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

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Abstract

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Evidence from Financial Distress in the Shipping Industry*

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March 19, 2020

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Abstract

A generally accepted view is that sophisticated bankruptcy procedures are required to mitigate coordination failures and fire sale discounts arising from financial distress. In this paper, we study an industry not subject to mandatory bankruptcy procedures; instead, the shipping industry has relied on privately negotiated contracts, and not on sovereign procedures, like the US Chapter 11. We describe how loan contracts, and private institutions including competition between ports, have adapted to mitigate the costs of distress. We find low levels of coordination failures and fire sale discounts of 11% on the sale of arrested ships. Both the direct and indirect costs of distress are no larger than those reported for US bankruptcy procedures.

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

Sammy Ofer (shipping magnate)

1 Introduction

The last thirty years have witnessed a significant expansion of judicial activity in corporate bankruptcy. Many countries have modeled law reforms on Chapter 11 of the US Bankruptcy Code, which grants courts the discretion to protect companies from creditors so as to increase their prospects of recovery. In particular, creditors can exercise their security interests only to the extent that these rights are not stayed by the court.[1] These mandatory bankruptcy codes have been justified by reason of mitigating coordination failures and large fire sale discounts. According to Jackson (1986), bankruptcy, by its very nature, raises a common pool problem. As a result, creditors runs destroy companies' value through under investment and premature asset sales. These problems are exacerbated by insufficient market liquidity, so that forced sales of assets are not fairly priced. Shleifer and Vishny (1992) make the connection to 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."

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 market failures. However, the empirical evidence for these convictions is sparse. Indeed, Warren and Westbrook (2005) complain that "thus far the debate over whether parties should be able to contract out of bankruptcy has been entirely theoretical" (p. 1201). It is fair to say that the principle of *freedom of contracting,* relying on the courts to enforce the contract is no longer considered a viable policy option. Jensen's (1997) call for the privatization of bankruptcy law is viewed as a somewhat idiosyncratic idea. The empirical evidence is not helped by the paucity of jurisdictions that rely on freedom of contracting regimes.[2]

In this paper, we provide empirical evidence on this debate by examining an industry where the resolution of financial distress is largely distanced from sovereign bankruptcy procedures

[1] No doubt, there are important cross-country differences in the court's discretion, 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 trend towards more court involvement has not been entirely consistent: see Baird and Rasmussen (2002) and Ayotte and Morrison (2009).

[2] An exception is an interesting literature on Scandinavian bankruptcy laws; see Stromberg (2000) and Eckbo and Thorburn (2008). See also Franks and Sussman (2005) for a discussion of English bankruptcy procedures

such as the US Chapter 11. In the shipping industry, the fact that ships operate across different jurisdictions, or on the high seas outside any jurisdiction, has loosened (although not completely eliminated) the grip of national bankruptcy laws. Advocates of legal activism might expect to find an industry plagued by coordination failures, costly seizure of assets and liquidations at large fire sale prices. As a consequence, shipping provides an interesting laboratory to study freedom of contracting, particularly when the industry is distressed.

We have three 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 a large extent, private, decentralized, highly differentiated, competitive and adaptable. Upon default, a creditor has the right to arrest a vessel in a port. While some ports are inefficient and corrupt, there are a significant number that are not. The ports compete on the basis of the efficiency of the repossession process.[3] In addition, contracts have evolved so as to strengthen creditor rights. For example, crews are granted seniority over the secured debt, committing the mortgage holder to pay any wage arrears from the proceeds of sale of the vessel. The rights of owners, creditors and other contractual parties are protected by the registration of the vessel. Registration is often made in flag-states, like the Marshall Islands, that compete with each other by offering a register of ownership and liens that protect the integrity of the parties' contractual rights. Furthermore, shipping companies are often organized as holding companies, with each vessel (or a group of vessels) owned separately by a different subsidiary, whereby default on one vessel does not entitle the creditor to seize another vessel in a different subsidiary i.e. the debt is on a non-recourse basis. This allows the creditor to take a 'double mortgage,' a contractual innovation that permits the lender, in the event of default, to take possession of a ship without a costly port arrest. We describe the mechanism in greater detail using the Eastwind case, a large U.S. operator that became distressed and formally entered US bankruptcy procedures in 2009.

Second, we take vessel arrests as a proxy for coordination failures. In a Coasian world (with financial frictions), companies that exhaust their capital lose their assets to better capitalized ones, but this transfer of ownership should not disrupt the assets from operating and generating cash. The mere threat of arrest should be sufficient to convince the debtor to sell the vessel "voluntarily" and repay the creditor. We document a low incidence of arrest, 0.4% of industry capacity (measured in DWT years) in recessions and close to zero otherwise. We develop a formal test that allows us to rule out, for a large proportion of shipping companies that went bust, the

[3]The Gibraltar Maritime Authority on its website describes itself as: "Widely recognized 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."

possibility that the bust was caused by a creditors run.[4] We link the low incidence of runs to the way freedom of contracting has functioned in shipping: by partitioning the company's assets between subsidiaries and by carefully allocating priority rights on assets, the shipping industry has managed to well-define property rights on these assets, so as to largely resolve the common pool problem.

Third, we substantiate concerns raised by Campbell, Giglio and Pathak (2011) that the standard Pulvino (1998) test, is biased by an unobserved quality component due to poor maintenance of ships pre-arrest.[5] We correct the bias by estimating the hazard rates, and thus the vessel's remaining economic life expectancy until its eventual "break up." We find that arrested vessels have a significantly shorter life expectancy. Pricing this quality correction reduces the 26% raw fire sale discount by about a half. Moreover, the remaining discount, which like Pulvino we interpret as a liquidity effect, is influenced by the institutional quality of the port of arrest: for vessels sold in low corruption ports the liquidity discount is only 11% (after adjusting for under maintenance) compared with 21% in high corruption ports. The evidence of shorter economic life expectancy of assets owned by distressed owners is consistent with Myers (1977) under-investment problem: for the same reason that such owners lack the incentive to strike Coasian bargains with their creditors, they also lack the incentive to properly maintain their assets. These findings are not specific to the shipping industry; similar patterns of longevity can be identified in the airlines industry for aircraft operating under Chapter 11 protection. We also estimate the direct costs of arrests and sale of ships using data from a UK port. We estimate the median costs at 8% (and the mean is 18%) of the gross proceeds of sale. The equivalent figures for US Chapter 7 and Chapter 11 bankruptcies are between 2% and 20%, as measured by Bris, Welch and Zhu (2006).

While we have so far discussed the ex post costs of distress, these costs will also have ex ante implications for leverage and the costs of financing. Using financing data from COMPUSTAT and from a private hand-collected data set from a shipping consultant, we are able to estimate leverage at both the company and the individual ship level. While average leverage of shipping companies is 40%, the loan to value leverage ratios of individual ships is 65%. Further, the interest costs of shipping finance are 6.5%, somewhat lower than that of other transportation companies, at 7.7%. It appears that strict enforcement of creditor rights in shipping does not appear to have restricted its leverage or increased the cost of debt finance, relative to other transportation industries.

[4] A creditors run is a special case of a coordination failure, which can bring down even a solvent firm.

[5] See Shleifer and Vishny (2011) for an excellent survey of the fire sale discount literature. For a similar effect in a securities markets see, among others, Coval and Stafford (2007).

Our results suggest that concerns regarding the freedom of contracting regime may have been misplaced. That being said, we do understand firms may change their policies to mitigate ex post inefficiencies that accompany stronger creditor rights. For instance, in this quest to minimize ex post coordination failures, firms may alter the scale of their business, leading to a sub-optimal industry structure. A freedom of contracting regime may work well for smaller firms, and less well for larger companies. An illustration is Hanjin Shipping, a very large South Korean shipping company, which carried 3.2% of world container capacity. It entered bankruptcy in 2016, causing large scale immobilization of vessels, and imposing considerable costs on cargo owners. It is possible to make a case that under Chapter 11 type procedures, the judge would have arranged an automatic stay and DIP ("debtor-in-possession") financing for Hanjin. While this would have mitigated the distress and could have been ex post efficient, such an injection would have come at the expense of existing creditors. It is important to understand the trade-offs attached to this decision, which have first-order implications for the ex ante financing of firms.

To summarize, we attempt to provide a detailed analysis of the operations of freedom of contracting regime using the shipping industry. We estimate the ex post costs of distress through some common metrics that have been discussed in the bankruptcy literature. These include direct costs of arrest and sale, the extent of coordination failures, and the fire sale discounts. For these metrics, freedom of contracting approximately does a good job. Competition between jurisdictions and contractual innovations generate strong creditor rights, which improves access to finance. There are, however, cases like Hanjin that question the robustness of the freedom of contracting regime, particularly for larger companies.

Our paper, with its emphasis on contractual innovation and jurisdictional competition, is related to the debate between those advocating competition between jurisdictions and those advocating harmonization. Romano (2002, 2005) has argued for competitive federalism in US securities regulation instead of a centralized SEC. LoPucki and Kalin (2001) have responded that competition between states to minimize tax liabilities within Chapter 11 filings has led to a race to the bottom. This debate between competition and harmonization extends to laws between different sovereign jurisdictions. The European Union has strongly supported harmonization, developing common standards in a wide range of financial activities including insolvency law and banking regulation.[6] 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

[6]See for example, Regulation (EU) 2015/848 on insolvency law which came 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.

competitive markets: see Hayek (1979), Bernstein (1992) and Greif, Milgrom and Weingast (1994).

The rest of the paper is organized as follows. In section 2 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. In Section 3 we discuss two case studies, Eastwind and Hanjin Shipping. Section 4 tests whether coordination failures can explain vessel arrests and provides some evidence of the economic costs of arrest and immobilization. Section 5 estimates the fire sale discount for arrested and auctioned vessels. Section 6 concludes the paper.

2 Institutional Description

The shipping industry is responsible for 90% of global trade.[7] Until the 1970s, the industry was largely controlled by maritime states, and in the case of oil tankers was dominated by the oil majors. Now both have largely been replaced by independents, including Greek and Norwegian shipowners.[8] Couper (1999) has described the pre-1970s period as one "of relative stability and prosperity for shipowners... although since 1970s shipping has become more international but much less stable. There is now virtually unimpeded international mobility of capital and labor in the industry, few barriers to entry and a free choice to shippers of competing ships." Technological changes in ship building have had a dramatic impact on the size and cost of ships: oil tankers have increased in size almost ten times, from 28,000 DWT pre-1970s to 250,000 DWT (supertankers), and containerization has revolutionized cargo traffic. All this has resulted in huge capital investment in both ships and port facilities. At the same time crew size has been reduced from an average of 40-50 per vessel to 20-30, an important factor in an industry where the crew accounts for 40% of operating costs. During the same period the financing in the industry has radically changed. As recently as the 1950s it was largely equity financed, and in recent decades it has become highly levered and very dependent on bank finance, as we describe below.

