices. To further strengthen his argument he provides another test using sales/leaseback agreements. This test is based on the key assumption that price differences at inception of the sales/leaseback transactions only depend on borrowers' credit risk and not on aircraft quality. He finds large (20%) differences in prices between credit constrained and unconstrained airlines and interprets this as a fire sale discount unimpacted by the quality difference of the asset. However, it is possible, even likely, that credit quality will be correlated with the quality of asset maintenance and therefore the price at inception will likely confound the two effects. There is an analogy to be drawn from sub prime financing of cars, where the interest charge reflected both the credit quality of the borrower as well as the maintenance effect. Defaults often led to poor maintenance and abandonment with consequent low recovery rates. This concern is also raised by Campbell, Giglio and Pathak (2011) with respect to domestic real estate; they state that: "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.[33] 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.

6.1 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.

[33] 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.

In the first stage, we estimate a hedonic model (characteristics-based approach) to calculate a ship's benchmark price. The equation is given by:

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

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 our analysis of the fire sale discount 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. [34] Denote T as the duration, which is the time elapsed until the ship breaks up. Since our sample is at annual frequency, we start with defining the *discrete-time* hazard function, which is the probability of breaking-up at discrete time t_j, $j = 1, 2, ..., N$[35], conditional on survival to time t_j:

$$hazard(t_j) \equiv \lambda_j = Pr(T = t_j | T \geq t_j)$$

The corresponding survival function, which equals the probability that the duration T equals or exceeds t is defined as:

$$S(t) = Pr(T \geq t) = \prod_{j|t_j \leq t} (1 - \lambda_j)$$

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

[35] N is the maximum duration, and $\lambda_N = 1$ so that the hazard rate at t_N is 1.

We can then calculate the expected future life expectancy given that the ship has survived until t_0 using the following formula[36]:

$$\frac{1}{S(t_0)} \sum_{j|t_j \geq t_0}^{j=N} S(t_j)$$

Therefore, the values of the life expectancy characterize how many years the ship will remain alive given the age at sale.

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 an instant 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 fire sale discount 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

[36]The derivation of the formula is as follows. Denote j where $t_j \geq t_0$ as k, $k+1$,..., N. The expected future life of the ship is $S(t_k)\lambda_{k+1} \times 1 + S(t_{k+1})\lambda_{k+2} \times 2 + ... + S(t_{N-1})\lambda_N \times (N-k+1)$, which simplifies into $\sum_{j|t_j \geq t_0}^{j=N} S(t_j)$ when we plug in the expression for S_t and $\lambda_N = 1$. We need to further divide $\sum_{j|t_j \geq t_0}^{j=N} S(t_j)$ by $S(t_0)$ as the life expectancy is calculated conditional on reaching t_0.

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 forced to be sold, 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[37] in life expectancy, with arrested ships having a lower life expectancy. [38]

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 5). 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.[39]

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.**]

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

[38] 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.

[39] It is interesting to speculate whether a bankruptcy procedure (with an automatic stay) might have incentivised owners of arrested ships to use the bankruptcy procedures earlier in the cycle of distress so as to reduce under maintenance. In this case the fire sale discount should include part of the under maintenance effect that bankruptcy procedures would mitigate.

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.

6.2 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.

We also compare the fire sale discount for sales of arrested ships with the discount for ships sold by distressed owners. In Table 10, we recorded the value weighted fire sale discount at 5.1 percent for arrested ships; this is very similar in magnitude with the value weighted discount of 3.2 percent for distressed ships (after the deduction of the under maintenance effect). Their similarity suggests that the cost of a delay in the sale of arrested ships is small. We may have expected the residual component i.e. the liquidity component to have been larger for arrested ships because the forced cash auction might have accelerated the sale and this would be expected to reduce the number of bidders and the auction price compared with distressed sales where more patience can be exercised in the sale process. The small discount attributable to illiquidity may be less surprising given that the auctions of arrested ships take place in an international marketplace and the information on bids is circulated to potential buyers electronically. Below we report the median number of bidders for a sample of auctions that is consistent with this observation.

