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

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May 2017

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Abstract

We study the resolution of financial distress in shipping, where the ex-territorial nature of assets has distanced the industry from on-shore bankruptcy legislation. We demonstrate how contracts and private institutions have adapted to the industry's special circumstances so as to deliver an effective resolution of financial distress. We investigate three costs of distress: coordination failures leading to the arrest of ships, the direct costs of arrest and auction, and the fire sale discount. We find that most arrests are not caused by coordination failures but rather are precipitated by debtors whose equity is far out of the money and where the ships are close to their break up values. The direct costs of arrest and auction are 8% of a vessel's value, and there is an average fire sale discount of 26%. However, when we control for the low quality of such ships (due to under-maintenance), their low value, and corrupt versus non-corrupt ports, the discount is no more than about 5%. We find an equivalent under-maintenance effect in aircraft operated by airlines in Chapter 11 bankruptcy. The results inform the debate about the need for mandatory bankruptcy laws that are justified by coordination failures between creditors and large fire sale discounts.

Keywords: Bankruptcy, Shipping, Freedom of Contracting, Fire Sales

JEL Classifications: G33, L33, G23

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Evidence from Financial Distress in the Shipping Industry*

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Abstract

We study the resolution of financial distress in shipping, where the ex-territorial nature of assets has distanced the industry from on-shore bankruptcy legislation. We demonstrate how contracts and private institutions have adapted to the industry's special circumstances so as to deliver an effective resolution of financial distress. We investigate three costs of distress: coordination failures leading to the arrest of ships, the direct costs of arrest and auction, and the fire sale discount. We find that most arrests are not caused by coordination failures but rather are precipitated by debtors whose equity is far out of the money and where the ships are close to their break up values. The direct costs of arrest and auction are 8% of a vessel's value, and there is an average fire sale discount of 26%. However, when we control for the low quality of such ships (due to under-maintenance), their low value, and corrupt versus non-corrupt ports, the discount is no more than about 5%. We find an equivalent under-maintenance effect in aircraft operated by airlines in Chapter 11 bankruptcy. The results inform the debate about the need for mandatory bankruptcy laws that are justified by coordination failures between creditors and large fire sale discounts.

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

Sami Ofer (shipping magnate)

1 Introduction

The last thirty years have witnessed a significant expansion of judicial 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. 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). And yet, it is fair to say that the principle of *freedom of contracting,* whereby privately (re)negotiated debt contracts, unrestricted by regulation or legislation, are strictly enforced 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.

It seems that these developments have been driven by a strong conviction that in the absence of vigorous court involvement, freedom of contracting is destined to be plagued by coordination failures. According to Jackson (1986), bankruptcy, by its very nature, raises a *common pool* problem. As a result, creditors runs destroy companies' value through under investment and premature assets sales. Moreover, 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." Pulvino (1998),in an influential study, estimates the fire sale discount, based on a sample of second-hand narrow-body aircraft, of upto 28% relative to the market benchmark. Remarkably little is known about the actual operation of freedom of contracting regimes, partly because law reforms have pushed them close to extinction.[1]

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). In this

[1]The exception is an interesting literature on Scandinavian bankruptcy laws; see Stromberg (2000) and Eckbo and Thorburn (2008).

paper, we study the resolution of financial distress in shipping, where the ex-territorial nature of assets has loosened (although not completely eliminated) the grip of national bankruptcy laws. While enabling freedom of contracting, ex-territoriality of assets also creates a major challenge: how to establish the rule of law, when ships operate across different jurisdictions, or on the high seas outside any jurisdiction, and sometimes visiting ports notorious for corruption and inefficiency. Advocates of legal activism might expect to find an industry plagued by coordination failures, costly seizure of assets and liquidations at fire sale prices. As a consequence, shipping provides an interesting laboratory to study the operation of a freedom of contracting environment, particularly when the industry is distressed.

We have four main findings. First, in spite of the potentially chaotic environment in which the industry operates, the rule of law has been established: it is, to 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 ineffective, there are a sufficient number that are not, and they compete on the basis of the expediency of the repossession process.[2] In addition, contracts have adjusted so as to strengthen creditors rights. For example, crews are granted seniority over debt, committing the mortgage holder to pay any wage arrears after they assist creditor repossession by sailing the vessel to a high quality port. In addition, shipping companies are mostly organized as holding companies, with each vessel owned separately by a different subsidiary. This allows the creditor to take a "double mortgage", first on the vessel and second on the shares of the subsidiary owning the vessel. In the event of default, the creditor can exercise control rights over the vessel by legal transfer of the collateral i.e. the shares, to its ownership thereby avoiding a costly port arrest. We describe the mechanism in great 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, 0.6% of industry capacity in recessions and close to zero otherwise. More significantly, most of the arrests occurred in companies that went bust i.e. were liquidated or were acquired. We develop a formal test that allows us to rule out, for a large proportion of these companies, the possibility that the

[2] 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."

bust was caused by a creditors run. A creditors run is an equilibrium where the creditor who is first to grab assets from the common pool of the company's assets jumps the queue and receives more than its fair share.[3] Hence, a run can be empirically identified by the observation that there are no assets left to grab, namely that the arrest rate approaches 100% of the company's available assets. We link this finding 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 within each subsidiary, the shipping industry has managed to well-define property rights on these assets, so as to largely resolve the common pool problem. We interpret the high arrest rates in bust companies as being in part the result of "dysfunctional owners": owning old, under-maintained vessels, with equity so far out of the money, that they no longer have any incentive to negotiate Coasian bargains with their creditors.