In the rest of this section, we discuss the influence of legal jurisdictions and the enforcement of creditor rights through an arrest in port and through more innovative contractual procedures.

[7] See Ernst Frankel (1989), "Shipping and its role in economic development", 1989 Butterworth and Co Publishers. See also, UNCTAD Review of Maritime Transport Report (2017)

[8] "Greek shipping accounts for 20% of the world merchant shipping fleet" New York Times, May 27, 1997

2.1 Ship Registration, Jurisdiction and Flags of Convenience

Ships must be registered in a jurisdiction; like the registration of a house, it confirms 'title' or ownership. However, while houses are usually registered in the jurisdiction of the owner, ships are not necessarily attached to any particular nation state, by virtue of the fact that they are for the most time on the high seas, outside any jurisdiction. Thus, the practice has emerged of registering the ownership of a ship outside the jurisdiction of the owner, and in places that are not necessarily near any maritime route; the places of registration are often known as flags of convenience. One such flag-state is The Marshall Islands, which has developed a highly efficient register of vessels despite it having less than 100,000 inhabitants and being far from any shipping route. In 2010, 61% of vessels by tonnage were registered with flags of convenience.

The flag is important because owners and creditors do not wish the ownership to be tampered with. Since this threat of tampering is perceived as sufficiently important, the mortgage deed or loan will frequently specify a particular flag-state that is recognized for its efficiency and honesty. The mortgage and any other liens will be registered side by side with the registration of the ship. The public register of ownership and mortgage together protect the buyer against a fraudulent change of ownership, and lenders against any sale of the ship that does not recognize their financial interest.

The flag states, like The Marshall Islands, are the primary regulators of vessels flying their flags, and the flag states set out the conditions that ships must meet to retain their registration (for example, the insurance of ships, minimum safety conditions, environmental standards, and crew conditions). Some flag states specify low standards or more often tolerate sub-standard ships and poor conditions for the crew. The flexibility of flags also allows shipping firms to hire labor from international markets, whereas, the traditional places of registration like the UK restricted the employment of foreign nationals and maintained minimum wages. This is important as the monthly wage of a Chief Officer from an emerging country is only $2000 compared with $7500 for western European officers.[9]

The uneven quality of regulation imposed by flag states, has led to efforts by UN agencies and state blocs like the EU, to prevent the dilution of safety standards or a race to the bot-

[9] Although safety and conditions of service for the crew will be specified by the flag, there are other societies that certify the safety of ships like Lloyds and Bureau Veritas. These societies inspect the ships to ensure minimum standards of maintenance.

tom.[10] International regulations by the UN and EU in theory permit the enforcement of these regulations when vessels enter the port-state of those countries which are signatories to the international rules. However, ships spend only a short time in port, and they have some discretion to choose ports with lax enforcement.

A consequence of jurisdictional choice is that a single ship may be subject to a multiplicity of jurisdictions that may affect enforcement of creditor rights, as well as the enforcement of other rules and regulations. The owner, with the agreement of the mortgage holder, may choose the flag, the port-state, and in the event of disputes between creditors and the owners, the place of arbitration e.g. Singapore or the Virgin Islands. International agreements, like the UN or EU provide a potential fourth jurisdiction.

In addition, there is significant competition between jurisdictions, particularly for those ports wishing to attract ships for refueling and maintenance, or flags wanting to attract the registration of ships. Owners of ships may 'flag hop,' although creditors may have incentives to prevent it. Port competition is important to creditors who, in the event of default or non-payment, may wish to have the ship arrested in a friendly port where it will be quickly seized, and then sold with the proceeds distributed to the creditors. This multiplicity of jurisdictions has the potential to produce a race to the bottom in the face of jurisdictional conflicts, and coordination failures resulting in creditors 'asset grabbing' and immobilizing the ships. Lenders might respond to these chaotic conditions by offering low levels of leverage or high interest rates.

In section 3 we describe two case studies of shipping bankruptcies: first, that of Eastwind, which illustrates how coordination failures may be avoided by efficient private contracting, and second, that of Hanjin Shipping, which was hit by coordination failures, large scale arrests and immobilization of ships, with heavy costs borne by cargo owners.

2.2 Ports, Arrests and Enforcement of a Creditor's Claim

Conditional on default, a creditor may instruct the port authorities to arrest a vessel and organize its sale to repay creditors. The choice of port of arrest will be influenced by the location of the vessel at the time of default. The task of locating a vessel and identifying the closest ports, is greatly facilitated by the development of GPS technology which allows every vessel to be tracked, and the data to be made public and continuously available.

[10] For example, the convention on health and safety of the crew, ILO 147 (1981), has been ratified by only about half of the countries operating the world's fleet and even then surveyors of ships often do not have the time to review thoroughly the conditions of the ship, particularly those pertaining to the crew.

To initiate an arrest, most port authorities will 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. Some, for example, Gibraltar, place great stress on the speed of arrest and subsequent sale of the vessel. In their port handbook, they state "In general, these matter are addressed with a minimum of delay and inconvenience... Modern IT technology is used to speed the process of appraisal and sale once the court has made the relevant order. Particulars of an arrested ship can be made available online within days of a survey." In addition, Gibraltar allows a sale by private treaty where the creditor identifies a buyer and the sale is executed without a public auction, at a price that the Admiralty Court deems 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 (Dutch) 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 have proven corrupt and inefficient and are to be avoided by creditors where possible, eg Lagos in Nigeria.

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 creditors, in these specialized ports, relative to the volume of trade. Using our data on 854 arrests relating to financial default (triggered by mortgage holder, unsecured creditor or crew), Table 1 shows that these six ports' share of the world's cargo trade is only 12%, while they have 34% share of arrest activity. 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 trade, in part at least because their arrest and sale procedures are not conducive to a speedy resolution.

As described above, competition between ports is targeted at creditors who wish to seize their collateral. Over the period of our sample the average duration of arrest to resolution declines from roughly 250 days in 1995 to around 50 days in 2006.[11] The intensity of competition between ports is illustrated by the case of Rotterdam, which until recently, was willing to arrest ships without independent evidence of debts outstanding, and obliged the owner to sue the creditor for the costs in the event of wrongful arrest. This illustrates how competition between jurisdictions can 'over-tighten' creditor rights. As we show later, strong creditor rights may enhance the borrowing capacity of shipping firms, and thereby influence the way the industry

[11]This decline in the duration of arrest over time is robust to controlling for the port of arrest, vessel type, and trigger for arrest. Results are available on request.

is organized, in terms of both its size and ownership structure. Although higher borrowing capacity is valuable it might be offset by a more costly ownership structure, for example, one that is widely fragmented.

[Table 1 about here.]

The sale of ships is facilitated by specialist dealers who have had long experience as shipping valuers and brokers. They disseminate information about the ship's quality and condition, the equivalent of housing survey reports, to would be buyers around the world.[12] Using a sample of hand collected data on UK shipping auctions, we found that the average number of bidders is 8, which is consistent with the view that the second-hand vessel market is a liquid one. In one auction, the number of bidders reached 23.

In principle, any creditor may arrest a ship, including the mortgage holder, the crew for non payment of wages, a ship's supplier (a bunker supplying fuel or a ship's 'chandler'), or a bank with an unsecured claim. An important difference between defaults in other industries, is that the arrest of a vessel immobilizes the asset, incurring direct costs and the indirect opportunity costs of lost business. In most other industries a creditor can lay a claim against a company but not stop its operations. One exception is airlines, where creditors can seize an aircraft in some jurisdictions.

2.3 Contractual Innovations

Here, we describe the corporate organization of a typical shipping company, and important features concerning collateral and the seniority of particular creditors' claims.

A shipping operator is frequently organized as a holding company with multiple subsidiaries, each one owning a single vessel or a group of vessels. A creditor facing a debtor default may try and immobilize a ship through a port arrest and an auction of the ship. In the event the ships are sold by the arresting authority, they will advertise the sale and reach out to potential creditors before they distribute the proceeds. The distribution will be made according to the priority of the claims.

[12] An example in the UK is CW Kellock who are internationally recognised ship valuers and auctioneers of ships. Founded in 1820, they have acted for the Admiralty Marshall of the Courts of Justice of England and Wales as brokers and valuers for more than 150 years. They have a worldwide data base of shipping sales going back more than 50 years.

Where the debts are non-recourse, the creditors can only pursue claims against the particular company or subsidiary with the debts outstanding. In this case each ship, or sometimes a group of ships, will be held in a separate company with the shares of the company held by the group. It is likely that the ships will be financed with a mortgage secured on the physical vessels (known as a maritime mortgage). In that event a creditor of one company may not pursue a claim against ships in a different company in the group. In shipping, a significant proportion of the lending tends to be on a non-recourse basis using ship mortgages.

The holder of the mortgage, like any secured lender, has the most senior claim on the ship, with some important exceptions. Most state-ports like the UK have introduced a maritime lien, which has the effect of making the crew's claims for wages and other benefits senior to all other creditors, including the mortgage holders. The rationale for this seniority (for what is normally an unsecured claim in bankruptcy), is that while ships are on the high seas, the crew may desert the ship in the event of non payment of their wages. This might threaten the value of the vessel and the cargo, but also pose a risk of collision with other shipping. This may expose the owner (and in some circumstances the lender) to a lawsuit. In addition, the maritime lien in many states protects the cargo owners, since their claim is also made senior to the mortgage holder. The maritime lien was a contractual innovation originally introduced by private contract, and subsequently standardised by statute in many countries.[13]

A second contractual innovation in shipping is the double mortgage. Assuming the ship is owned by a company which is financed on a non recourse basis, and the shares are held by the holding company, a lender with a mortgage on the physical vessel may also take collateral on the shares of the subsidiary that owns the particular vessel. Thus, the lender has both a mortgage on the physical vessel and on the shares of the company owning the same vessel; this is the basis of the 'double mortgage'. We describe in the Eastwind case study below how this double mortgage can, in the event of default, allow the lender to repossess a ship on the high seas. The double mortgage is executed by the lender, at the time the loan is agreed, and permits the lender to acquire the collateral of the shares and signed but undated letters of resignation of the owner's board of directors. When default occurs, the lender dates the letters of resignation and appoints its own board of directors, thereby acquiring ownership and control of the shares on the vessel from the borrower. The lender is then in a position to sell the vessels, discharge the mortgage without sailing it to a port and having it arrested. The result is that this procedure

[13]Refer to Teiniu (2013) and Hill (1998) for a historical background of maritime liens.

minimizes the costs associated with enforcing its collateral by seizing the ship in port. This is even more important if the nearest efficient port is some days sailing.[14]

The costs of arrest and auction include the direct costs of sale, the port fees and crew costs while in port prior to sale, or until the creditor discharges the debts by some other means. Most of these costs can be avoided by the exercise of the repossession rights on the high seas using the double mortgage. Also, because the sale of the ship can take place without the participation of the state-port, this will reduce not only direct transactions costs, but also reduce any potential fire sale costs associated with a sale undertaken by the port authorities, who may try for a speedy sale. Finally, if the ship is laden with cargo, seizing a ship in a port, other than that designated in the cargo contract, exposes the creditor to a lawsuit in the event of a delay in the delivery of the cargo and possible damage in transit.[15] As a result, it is a rule in shipping that a creditor should try and avoid an arrest when the vessel is laden with cargo. There are no such constraints on repossession on the high seas using the double mortgage.