[**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%, and as low as 3.7% if the forced sales are confined to low corruption ports. The empirical evidence on fire sales sheds some light on the analytical framework described in Section 2. There we argued that fire sales might be the result of a liquidity discount which could be mitigated by a bankruptcy procedure with an automatic stay so to overcome co-ordination problems among creditors. The evidence in this section suggests that the value of an automatic stay is quite limited because the implied liquidity component of the fire sale discount in cash auctions is quite similar to those for sales by distressed companies. The lack of a liquidity discount is also consistent with the evidence in earlier sections that coordination failures are largely absent from this industry and therefore are not the triggers for arrests.

6.3 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.**]

6.4 Discussion of recent Chapter 11 shipping bankruptcies

Since 2011 there have been approximately ten shipping companies that have filed for Chapter 11 protection. The majority have been non-US companies with virtually no assets in the US, for example, Genco Shipping and Marco Polo Seatrade.[40] It might be argued that such filings represent a breakdown of bargaining and therefore a violation (or limitation) of freedom of contracting.

It appears that this spate of filings is the result of macroeconomic conditions: The US financial crisis, followed by the Eurozone crisis and a consequent collapse of shipping charter rates. The result is an industry facing economic distress with severe overcapacity. It might be argued that these industry conditions provide an important justification for Chapter 11, in the spirit of Shleifer and Vishny (1992), cited earlier, where industry distress are predicted to result in fire sales of assets. They would argue that Chapter 11 would slow down asset sales and diminish the probability that sales of ships would be sold to inferior users of those assets.

However, in all the ten companies that filed for Chapter 11, only those companies that filed with creditor support succeeded in maintaining the company as a going concern. Those companies that filed without creditor support were liquidated in Chapter 11 (see 'Creditor Support Essential for Smooth Sailing in Shipping Restructurings').[41] In a separate article, the author

[40]See Thomas j. Belknap, 2013, Does Chapter 11 Work for Foreign Shipping Companies, Maritime Reporter and Engineering News, April.

[41]Scott Greissman, White & Case LLP, Marine Money, October/November 2016.

writes, 'Those [companies] that were unable to negotiate prearranged restructuring agreements with their lenders have typically failed in their renegotiation efforts'.[42] In six cases, the company filed without secured creditor support, and 'all vessels were ultimately sold or returned to the applicable secured lenders' (see Greissman, 2016). In four cases, for example Nautilus Shipping, the companies filed with support from secured creditors. These filings were accompanied by pre-packaged plans of reorganization, emphasizing the consensual nature of the reorganization. They were 'large or more complex/non traditional corporate and capital structures. Importantly, these cases attracted support from new investors or existing lenders. One interpretation of these cases is that [major] creditors have used these State-sponsored procedures voluntarily, as a substitute for private recontracting. It may be that off the shelf standardized procedures provide a low cost way of executing such plans. In this respect, State procedures may provide standardized contracts, which are cheaper than private contracts and which are less open to legal challenge. Such State contracts also avoid the free riding that accompanies contractual innovations.[43]

In summary, shipping, which is a highly volatile industry, has developed sophisticated mechanisms to privately restructure distress companies. In the infrequent cases, where consent is not forthcoming use of Chapter 11 ensures orderly restructuring. However, these largely require the consent of major creditors. Discussions with banks specializing in loans to the shipping industry suggest that there is very little concern about strategic default as they have alternate mechanisms in place (for example the double mortgage discussed earlier) to ensure that their claims are well protected.

7 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

[42] Timothy A. Davidson II and Joseph Rovira, 2014, International Shipping Companies Successfully Navigate Chapter 11 with Prenegotiated Plans of Reorganization, June 18, client paper, respectively.

[43] An example of a contractual innovation was the floating charge and procedure of administrative receivership privately introduced as part of a debt contract in England in the 19th century and still in use today. The use of the floating charge in debt contracts was challenged in the courts on a number of occasions, and its refinement and standardization took decades to complete (see Franks and Sussman (2005)).

to choose the port of arrest to minimize costs. The proceeds from the auction will then be used to repay creditors, according to the contract.

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 in the debt contract. 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 claims some connection 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 largely playing 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 often 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 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 Hayek's test of "spontaneous order".

A few comments are worth highlighting. First, it should be noted that we are not running a horse race between freedom of contracting and Chapter 11. In fact, freedom of contracting could potentially include off the shelf procedures like Chapter 11. Second, we are not making any efficiency claims here.[44] Chapter 11 was introduced based on the rationale that absent such a reorganization mechanism, we would witness severe coordination problems and large fire-sale discounts. There was also a concern that innovation in contracts would be slow under a freedom of contracting regime because of free rider problems. We find that such fears are largely misplaced at least for the shipping industry. That being said, we do believe that state sponsored bankruptcy procedures have a role to play. In particular, such procedures have the potential for solving free rider problems associated with contractual innovation. But we question whether procedures be made mandatory as they provide legal restrictions to contracting.

Notwithstanding, the question remains, whether these results extend to other industries? 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 complementarities make the segregation of assets more difficult. In this respect, we would be cautious in generalizing

[44] It is practically impossible for an empirical paper to make normative claims. We understand that ex-post inefficiency may be ex-ante inefficient. Moreover, the theory of second best a la Lipsey and Lancaster (1958)cautions us against welfare claims.

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.

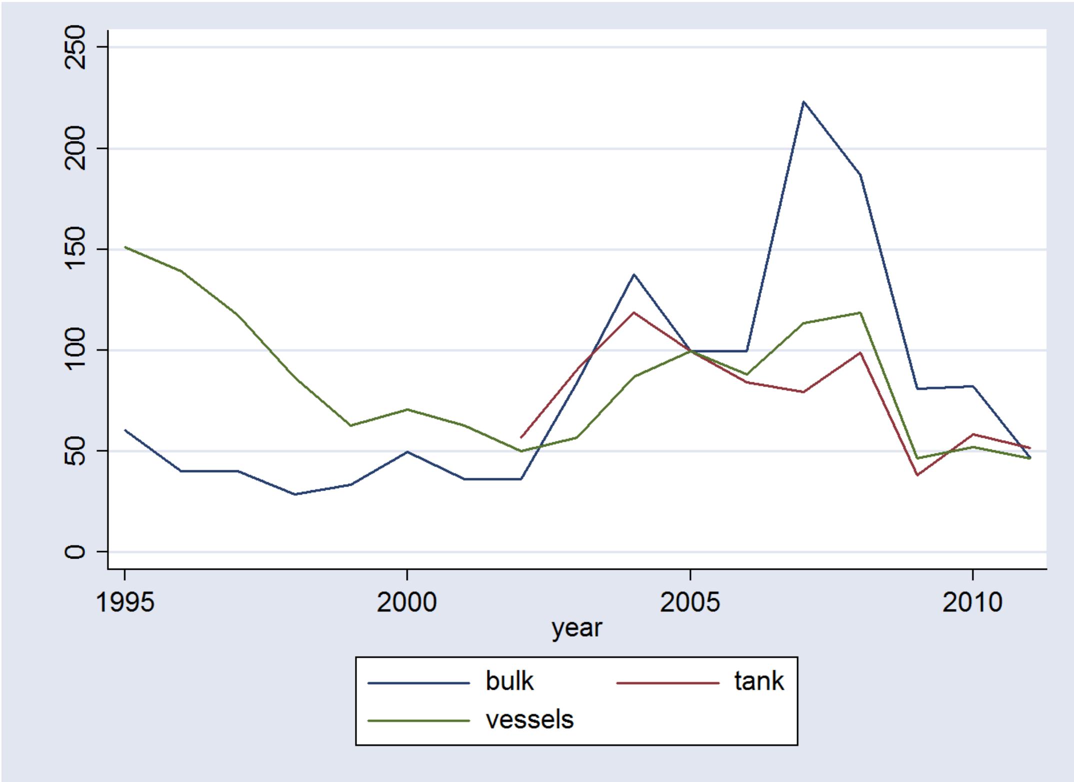

Figure 1: Charter Rates and Vessel Price Indexes, $P_{2005} = 100$. In this figure, we show the charter rates in the tanker business and the price indexes of vessels from 1995 to 2011.