2.4 How is the Industry Financed?

Notwithstanding the contractual innovation, there may remain considerable uncertainty surrounding the enforcement of creditor rights in particular jurisdictions. One response by creditors might be to reduce lending to this industry. However, the evidence suggests that the industry is the most highly levered among the transportation industries. Drobetz et al. (2012) show that debt has traditionally been the most important source of external financing for the industry where, "More than 80% of all external funding needs in the shipping industry were traditionally covered by debt finance." The study reports leverage ratios of large listed shipping companies as being more than two thirds higher than the average of other industrial firms. For a sample of companies spanning a period from 1992 to 2010, they report leverage ratios of 41% compared with 25% for other firms.

These findings tell only part of the story, since typically shipping companies are formed as groups with multiple subsidiaries, where debt is netted out at the subsidiary level. To investigate the impact of this netting out, we obtained private data from a shipping consultancy firm for the financial accounts of 27 subsidiaries of various shipping firms, registered in several jurisdictions; see Table 2.[16] The average loan to value ratio, at the inception of the loan, was 65% (median

[14]The port authorities will want to see evidence of default, usually provided by a lawyer for the shipping firm

[15]It is for this reason that seizures and arrest often take place in the port where the cargo has been discharged; if, however, the port is corrupt or inefficient that may not be possible.

[16]We are grateful to Captain Kaizad Doctor for supplying us with these data.

70%). The loans had original maturities of between 4 and 12 years, amortized quarterly, although some also had balloon loan payments. The average interest rate spread (above LIBOR) on the loans was 2.35 percent.

[Table 2 about here.]

To better benchmark against other industries, we use COMPUSTAT (North America and Global), comparing a sample of 647 shipping firms with 923 firms in other transportation industries (e.g. airlines, railroads, and trucking companies). The interest rates in shipping average 6.5% compared with 7.7% in other transportation industries, although leverage in shipping is higher at 40.4% compared with 35.2% in other transportation firms. In Table 3, we regress the leverage ratio and interest rate, respectively on firm level controls such as asset tangibility, profitability and an indicator variable for whether the firm belongs to the shipping industry. We find that leverage ratios in shipping firms are higher than other transportation firms, even after accounting for leasing.[17] Also, the interest rates in shipping are significantly lower than other transportation industries.

[Table 3 about here.]

2.5 Data Sources and Summary Statistics

We combine data from several sources for the empirical analysis that follows in the paper. This section describes the key features of our data and the sample construction process.

Ownership Database: Our main data source is Lloyd's List Intelligence (henceforth LLI) originally part of Lloyd's of London, the famous syndicate of insurance underwriters.[18] 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.[19] Our sampling window begins in 1995 and ends in 2010. We focus on merchant vessels (bulk, containers, reefers and tankers), but exclude passenger ships and highly specialized technical vessels (e.g. oil exploration vessels). We also exclude small

[17] Leverage Ratio inclusive of capital and operating lease obligations is computed using definition from Graham, Lemmon, and Schallheim (1998). That is, operating lease is defined as the discounted sum of minimum rental commitments over the next 5 years.

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

[19] Lloyd's List, is an industry news bulletin, in existence since 1734 and Lloyd's vessel register has been in existence since 1764.

vessels below 10 dead-weight 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. Technical information for the vessel, including the vessel type, size, built date, and scrap date are also included in the database.

Vessel Arrest Database: The data on vessel arrest is also collected from Lloyd's List Intelligence. This database provides detailed information about vessel arrests including, the vessel IMO number, port of the arrest, and the duration of arrest along with the arrest start date and arrest end date. In many cases the database contains a short narrative describing the circumstances of the arrest. As we will describe below, we use this information in the narratives to classify the trigger for arrest and the resolution of arrest.

Transaction Level Database: The vessel transaction data is collected from Clarkson Research Services Limited (CRSL), a shipping broker, which supplies price information for secondary market transactions. This database includes the vessel IMO number, date of sale, sale price, and the seller and buyer identity. Technical characteristics of the vessel that impact its sale price are also included: these are details on vessel age, size, length, depth, special units, draft and freeboard. Appendix A reports the definitions of these vessel related variables. The CRSL and LLI data sets are merged through IMO numbers, to identify the vessel sales of arrested vessels. Our sample period is from 1995 to 2010.

Records of Arrests in UK Ports: We augment our LLI arrest database with detailed records of a sample of vessel arrests in UK ports. This vessel survey is carried out by the Admiralty Marshal, an officer of the maritime courts. The records provide more detailed information about the direct costs of the arrest, including those for keeping the vessel in port and auctioning it, as well as a description of the state and quality of the vessel provided to all potential bidders in the auction, and finally, the value of all the bids submitted.

COMPUSTAT: Financial data for the transportation industry is collected COMPUSTAT North America and COMPUSTAT Global. Annual financial data on firms is collected from 1965-2018. In this sample we have 647 shipping firms, and 923 other transportation firms (including airlines, railroads, trucking companies, etc.).

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 4. 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 4 and 5. Technological advances coupled with the economies of scale of larger ships, have resulted in a steady increase in the average vessel size during our sample period. The fleet has only aged slightly, increasing from 15.6 years in 1995 to 16.1 years in 2010. The merchant vessel fleet in 2010 comprises bulk carriers (29%), tankers (43%), container ships (17%), reefer ships (5%), and roll-on/roll-off ships (6%).

[**Table 4 about here.**]

Since the early 2000s the shipping 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[20] have gone through a similar cycle, albeit of a less erratic nature. Figure 1 also plots a price index for vessels.

[**Figure 1 about here.**]

3 A Tale of Two Shipping Bankruptcies

In this section we review two shipping companies that entered bankruptcy, Eastwind and Hanjin Shipping. Eastwind entered Chapter 7 in the US while Hanjin Shipping entered bankruptcy procedures in South Korea and in the US. We chose these two companies because they illustrate in one case a very orderly disposal of assets without significant coordination failures and in the other case, a disorderly disposal of assets. The empirical part of our paper is aimed at resolving the question as to which case study better characterizes the outcome of financial distress in this industry.

3.1 Eastwind

The distressed New York based shipping company Eastwind owned, at the time of default, around 90 vessels. Nordea, a Scandinavian bank with an extensive portfolio of maritime loans,

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

had double mortgages on 12 of Eastwind's vessels. These mortgages entitled the company to acquire ownership of the vessels in the event of default. To facilitate these rights, the board members of each of these subsidiaries had pledged, at the time of loan origination, signed but undated resignation letters. In the event of default, the lender could date those letters replacing the board with its own appointees thereby facilitating a rapid and unopposed transfer of ownership and the sale of the ships to a third party.

Although Eastwind was delinquent, Nordea made many attempts to restructure the distressed company without repossession. However, at some point it received news that Eastwind was about to file for bankruptcy in the US. Fearing the direct legal costs as well as the dilution of their rights in bankruptcy,[21] Nordea declared Eastwind in default on June 21, 2009. At the same time they dated the resignation letters of the current Eastwind directors, and appointed new directors for each of the subsidiaries. Simultaneously, the new directors approved the sale of the twelve ships, on behalf of the bank, to Samama's Draften Shipping, a company controlled by the Ofer family. We are informed that the value of the proceeds of sale were more than $50 million.

Eastwind filed for Chapter 7 bankruptcy one day later on June 22. The Chapter 7 Trustee sued Nordea on the grounds that the ships belonged to the bankruptcy estate and were subject to the automatic stay, and therefore Nordea was not entitled to sell the ships. The judge decided that the sale by Nordea of the subsidiaries was valid, and that the pre-default managers lacked the appropriate authority to file for bankruptcy.[22]

There are several issues that this case clarifies. First, that Nordea did not have to arrest the vessels in a port in order to gain control of its collateral and sell the vessels. The immediate sale of vessels on the high seas avoided the cost of sailing the vessels to a port to arrest and auction the vessels. This saved the direct costs of arrest and auction, which we have estimated below at 8% of the vessels value, but it also saved the costs of immobilising the vessels and the opportunity to charter out the vessels. Second, had Nordea delayed by just a day, the entry of Eastwind into US bankruptcy would have triggered an 'automatic stay' on the assets by a US court, with a corresponding delay to the recovery of Nordea's debt and the potential dilution of their claims. Even so, Nordea still had the option of arresting the vessels in a non-US port, despite entry

[21] The fact that Eastwind was an American company is not a prerequisite for a filing of bankruptcy in the US. 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

[22] The case was settled with Nordea paying the trustee $750k, in return for the Trustee's recognition that the sale was valid.

of the company into Chapter 7 and the automatic stay, but that might have placed Nordea in conflict with the US court.[23] The ruling in this case highlights the potential for jurisdictional conflict that the shipping industry has faced on the enforcement of creditor rights. It also shows that although the industry has largely managed to distance itself from national jurisdictions, in a way described below, it has not achieved full separation.