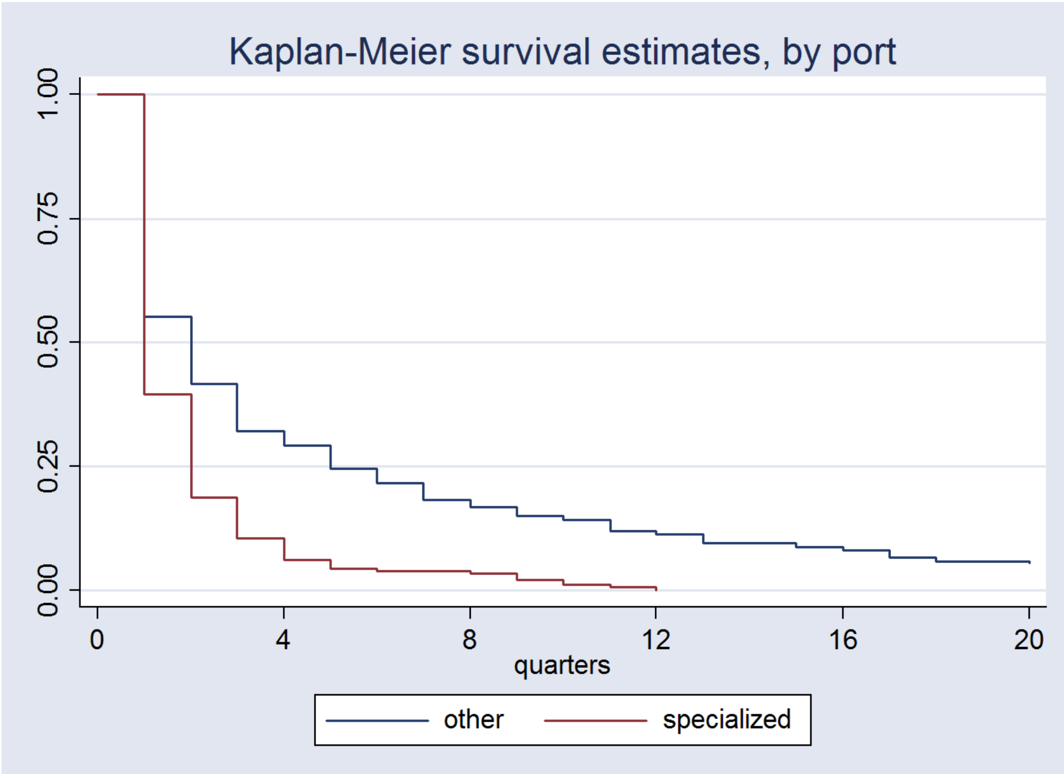

Figure 2: Duration of Arrest in Specialized and Other Ports. In this figure, we plot a Kaplan-Meier (non-parametric) estimate of the duration of arrest, for the six specialized ports and the other remaining ports.

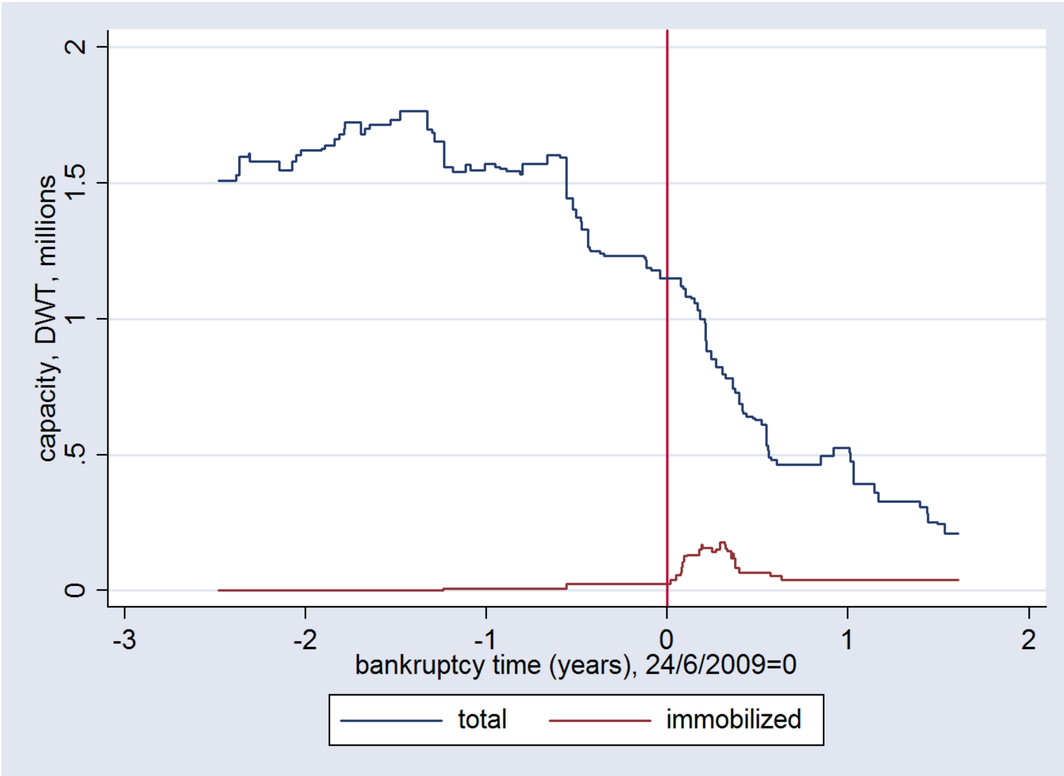

Figure 3: Eastwind's Cycle of Distress. In this figure, we track Eastwind's cycle of distress on a daily frequency. The top (blue) line tracks the company's total capacity (in millions of DWTs) while the bottom (red) line tracks capacity that is immobilized due to arrest.