While we have discussed the sale of Eastwind's twelve ships, it is also important to report evidence of coordination failures across its entire fleet of ships. The top line in Figure 2 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 elaboration. First, Eastwind started to downsize at least a year before it filed for bankruptcy. That downsizing was achieved with hardly any arrests. Presumably, at that time Eastwind still had equity in the vessels and was willing to cooperate with its creditors. Second, the arrest rate started to pick up following the bankruptcy filing, consistent with the hypothesis that financial distress leads to vessel arrests. Over the entire cycle, Eastwind divested around 1.5 million DWT, while the capacity under arrest amounted to roughly 0.2 million DWT-years. Hence, on average, 13% of the downsized capacity was immobilized for one year. Third, 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 only 22%. 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 prioritized amongst all other creditors, coordination failures do not occur because no creditor can "jump the queue" by grabbing an asset.[24] We formally test this hypothesis in Section 4 on a large sample of vessel arrests, and a sample of shipping companies that went bust.

[23] In another case concerning Eastwind, the same federal judge refused to enforce the rights of another creditor. Upon Eastwind's default, the UK insurer to Eastwind had terminated the insurance of its vessels. The Trustee in Chapter 7 litigated against the insurers, arguing that under US law they were obliged to continue the insurance until the bankruptcy procedures were completed. The Trustee's reasoning was that without insurance, vessels away from the home port would be unable to complete their voyages or, the bankruptcy estate would have had to use its scarce funds to pay the insurance. The federal judge, while recognizing that an English court would likely rule in favor of the insurer, applied US law and ruled in favor of the trustee, contrary to the contract which specified that in the event of a dispute English law would apply. The judge 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. By forcing the British insurers to continue the contract, their unpaid fees were pooled with other Eastwind's unsecured creditors, and subject to a "haircut."

[24] We do not exclude a run on an individual vessel, although with fewer creditors, this becomes easier to avoid.

[**Figure 2 about here.**]

3.2 Hanjin Shipping

A more recent bankruptcy, in August 2016, with quite different outcomes, is that of Hanjin Shipping. Hanjin was the seventh largest shipping company in the world operating with 142 ships, 38 under ownership and the rest under charter. Its business was badly hit by low freight rates, overcapacity in the industry and with bought-in charter contracts with very high daily charges, relative to their spot rates. Hanjin filed for bankruptcy in a number of jurisdictions, including South Korea and the United States, the latter under Chapter 15 of the US code which limited the court's jurisdiction to US-based assets. The Wall St Journal (October 13, 2016) stated that as a result of the bankruptcy, eight vessels had been arrested, 43 were at sea, and 39 were outside ports at risk of arrest.

While many of these problems were resolved within days or weeks of the filing, it is likely that significant costs were imposed on various stakeholders, particularly the cargo owners. For example, Reuters reported that the collapse caused 'worldwide supply chain and shipping disruption as cargo ships were left stuck at ports and canals waiting for cash payments.'[25] Another publication (Ocean Insights) claimed that the bankruptcy stranded more than $14 billion in cargo, ranging from televisions to textiles to spicy kimchi, scattered all over the globe, and represented 3.2% of the world's global container capacity. This case illustrates the costs of externalities associated with the failure of large firms.[26]

It was largely the unplanned nature of the bankruptcy and the way Hanjin was financed that precipitated the crisis and contributed to the costs.[27] The bankruptcy was triggered by a refusal of Hanjin's shareholders and main creditor banks to re-negotiate an out of court restructuring. It is highly likely that they did not internalise the costs of supply chain disruption; nor, could those affected by the disruption, particularly the owners of the cargo, coordinate in a timely manner and participate in any out of court restructuring with creditors. It is likely that an automatic stay and debtor in possession financing would have avoided some of those costs to Hanjin's creditors

[25] See "Hanjin Shipping files for receivership, as ports turn away its vessels." Reuters. 31 August 2016.

[26] See "Lessons Learned From Hanjin collapse-visibility is the key to success", Matthias Dyck, Oct 18, 2017

[27] A significant part of Hanjin's debt was on a recourse basis, an issue discussed later. See "Lessons Learned From Hanjin Shipping's Bankruptcy", Peter S Goodman, Law 360

and customers. The case raises the important question whether state sponsored bankruptcy codes are desirable, and whether they should be made mandatory or optional.[28]

The remainder of the paper empirically addresses the question, whether the evidence in the shipping industry is more consistent with the Eastwind or the Hanjin Shipping bankruptcy outcome.

4 Arrest & Sale of Vessels Owned by Distressed Firms

In this section, we empirically examine the extent to which the shipping industry is disrupted by frequent and costly arrests of ships, the identity of the creditor triggering the arrest and, the proportion of vessels arrested for companies that are liquidated. For a small sample of vessels we are also able to document the direct costs of arrest and sale.

4.1 Arrest of Vessels

An arrest followed by the repossession and sale of the vessel is the ultimate remedy available to a secured creditor to obtain repayment. Therefore, we use arrests as a proxy for coordination failures. Anecdotal evidence indicates that to negotiate a workout, banks prefer to use their right to arrest the vessel as a potential threat. Unless the owner has lost all hope of recovery, it is in his best interest to avoid the vessel arrest and accept a Coasian bargain. The data

[28]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 (see Thomas J. Belknap, 2013, Does Chapter 11 Work for Foreign Shipping Companies, Maritime Reporter and Engineering News, April.) 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 (see 'Creditor Support Essential for Smooth Sailing in Shipping Restructurings,' Scott Greissman, White & Case LLP, Marine Money, October/November 2016). 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 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. An example was the floating charge privately introduced as part of a debt contract in England in the 19th century and still in widespread use today. The contract was challenged in the courts, and its refinement and standardization took decades to complete (see Franks and Sussman, 2005).

presented below is consistent with the view that such Coasian bargains, which avoid the direct cost of arrest and the opportunity cost of foregone cash flows during the arrest, are negotiated in the vast majority of cases. A simple workout would be a "voluntary" sale of the vessel, sometimes to a buyer found and even funded by the bank, using the proceeds to repay the bank, but allowing the owner to operate his remaining, downsized, fleet. We are also aware of more complicated workouts. For example, Pillarstone, a platform set up by KKR to manage the distressed shipping loans for banks is willing to inject cash into distressed loans. In return, the bank, itself capital constrained but recognizing the going concern value of the vessel, typically allows the new loan to be senior to the mortgage. Such a Coasian bargain is akin to Chapter 11 debtor in possession financing, albeit executed as a privately negotiated voluntary transaction.

During the sample period, LLI reports 2,195 arrests. This is a small number relative to the $370,000$ vessel-years recorded in Table 4 above. Figure 3 plots the fraction of the fleet's capacity, measured in DWT, that is under arrest, computed on a daily frequency. We exclude from the measure non-financial arrests, namely those with an "other" trigger (see Table 5 below).[29] Capacity under arrest, measured in DWT years is 0.4% during industry recessions and close to zero otherwise.

[Figure 3 about here.]

LLI narratives[30] reveal a variety of factors that provoke an arrest apart from financial distress: a drunken shipmaster, contraband, violation of international sanctions, fire, collision with another vessel, or disputes with suppliers. It is not always possible to distinguish financial from other factors that might trigger an arrest. For example, a client may have a vessel arrested on the grounds that the owner mishandled a cargo and caused damage. In such an event, it would be easy for a financially sound owner to find a bank that would guarantee payment, conditional on a ruling in favor of the client, and thereby quickly lift the arrest warrant. However, a distressed owner may not be able to obtain such a guarantee, thereby prolonging the arrest and exacerbating its own distress.

In the case of financial distress there are a variety of creditors that might trigger an arrest. Creditors may be divided into several categories: (i) operational creditors, e.g. the suppliers of

[29]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.

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

fuel (i.e. bunker suppliers) and suppliers of ship stores, known as ship chandlers, (ii) voyage related creditors, e.g. the crew and cargo owners, (iii) Government creditors, e.g. port authorities, and (iv) financial creditors e.g. mortgage holder(s). While the number of creditors maybe fewer than in other industries their ability to immobilise a vessel via a ship arrest provides far stronger control rights than in other industries.

Table 5 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. With reasonable confidence, we identify 538 arrests that are not directly related to debt collection, and another 803 arrests as being unlikely to be related, leaving 854 arrests as being definitely related to the failure to repay secured debt, as well as the wages of the crew and unsecured creditors e.g. bunkers. Of these 854 cases, 20% of the vessels are auctioned and the proceeds distributed to the creditors. 11% (of these 854) are "broken up" – industry jargon for scrap, against only 6% for the rest of the population – another indication of low quality in arrested vessels, a matter on which we shall elaborate in the next section. Most of vessel breakups take place in poor countries with weak environmental regulation like Pakistan or Bangladesh. The cost of supplying a vessel for a lengthy journey to a breakup destination might incentivise a distressed owner to abandon a vessel under arrest, biasing the length of arrest statistics.

[Table 5 about here.]

4.2 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 while in port, 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 6: the median period for which the vessel was immobilized 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 median sale value of a vessel is only $1 million, compared with an average value of ships sold of $9 million dollars for our entire sample. The costs of immobilization are not particularly small when we take into account the fact that

these do not include the loss of any forgone income during arrests. Bris, Welch and Zhu (2006), in an analysis of direct and indirect costs of US bankruptcies, state "Bankruptcy costs are very heterogeneous and sensitive to the measurement method used...". They document a range of 2% to 20%. Our estimates of direct costs for shipping lie within this range.[31]

[Table 6 about here.]

4.3 Distressed Sales of Vessels

We extend what we have learnt from Eastwind's decline (see Figure 2) to the entire sample. Since we lack comprehensive financial data, we identify financial distress using the event of arrest. For a given arrest event, irrespective of the trigger, we assume that the owner of the arrested vessel is distressed during a 3 year period straddling the arrest event. We use two additional tighter definitions to identify distress: first, where there are multiple (at least two) arrests for the same owner within a three year calendar period, and second, where the arrest event is triggered by a mortgage holder, crew or an unsecured creditor (e.g. bunker supplier). For each of these three definitions of distress, we look for sales of ships that occurred over the three year window straddling the event year of arrest. We also identify companies at the extreme level of distress which went bust. We define a bust company that had at least one vessel arrest and subsequently disappeared from the ownership register. We only classify a company as a bust if it had suffered an arrest to ensure we do not capture a non-distressed company that disappeared from the ownership register because of a merger or other reasons, unrelated to distress.

To provide some validation for our metrics for distress and bust, we undertook a Factiva search for distress and bankruptcy in the shipping industry. We found twenty six firms that were seriously distressed or entered bankruptcy (the list is available on request). All 26 show up in our distressed sample, and 22 show up in the bust sample. Eastwind shows up in the distress sample, but not the bust one, because at the end of 2010 the company was still registered and owned 7 ships.