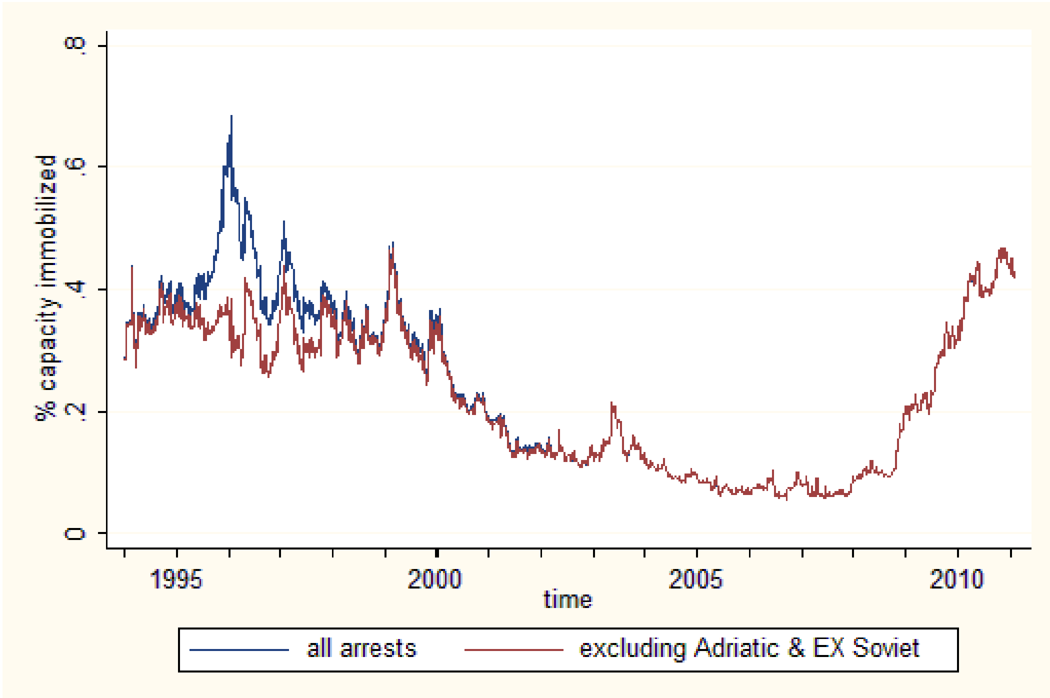

Figure 4: Immobilized Capacity as a Percentage of Total Capacity. In this figure, we track the amount of immobilized capacity as a percentage of total industry capacity, measured in DWT. The bottom (red) line also excludes the bankruptcy of Adriatic Tankers and some ex-soviet companies that went bankrupt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

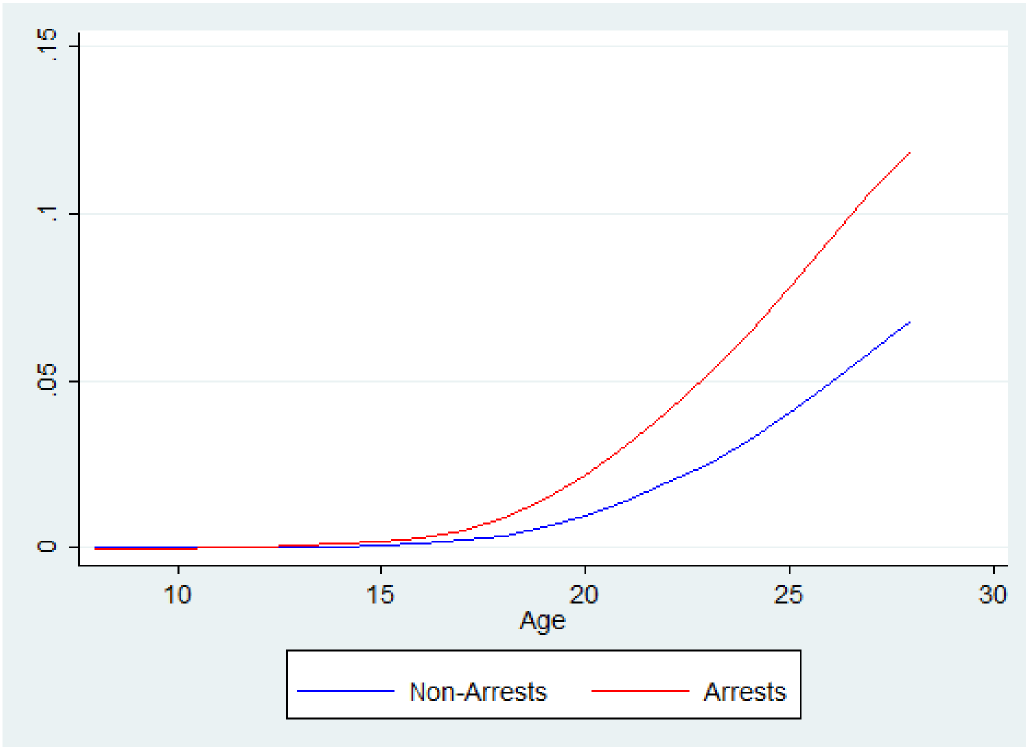

Figure 5: Hazard Rate for Arrested and Non-arrested Vessels. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the arrested (red/top line) and non-arrested (blue/bottom) vessels at any given age.