During the three year window straddling the arrest event for a given company, we locate all the vessels sold at the holding company level. We classify the non-arrested vessels sold by these distressed firms as distressed sales. Table 7 reports the arrest rates for different definitions

[31] They cite much longer periods for both Chapter 7 and Chapter 11 bankruptcies. The average time spent in a Chapter 11 bankruptcy is 828 days (median time is 866 days)and 709 days (median time is 672 days) for Chapter 7 bankruptcies.

of distress. The unconditional probability of arrest in DWT years is just 0.21% (see Panel A) which is consistent with Figure 3 above. The arrest rate increases to 0.41% when capacity is measured in vessel years. The difference reflects the smaller size of arrested vessels. While the unconditional vessel size is 37,226 DWT, the average size of an arrested vessel is only 18,861 DWT.

In Panel B of the table, we report the number of arrests and sales (of non arrested ships) for distressed firms, where a distressed firm is classified as one with at least one or multiple arrest events, respectively. The number of arrests for distressed firms with at least a single arrest event is 215, and the number of arrests for distressed firms classified on the basis of multiple arrest events is 130. More significantly, the number of sales of ships during the distressed episode is 410 for firms with at least one arrest and 218, for those with multiple arrests. In Panel C, we further restrict distress events to creditors triggering arrest (including the mortgage holder, the crew and the unsecured creditor). These creditors are responsible for around 60% of all arrests documented in Panel B. In Panel D, we compare the statistics on arrest for the bust and non bust samples. We show that the number of arrests is slightly greater in the bust sample at 1,126 compared with the non bust sample, at 1,069, but the probability of arrest is much greater in the bust sample, 6.83% using vessel years, compared with 0.19% for the non bust sample. These comparative statistics confirm the effectiveness of our proxies for distress.

[Table 7 about here.]

4.4 Arrests, Coordination Failures and Firm Liquidation

If all vessels were separated into limited liability companies with non recourse lending, we would not expect a coordination failure on one vessel to spillover to another vessel. However, where the financing of vessels is recourse, that is the debt is issued at the holding company level, then we would expect spillovers and to observe multiple vessels being arrested. We draw on the insight presented in Figure 2 above, tracking Eastwind's decline: that an arrest rate well below 100% throughout the distress cycle, is not consistent with a creditors run. In a run, creditors are driven by a first-mover advantage, and would thus grab any asset that has not already been seized by another creditor. We might infer from Eastwind that either the ships were financed with non-recourse debt or the company was able to strike a Coasian bargain with its creditors. In fact we know that twelve of Eastwind's vessels were subject to a double mortgage with Nordea Bank, the equivalent of non-recourse financing. In contrast, Hanjin had large amounts of unsecured

debt at the holding company level and many of their ships were financed on a recourse basis.[32] As we discussed earlier in the paper, this created what looked like a creditors run.

We apply the analysis used in Eastwind to the firms in our sample. We measure the proportion of ships that were arrested during the period of distress, for companies that disappeared from the ownership register following an arrest; we refer to those companies as bust companies. If there was a creditors run, we would expect to observe a high proportion of arrests, close to 100%. For each company that went bust, we record the number of vessels owned by the company before it entered into distress. As previously defined, a distress episode is a 3 year window straddling the arrest of a vessel (eighteen months either side of the arrest event). Therefore, we record the fleet size of a company 18 months before the first arrest is triggered, and compute the arrest rate for the firm, as the ratio of the number of vessels arrested to the total fleet size pre-distress.

We focus on the shipping companies that had at least 5 vessels prior to entering distress, and identify 165 companies that went bust. In Table 8 we report the distribution of arrest rates for these companies. A low arrest rate implies that either most of the company's debt was non-recourse, or the company was able to negotiate a Coasian bargain with most of its creditors. In columns (1) and (2), we find that only 7 of the 165 firms had an arrest rate of more than 80%. We conjecture that these cases are likely instances of a creditors run. In columns (3) and (4) of Table 8, we further condition our sample on shipping companies with at least 10 vessels pre-distress. We find that 4% of the 80 shipping companies that went bust had an arrest rate over 80%.[33] If we lower the threshold of a creditors run to an arrest rate of 60% or more, the proportion of companies in this category would rise to 9%.

The 7 companies with an arrest rate of 80% or more (see columns (1) and (2)), owned a total of 138 ships, of which 118 were under arrest. One company, Adriatic Tankers owned 86 of these ships, of which 73 were arrested. An investigation of the circumstance of their failure suggests the company entered formal bankruptcy largely due to economic distress. This culminated in a dispute with an international labour union, triggered by the large scale abandonment of ships by crews in European ports because of non-payment of wages (see Couper (1999)).[34] In

[32] Loans which are recourse are often called 'sister ship clauses' because creditors of one company in the group (or of the holding company) may grab assets of another company in the same group.

[33] When we condition on at least 20 vessels pre-distress, 2 out of 29 companies had an arrest rate greater than 80%. Results available on request.

[34] "Many of Adriatic Tankers' seafarers fell foul of the police in Rotterdam while abandoned ashore awaiting their wages...they were required to see that they were repatriated whether they had been paid or not." (page 44 of Couper (1999))

addition, a significant amount of the company's debt was in the form of (unsecured) private placement debt with a large number of US insurance companies and pension funds rather than the traditional ship mortgage. One result of this financing would have been the common pool problem described earlier by Jackson (1986), and an increase in coordination failures. A second company, Abu Dhabi Container Line, had 10 ships of which 8 were arrested. The ships were only about 2 years old, and their failure was due to systemic mechanical (engine) failure that affected most of their vessels; the failure sharply diminished their earning power.[35] Like Adriatic, this is a case of economic distress. Metrics for the quality of these arrested ships suggest they were below the average of our sample: of the 118 arrested ships, 10, or about 8%, were broken up. The arrested vessels are also smaller (on average 29,310 DWT versus 46,497 DWT for non arrested vessels owned by bust companies).

This analysis also suggests that many bust companies managed to liquidate their assets without resorting to a significant proportion of arrests. 82 of the bust companies had arrest rates of below 20% of their capacity. The relatively low rate of arrests for the whole industry, and for bust companies in particular, is likely to be a direct consequence of the fact that contractual rights of creditors on individual ships were well defined. Notwithstanding, a small proportion of bust companies were subject to a high arrest rate and coordination failures which bore a resemblance to a creditors run. However, there is some indication that these coordination failures may have been more the result of economic distress rather than financial distress. Chapter 11-like procedures are usually justified on the basis of financial distress, so as to avoid premature liquidation of economically solvent firms.

[Table 8 about here.]

5 Estimating Fire Sale Discount

LLI's arrest narratives, which we have used in order to classify arrests by trigger and resolution (see Table 5 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

[35] As a result, the quality discount on these ships was much higher than on other arrested ships, 22% versus 13%. See section 5 for a description of the quality discount.

the standard technique of measuring the fire sale discount, pioneered by Pulvino (1998) may be biased as it takes into account assets observed characteristics that affect the price of the vessel or the aircraft, like age or model, but not unobserved characteristics such as the quality of maintenance. In this section, we suggest a method that can proxy for this unobserved maintenance. More specifically, we use duration analysis that measures the vessel's "economic life expectancy", that is the expected number of years of service until it is "broken up", conditional on its "registered age", that is the number of years since it started service. We first demonstrate a vessel under arrest is effectively older by roughly 1.7 years compared with a non arrested vessel. We then price this effect using the standard hedonic price regression. As a result, the Pulvino measured discount is reduced by about one half.

5.1 Hedonic Regression

Fire-sale discounts are measured against a price benchmark: the counterfactual sales price of a given arrested ship, i.e., had the sale not been forced. We apply our technique in two stages. In the first stage, we estimate a hedonic model, based on observed characteristics, to calculate a ship's benchmark price. The equation is given by:

$$log(Price)_{it} = \beta_t + \beta X_{it} + \epsilon_{it} \tag{1}$$

where $Price_{it}$ denotes the price of vessel i transacted in period t. β_t is year fixed effect. X_{it} denotes a vector of technical characteristics (such as DWT, vessel length, breadth, freeboard and draft), transaction characteristics (such as whether the transaction was part of a block sale of several vessels and the age (Age_{it}) of the vessel at sale) and the vessel's type (bulk carrier, tanker, container etc.). Definitions of vessel-related variables are provided in Appendix A. The results are reported in column 1 of Table 9. An adjusted R^2 of 87% indicates that the predicted ship price from the hedonic model can serve as a good benchmark. Notice that a Block transaction is priced 2.4% higher than an ordinary transaction.

Following the methodology of Franks et al. (2020), we proxy for an unobserved quality component of the vessel by including the imputed life expectancy of the vessel in the hedonic regression. We can only make this correction because vessels (unlike houses) have a finite life and are eventually broken up.[36]

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

We denoted the hazard function by $\lambda_i(Age)$. The hazard function gives us the hazard rate for a ship i as a function of its age. The hazard rate corresponds to the probability of vessel i breaking up at a certain age conditional on surviving upto that age. Furthermore, we define the remaining economic life expectancy of a vessel at a given age as:

$$L_i(Age) = (1-\lambda_i(Age)) \cdot \lambda_i(Age+1) + (1-\lambda_i(Age)) \cdot (1-\lambda_i(Age+1)) \cdot \lambda_i(Age+2) \cdot 2 + ... \quad (2)$$

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 irrespective of their type. We find that for a ship at any given age, the probability of an instantaneous breakup, i.e. hazard rate, is higher for arrested ships relative to non-arrested ships, as plotted in Figure 4. In robustness tests, we estimate a Cox proportional hazard model that allows us to partially control for the characteristics of ships. The results are qualitatively very similar. The relevant methodology is described briefly in Appendix B.

[**Figure 4 about here.**]

In column 2 of Table 9 we add the derived "Life expectancy" ($L_i(Age)$) 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 9 about here.**]

In the second stage, the fire sale discount is calculated by regressing the residual from the hedonic model on a dummy indicating whether a ship is a forced sale, to derive the fire sale discount on arrested ships.

In Table 10 we report the price discount partitioned by whether the sale was made after an arrest, or whether the sale was made by a distressed owner but without an arrest. In column 1 (without quality correction, W/O QC) we examine the fire sale discount on arrested ships and find that, on average, they are sold at a discount of 26.2% relative to normal ship transactions. These estimates are quite similar to those that have been reported in Pulvino (1999) on the sale of used commercial aircraft by airlines operating under bankruptcy protection. In column 2, where we control for the quality of the ship by adding life expectancy of ships, this discount

reduces to 13.8%, suggesting that roughly half of the raw 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] We find 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 (Results available on request).