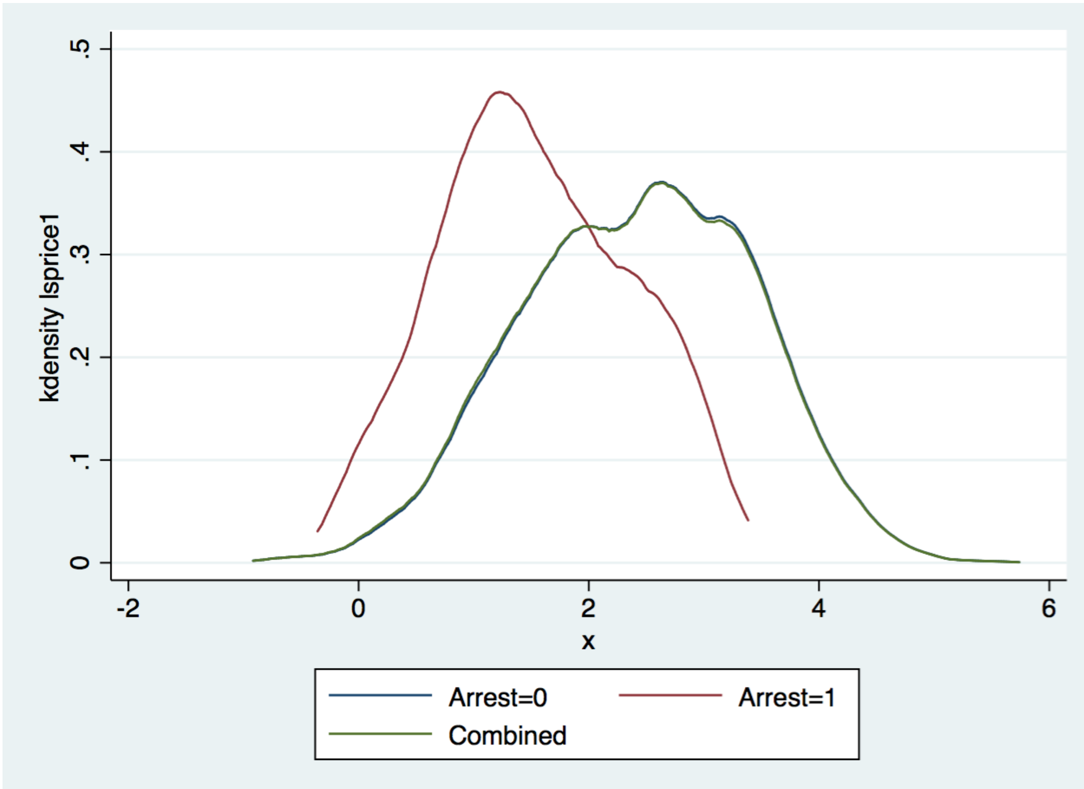

Figure 6: Value Distribution of Arrested and Non-arrested Ships. In this figure, we plot distribution of values of ships sold under arrest and those sold privately. The value distribution for the combined sample of arrested and non-arrested ships is also plotted.

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	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	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	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 ($\frac{imob_i}{peak\_capacity_i}$) with the scale of the downsizing ($\frac{\Delta capacity_i}{peak\_capacity_i}$) for the sample of distressed companies. The first column reports the simple regression with $\frac{\Delta capacity_i}{peak\_capacity_i}$, but without *Dbust*. The second and the third columns report, respectively, the results using the non-bust companies subsample and bust companies subsample. Specification (4) corresponds to equation (2). Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1)	(2)	(3)	(4)
Sample	All	$Dbust = 0$	$Dbust = 1$	All
$\frac{\Delta capacity_i}{peak\_capacity_i}$	0.245***	-0.007		
	(0.048)	(0.013)		
$Dbust_i$			0.266***	0.242***
			(0.031)	(0.047)
$\frac{\Delta capacity_i}{peak\_capacity_i} \times (1 - Dbust_i)$				-0.007
				(0.055)
constant	-0.098**	0.025**		0.025
	(0.042)	(0.010)		(0.043)
Adjusted R^2	0.008	0.000	0.063	0.034
Observations	3,061	1,958	1,103	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).

	$max\{daily\_arrest\_rate_{d,i}\}_d$		$mean\{daily\_arrest\_rate_{d,i}\}_{max\pm 45d}$	
	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
Sum	1176	100	1176	100

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 × 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%