In columns 3 and 4, we also calculate the fire sale discount on ships that are sold by distressed owners, but which have not been arrested. The variable *Distressed(>=1)* is an indicator variable that takes on a value of 1 for non-arrested ship sales by firms that are defined as distressed because they have experienced at least a single arrest episode in the 3 year event window straddling the vessel sale (same definition as in section 4). In columns 5 and 6, we use a tighter definition of distress and restrict the classification of distress sales to non-arrested vessel sales by owners that have experienced multiple arrest episodes in the 3 year event window straddling the vessel sale (*Distressed(>1)*). We find the raw fire sale discount for distressed sales to be 11.4% and it drops slightly to 11% when we control for quality. The discount on sale of non-arrested vessels by distressed owners remains almost identical when we use a tighter definition of distress triggered by multiple arrest events.

In columns 7 and 8, we focus on distress events where there is an arrest triggered by mortgage holders, crew and unsecured creditors. The variable *Distressed(Fin)* takes on a value of 1 for non-arrested ship sales by firms that have experienced at least a single arrest episode triggered by a mortgage lender, unsecured creditor, or crew in the 3 year event window straddling the vessel sale. We report a similar fire sales discount of 10.6% on distressed sales triggered by creditors. The fire sale discount on distressed sales of ships is therefore, robust to different definitions of distress.

The small quality discount in distressed sales suggests that under-maintenance does not seem to be a significant factor for sales of ships that belong to distressed owners, but which have not been arrested. In columns 4, 6, and 8, we note that virtually the entire quality discount is driven by arrested ships. The overall discount for arrested ships decreases from 26.2% to 13.8% when one controls for the quality of ships. After correcting for the quality discount in column 4, we estimate the fire sale discount at 13.8% for arrested ships; which is very similar in magnitude to the discount of 11% for sales of (non arrested) ships by distressed firms. Their similarity suggests that the cost of the forced sale resulting from an illiquid market for arrested ships is modest. We may have expected the liquidity component to be larger for arrested ships because the forced

[37] This can be calculated by $(26.2\% - 13.8\%)/7.5\% \simeq 1.7$.

cash auction might have been expected to accelerate the sale, which could have reduced the number of bidders and the auction price compared with distressed sales, where more patience can be exercised during 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. Consistent with this observation, we report in Table 13, a relatively high number for the median number of bidders for a sample of auctions.

[Table 10 about here.]

In summary, we find that arrested ships generate a raw fire sale discount of roughly 26%, which is similar to what has been documented in prior studies on aircraft and foreclosed homes. Interestingly, however, we find that as much as half of this discount is due to the unobserved low quality of arrested ships. Moreover, the fire sale discount with quality correction is similar to the liquidation discounts on distressed sales, indicating that the costs of delay (and by inference, the benefits of automatic stay) are small in the shipping industry. In the next sub section, we explore some other determinants of the fire sale discount.

5.2 Other Determinants of the Fire Sale Discount

In Table 11, we conduct additional cross-sectional tests to investigate the heterogeneity in the fire-sale discount. 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 defining a corruption index, we use the one devised by La Porta et al. (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.[38] As can be seen in Table 11, 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 2 and 3).

[**Table 11 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 12. 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 the quality correction, the discount largely 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 12 about here.**]

In summary, the raw fire sale discount in our paper is very similar to the fire sale discount that has been documented by Pulvino (1999). 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. If the forced sales are confined to low corruption ports the discount is reduced to 11%. Where the fire sales are a result of a large liquidity discount, they can be mitigated by a bankruptcy procedure with an automatic stay so as to overcome coordination problems among creditors

[38]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.

and forced sales of assets. However, the evidence in this section suggests that the value of an automatic stay may be 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 large liquidity discount is also consistent with the evidence in earlier sections that costly coordination failures are largely absent from this industry.

5.3 Auctions

An important result in this paper is that auctions of arrested ships result in low fire sale discounts after corrections for under-maintenance and for low quality ports. A key issue here is how efficient the auction process is in high quality ports. One aspect of efficiency is the number of bidders for a vessel that is being auctioned. Using the same hand-collected sample of UK auctions used in Table 6, Table 13 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. However, the spread between the top two bidders is large, 24% on average.

The liquid market in these auctions reflects the sophisticated dealer network, where dealers are long established and therefore can more easily communicate with potential buyers. Some of these dealers, for example CW Kellock, have been trading in this market for more than 100 years. The ability to survey a ship quickly and accurately, possibly in a distant port, expedites the process of sale. This is particularly important because many of the arrested vessels might have defects and will be of low quality.

[**Table 13 about here.**]

5.4 Comparison of Fire Sale Discount

In this section we discuss whether the absence of state mandated bankruptcy procedures results in larger fire sale discounts on disposition of assets by a firm. We benchmark our results in the shipping industry against fire sale discounts reported in assets operating under different bankruptcy regimes. In Table 14 Panel A, we show that the 26% raw fire discount on the sale of arrested ships, is comparable to the 27% fire sale discount documented in foreclosed home sales (Campbell et al. (2011)), and the 20-30% fire sale discount documented on the sale of commercial aircraft by airlines operating under U.S. bankruptcy protection (Pulvino (1999)).

The under-maintenance effect on ships raises the question as to whether the same effect could be present in other empirical studies documenting large fire sale discounts. For example, in an analysis of Eastern Airlines' bankruptcy Weiss and Wruck (1998) have noted that "the discount on Eastern's airplanes could be due to many factors including its distressed situation and/or poor maintenance." It is fairly common for airlines to swap engines and other parts of an airplane, and subsequently sell aircraft that have been fitted with second hand parts. Franks et al. (2020) document an under-maintenance effect in aircraft sold by airlines operating under bankruptcy protection. Identical patterns of longevity can be identified for aircraft owned by airlines operating under bankruptcy protection, and such aircraft have a significantly lower remaining economic life expectancy versus the aircraft owned by non-bankrupt airlines. Moreover, these aircraft also have lower flying hours compared to other similar aircraft flown by the new operator.

The quality correction due to under-maintenance is also well documented in the real estate literature. Even though the raw fire sale discount on sale of foreclosed houses is 27%, Campbell et al. (2011) express concerns over the vandalism and poor maintenance of foreclosed houses. They also document around 8-9% poor maintenance discount on houses sold by older sellers. In a separate study of forced house sales in Denmark, resulting from sudden death of house owners Andersen and Nielsen (2017) report an average fire sale discount of 8.9%. In their setup sudden deaths provide a close to random draw of house owners, which ensures that individual and house characteristics are exogenous. Therefore, we can conclude that the under-maintenance effect is not specific to the shipping industry, rather it has been recorded in other real assets as well.

[Table 14 about here.]

Pulvino (1999) finds evidence indicating that neither protection under Chapter 11 of the bankruptcy code nor court-supervised liquidation under Chapter 7 of the code are effective at eliminating fire sale discounts. Our paper complements this finding by documenting similar fire sale discounts in freedom of contracting regimes. Empirically the findings do not support the contention that mandatory bankruptcy procedures help mitigate fire sale discounts and improve resource allocation. We even observe that after controlling for the lower quality of arrested ships, the quality-adjusted fire sale discount is similar in magnitude to the fire sale discount reported in financial assets (see Table 14 Panel B).

6 Conclusion

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

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 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. 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.

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.[39] 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 the procedures should be made mandatory or optional. We recognize that in the case of large firm failures like Hanjin, mandatory Chapter 11 might be desirable to internalise the externalities.

Even ignoring the externalities associated with large firm failures, the question remains, whether our 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 mandatory 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, airlines, oil and gas, and mining companies. Congress has already recognised the value of limiting the intrusion of bankruptcy law into some of these industries by exempting them from an automatic stay, for example, aircraft under the Capetown Convention (Section 1110, 1994 Bankruptcy Act), and private-label mortgage collateral (2005, BAPCPA); see Lewis (2019). In addition, Section 363(b) of the US Bankruptcy Code allows a company

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

to sell its assets outside the ordinary course of its business during Chapter 11 bankruptcy proceedings.

However, there are many industries where asset complementarities make the segregation of assets more difficult. In this respect, we would be cautious in generalizing our results to other industries. Nevertheless, even here we might speculate that contractual innovations and well-developed capital markets might mitigate many of the costs claimed as justifying a mandatory and 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 weight of the cargo plus the weight of the container, trailer, shipment or 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.

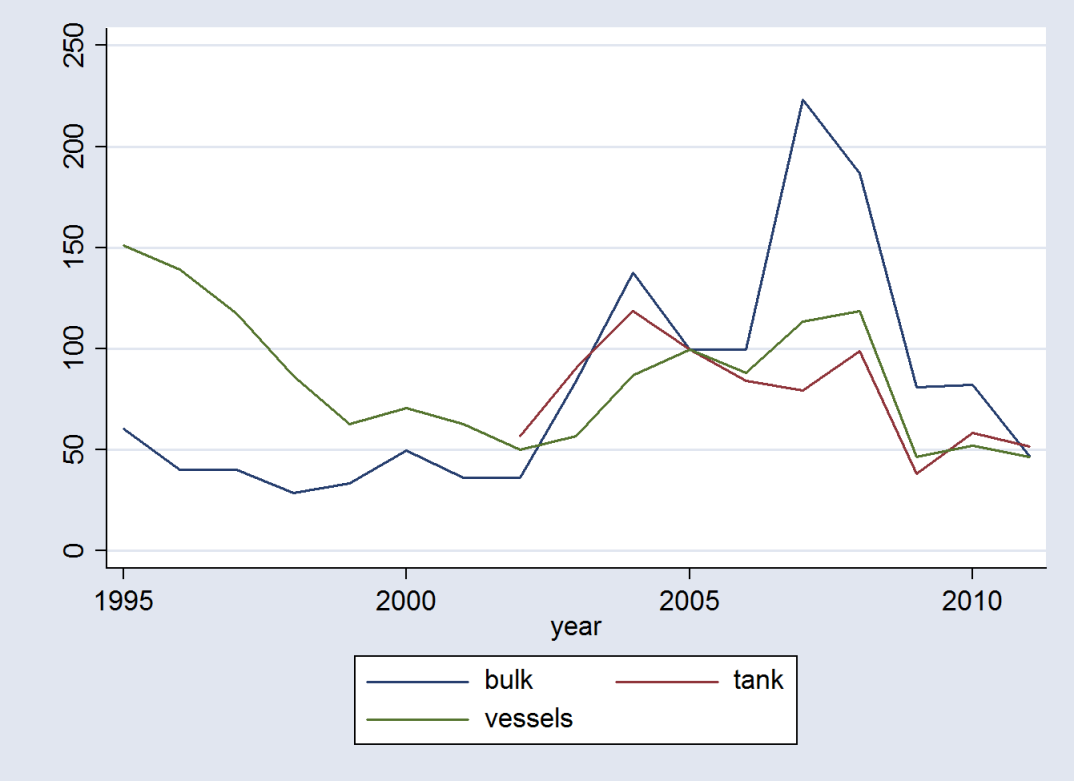

Figure 1: Charter Rates and Vessel Price Indexes, $P_{2005} = 100$**.** In this figure, we show the charter rates in the tanker and bulk rate businesses and the price indexes of vessels from 1995 to 2011.

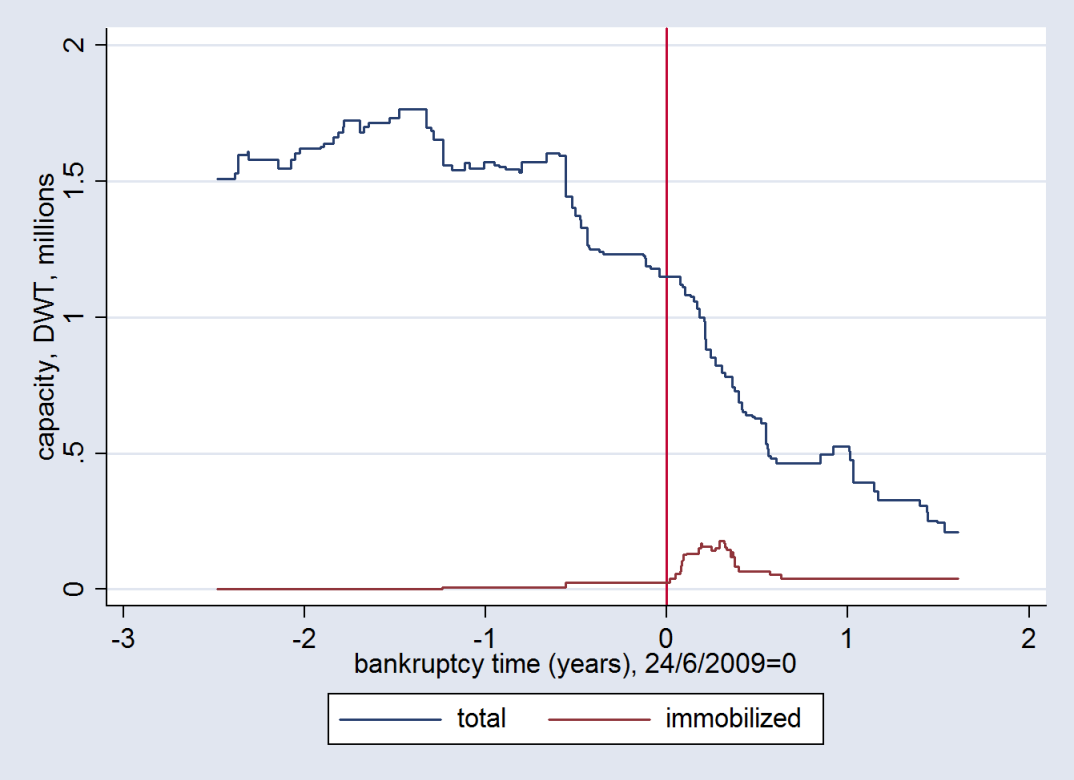

Figure 2: Eastwind's Cycle of Distress. In this figure, we track Eastwind's cycle of distress on a daily frequency. The top (blue) line tracks the company's total capacity (in millions of DWTs) while the bottom (red) line tracks capacity that is immobilized due to arrest.

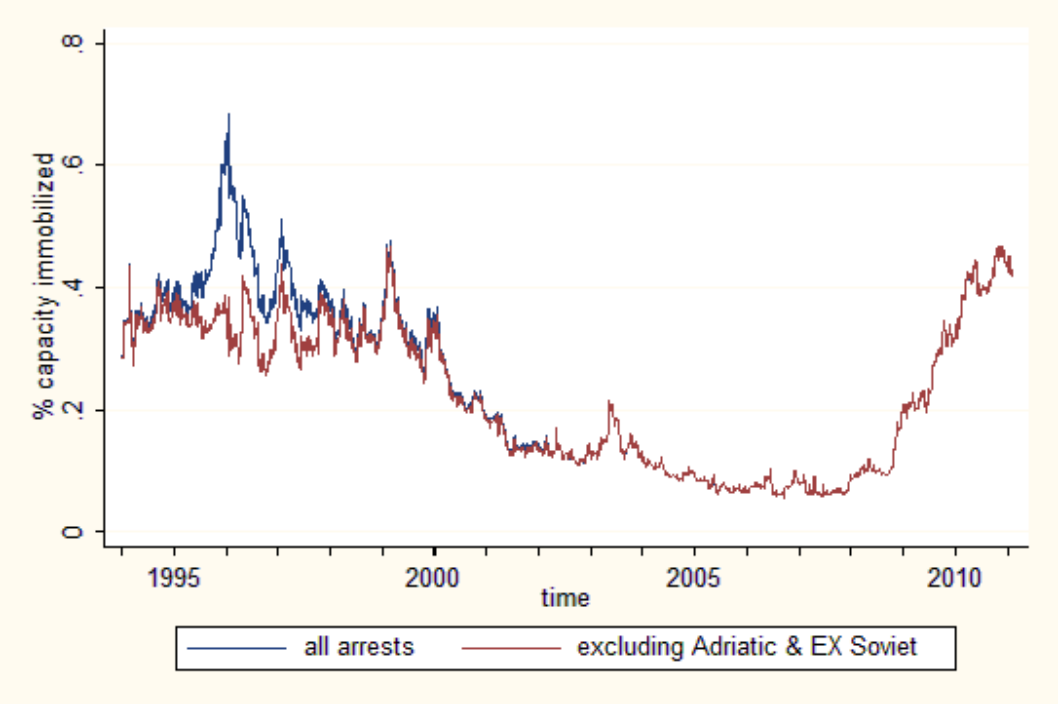

Figure 3: Capacity under Arrest as a Percentage of Total Capacity. In this figure, we track the amount of immobilized capacity (that is, capacity under arrest) as a percentage of total industry capacity, measured in DWT. The bottom (red) line excludes the bankruptcy of Adriatic Tankers and some ex-soviet companies that went bankrupt with old and sub-standard fleets following the break-up of the Soviet Union.

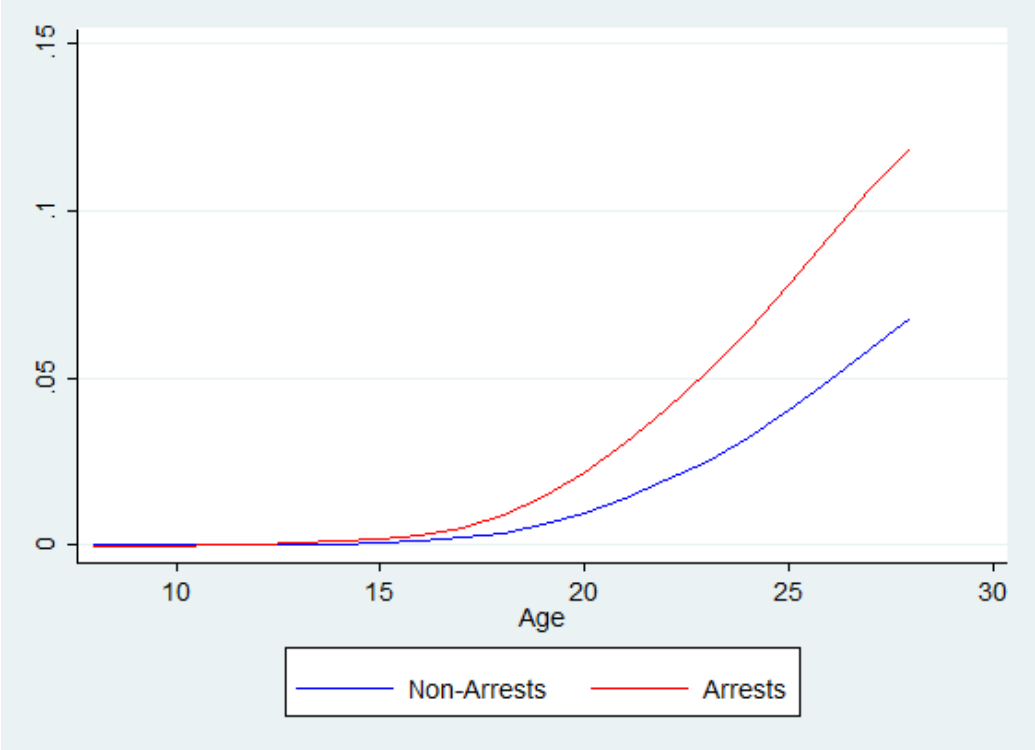

Figure 4: Hazard Rate for Arrested and Non-arrested Vessels. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the arrested (red/top line) and non-arrested (blue/bottom) vessels at any given age.

Table 1: 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 854 arrest cases triggered by failure to repay secured debt, unsecured creditors or the wages of the crew. *N arrests* reports the number of arrests by each port. *Arrest(%)* reports arrests as a percentage of total arrests. *Traffic(%)* reports the traffic on the port as a percentage of global shipping traffic.

	N arrests	Arrest (%)	Traffic (%)
Arrest specialized ports			
Gibraltar	35	4.1	0
Hong Kong	20	2.3	1.7
Netherlands	47	5.5	3.5
Singapore	44	5.2	3.3
South Africa	28	3.3	1.2
UK	115	13.5	2.8
other	565	66.2	87.6
High volume ports			
Australia	12	1.4	5.1
China	13	1.5	15.8
Germany	10	1.2	2.3
Japan	3	0.4	6.6
South Korea	5	0.6	5.8
USA	38	4.4	11.9
other	773	90.5	52.5

Table 2: Funding data for twenty seven vessels

This table reports capital structure information at vessel level from the accounts of 27 subsidiaries of 7 shipping firms registered in several jurisdictions. Statistics on five variables are reported, as listed in column 1. Source: Data supplied by a shipping consultancy firm.

	mean	median	min	max
maturity of loans (years)	7	6	4	12
loan amount ($, million)	43.5	51.3	14.7	70
loan/value (%)	64.8	70.1	44	76
balloon payments (n=25, $ million)	18.3	14.4	0	48.1
spread over LIBOR (%)	2.35	2.75	1.4	2.75

Table 3: Comparison of Leverage in Shipping versus other Transportation Industries

This table compares the leverage ratio and interest rates on shipping loans versus other transportation loans. In columns (1) and (2), the dependent variable is the book leverage ratio (Total Debt/Total Assets). In columns (3) and (4), the leverage ratio includes capital and operational lease obligations. In columns (5) and (6), the dependent variable is the Interest Rate. The leverage ratio and interest rate are regressed on an indicator variable for whether the firm belongs to the shipping industry, and firm level controls such as asset tangibility and profitability. *Shipping Firm* is the indicator variable that takes value 1 if the firm is a shipping firm. The variable *Tangibility* equals Tangible Assets/Total Assets. *Profitability* is defined as operating income after depreciation scaled by (lagged) total assets. Country and year fixed effects are included. Source: Data is from COMPUSTAT (North America and Global)

	(1) Leverage Ratio (W/O Leasing)	(2) Leverage Ratio (W/O Leasing)	(3) Leverage Ratio (With Leasing)	(4) Leverage Ratio (With Leasing)	(5) Interest Rate	(6) Interest Rate
Shipping Firm	0.046***	0.026***	0.047***	0.047**	-0.005***	-0.002**
	(0.002)	(0.002)	(0.017)	(0.020)	(0.001)	(0.001)
Tangibility		0.229***		-0.225***		-0.047***
		(0.008)		(0.036)		(0.002)
Profitability		-0.354***		-1.047***		-0.044***
		(0.017)		(0.121)		(0.006)
Year FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Observations	22,203	20,070	5,393	4,538	22,203	20,070
Adjusted R^2	0.103	0.185	0.020	0.276	0.103	0.179

Table 4: 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 5: Arrests, by trigger and resolution

This table reports the number of arrests triggered by various creditors, and how the arrest event was subsequently resolved. The classification is made on the basis of LLI narratives in conjunction with other information including data on transfer of ownership and, break-up of vessels.

		Party Triggering Arrest					
		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 6: 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 7: Capacity under arrest, by outcome

This table reports the capacity under arrest for all the arrested ships identified in Table 5. Panel A describes the probability of arrest based on all the vessels in the sample. Panel B reports the capacity sold for the population of firms affected by the occurrence of a distress event. Further they are partitioned based on the occurrence of a single arrest event ($Arrest >= 1$) or multiple arrest events ($Arrest > 1$). Panel C restricts the sample to distress episodes triggered by mortgage, crew and unsecured creditors. Panel D further partitions the sample into companies that went bust and those that did not. A shipping firm is classified as *bust*, if the firm had at least one arrest episode, and subsequently it disappeared from the ownership register. 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
Capacity under arrest	1,580	30
No. of arrest events	2,195	
Probability of arrest	0.41%	0.21%
Avg. duration of arrest (years)	0.75	
Avg. vessel size (DWT)	37,226	
Avg. size in arrest (DWT)	18,861	

Panel B	Distressed Firms with Arrested Vessels			
	Arrest>=1		Arrest>1	
	vessel years	DWT years,10^6	vessel years	DWT years, 10^6
Capacity sold under arrest*	10,507	361	5,605	178
No. of sales during arrest episode*	410		218	
No. of arrest events	215		130	

Panel C	Distressed Firms with Arrests triggered by Mortgage/Crew/Unsecured Creditors			
	Arrest>=1		Arrest>1	
	vessel years	DWT years,10^6	vessel years	DWT years, 10^6
Capacity sold under arrest*	6,852	242	4,132	121
No. of sales during arrest epsiode*	261		159	
No. of arrest events	128		80	

Panel D	No Bust		Bust	
	vessel years	DWT years, 10^6	vessel years	DWT years, 10^6
Total capacity	380,611	12,837	12,485	632
Capacity under arrest	726	19	853	23
No. of arrest events	1,069		1,126	
Probability of arrest	0.19%	0.15%	6.83%	3.66%
Avg. duration of arrest (years)	0.68		0.76	

*These include the sales of non-arrested ships during an arrest episode (distress event)

Table 8: The distribution of arrest rates for companies that went bust

This table focuses of *bust* companies, that disappeared from the ownership register following an arrest event. *Arrest Rate* is defined as the proportion of vessels arrested to the total number of vessels owned by the firm pre-distress (i.e. 18 months prior to the arrest of the firm's first vessel). The table reports the frequency and the percentage of companies that went bust using 6 different partitions of arrest rate. In columns (1) and (2), we condition on companies having at least 5 vessels pre-distress, and in columns (3) and (4) on companies having at least 10 vessels pre-distress.

	At least 5 vessels		At least 10 vessels	
	frequency	percentage	frequency	percentage
(0,20%)	82	49.7	50	62.5
[20%,40%)	48	29.1	14	17.5
[40%,60%)	19	11.5	9	11.3
[60%,80%)	9	5.5	4	5.0
[80%,100%)	5	3.0	3	3.8
100%	2	1.2	0	0
Number of bust firms	165	100	80	100

Table 9: Hedonic Model, with and without quality correction

This table reports the results from the first stage hedonic regression as in equation 1. 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	0.024***	0.024**
	(0.009)	(0.009)
Age	0.042	0.145*
	(0.075)	(0.081)
Age^2	0.000	-0.001***
	(0.000)	(0.000)
Special unit	-0.001	-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	0.035***	0.035***
	(0.003)	(0.003)
Depth	0.047***	0.046***
	(0.005)	(0.005)
Draft	0.015***	0.014***
	(0.005)	(0.005)
Freeboard	-0.000	-0.000
	(0.000)	(0.000)
Life Expectancy		0.075***
		(0.011)
Time FE	YES	YES
Type FE	YES	YES
Observations	9,479	9,479
Adjusted R^2	0.873	0.872

Table 10: Fire Sale Discount: Difference between actual price and imputed price

This table reports the results from the second stage which regresses the price discount (residual from the hedonic regression) 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. In columns 3 and 4 we classify the sales by firms with at least one arrest episode in the 3 year event window straddling the arrest as *Distressed*(>= 1) sales. In columns 5 and 6 we classify the sales by firms with multiple arrest episodes (more than one) in the 3 year event window straddling the arrests as *Distressed*(> 1) sales. In columns 7 and 8 we classify the sales by firms with arrests triggered by financial triggers (i.e. mortgage, unsecured and crew triggered) in the 3 year event window straddling the arrest as *Distressed*(*Fin*) sales. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	W/O QC	With QC	W/O QC	With QC	W/O QC	With QC	W/O QC	With QC
Arrested	-0.262***	-0.138***	-0.262***	-0.138***	-0.261***	-0.137***	-0.261***	-0.138***
	(0.038)	(0.039)	(0.038)	(0.039)	(0.038)	(0.039)	(0.038)	(0.038)
Distressed(>=1)			-0.114***	-0.110***				
			(0.035)	(0.035)				
Distressed(>1)					-0.105*	-0.103*		
					(0.060)	(0.061)		
Distressed(Fin)							-0.109**	-0.106**
							(0.052)	(0.053)
Constant	-0.000	-0.000	0.000	0.000	-0.000	0.000	-0.001	-0.001
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	8,950	8,950	8,950	8,950	8,950	8,950	8,950	8,950
Adjusted R^2	0.011	0.003	0.012	0.004	0.011	0.003	0.011	0.003

Table 11: Fire-sale Discount Decomposition Analysis: Second Stage Regression Results

This table reports the results from the second stage which regresses the residual from the hedonic regression on an indicator variable that takes on a value of 1 if the ship is arrested and 0 otherwise. Column (1) represents the full sample. Columns (2) and (3) split the sample of arrested ships 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)	(2)	(3)
	Full Sample	High Corruption	Low Corruption
Arrested	-0.134***	-0.214***	-0.110***
	(0.035)	(0.060)	(0.040)
Constant	0.000	0.000	0.000
	(0.003)	(0.003)	(0.003)
Observations	9,673	9,550	9,627
Adjusted R^2	0.003	0.003	0.002

Table 12: Fire-sale Discount and Business Cycles: Second Stage Regression Results

This table reports the results from the second stage which regresses the residual from the hedonic regression 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)	(2)	(3)	(4)	(5)	(6)
	W/O QC	W/O QC	W/O QC	With QC	With QC	With QC
	Good Time	Bad Time	Interaction	Good Time	Bad Time	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	5,373	4,054	9,427	5,373	4,054	9,427
Adjusted R^2	0.002	0.022	0.012	0.000	0.008	0.004

Table 13: Auction data from UK ports

This table describes the number of bidders for vessels arrested and sold in UK ports. Column 2 reports the number of bidders, column 3 reports the spread between the top 2 bidders as a percentage of the sales price, and column 4 reports the spread between the top 3 bidders as a percentage of the sales price.

	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%

Table 14: Comparison of Fire Sale Discount across Asset Classes

This table lists the fire sale discounts reported by several papers across different asset classes in real assets and financial assets. The table also reports the quality-adjusted fire sale discounts for real assets.

Panel A		**Real Assets**			
Asset Class	Reason for Fire Sale	Raw Fire Sale Discount	Paper	Quality-Adjusted Fire Sale Discount	Paper
Ships	Arrested Sales	26%	This Paper	13%	This Paper
Houses	Foreclosures or Forced Sales	27%	Campbell et al.(2011)*	9%	Andersen et al.(2016)
Aircraft	Distressed Sales	15%	Pulvino(1998)	8%	Franks et al.(2020)
Aircraft	Sales in Chapter 11 Bankruptcy	20%	Pulvino(1999)	9%	Franks et al.(2020)
Aircraft	Sales in Chapter 7 Bankruptcy	30%	Pulvino(1999)	12%	Franks et al.(2020)

Panel B	**Financial Assets**		
Asset Class	Reason for Fire Sale	Fire Sale Discount	Paper
Equity	Forced stock sales by distressed Mutual Funds	8-10%	Coval et al.(2007)
Bonds	Downgraded corporate bond sales by constrained Insurance Firms	6-7%	Ellul et al.(2011)
Debentures	Hedge Fund deleveraging during 2008 crisis	10-15%	Mitchell et al.(2012)

*Campbell et al. (2011) extensively document that the discount on foreclosed homes could be due to vandalism and/or poor maintenance. In a separate set of non-foreclosed houses sold by old homeowners they document an 8-9% discount, which is interpreted as an under-maintenance discount as old people have lower incentives to maintain their homes.

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