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.[4] 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 the effect reduces the 26% discount rate by about a half. Moreover, the remaining discount, which like Pulvino we interpret as a liquidity effect, is present only at the lower end of the value distribution: there is no evidence that high-valued vessels are sold significantly below the market benchmark. The discount is also affected by the port of arrest: for vessels sold in low corruption ports the liquidity discount is only 3-5% (after adjusting for under maintenance) compared with 13 percent 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.

Fourth, we demonstrate that our findings are not specific to the shipping industry and that similar patterns of longevity can be identified in the airline data similar to that used by Pulvino (1998). Using a data base with approximately 16,000 aircraft covering the 1990-2014 period, we find that aircraft owned by companies in Chapter 11 have a remaining economic life expectancy 1.7 years shorter than those aircraft owned by non bankrupt companies. Moreover, such aircraft have lower utilization rates, measured by flying hours. The effect is well known in the technical

[3] A creditors run is a special case of a coordination failure, which can bring down even a well capitalized company,

[4] 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).

aviation literature: that low maintenance can affect aircraft utilization, and the effect is stronger for older aircraft; see Conklin & de Decker (2000).

Our paper is also 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.[5] We also see this debate in the more general context of the "spontaneous" generation of law and institutions through the decentralized interaction of traders within competitive markets: see Hayek (1979), Bernstein (1992) and Greif, Milgrom and Weingast (1994).

The rest of the paper is organized as follows. In Section 2 we describe a simple analytical framework based upon a theoretical model of the literature. In section 3 we describe our data. In section 4 we discuss the institutional structure of the industry including how property rights are registered and enforced particularly in the case of an arrest of a ship. Section 5 tests whether coordination failures can explain vessel arrests and provides some evidence of the economic costs of arrest and immobilization. Section 6 estimates the fire sale discount for arrested and auctioned vessels, while section 7 estimates the under maintenance effect and quality discount for aircraft owned by bankrupt airlines in Chapter 11. Section 8 concludes the paper.

2 Analytical Framework

The notion that competitive markets generate an efficient allocation of resources has been a core argument in favor of laissez-faire economics and one of the guiding principles of modern capitalism. Nevertheless, while market failures provide an important justification for government intervention, it is widely agreed that the intervention needs to be based on an exact identification of the constraint that has created the market failure; they include information asymmetries, cash

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

constraints or coordination failures that prevent parties from reaching a Coasian bargain.[6] A bankruptcy procedure that allows the court to, say, stay a creditor's repossession right is one such intervention. According to Schwartz (1998), bankruptcy courts have a mandate to intervene only when the Coasian Bargain fails to materialize.

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

- $t = 1$ cash flow is either 100 or 0 with equal probabilities. We interpret a 0 outcome as financial distress.
- $t = 2$ cash flow is either 100 or 0, with equal probabilities, independently of $t = 1$ outcome.
- Cash flows are non-verifiable and, therefore, can be diverted away by E.[7]
- At $t = 1$, the project can be liquidated for $L = 30$. The liquidation value is determined by the cash flows that another operator, less effective than E, can generate by using the asset.
- For simplicity, normalize the interest rate to zero and assume that E has all the bargaining power.

Since non-verifiability excludes debt contingent cash flows,[8] the only funding instrument is secured debt with a face value of 30, granting F in period 1 the right to liquidate the project in case of default. The contract is implemented as follows: if period 1 cash flow is 100, it is in E's best interest to repay the debt. If, however, period 1's cash flow is 0 (financial distress) E has no choice but to default, in which case it is in F's best interest to exercise his liquidation right. Notice that the non pledgeability of period 2's cash flows prevents E from rescheduling the debt, thereby "buying back" F's liquidation right.

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

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

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

It follows that financial distress destroys value: an asset with a continuation value of 50 is sold off for 30, to a less efficient operator. Nevertheless, no Coasian bargain could ameliorate the situation. Indeed, a bankruptcy procedure that stayed F's liquidation rights would avoid the value destruction of $20 = 50 - 30$ but undermine the creditor's value. From an ex ante point of view, a stay that removes E's only incentive to perform against the terms of the loan, would also destroy F's incentive to lend, and is not even in E's best interest.[9] Such a stay of liquidation rights can only create value if the judge has a better technology than the private parties for verifying the cash flows. It is not obvious why the judge should have a better technology. Even if he did, there is no need to impose or mandate it on the parties: it is in their best interest to commit themselves voluntarily, ex ante in the debt contract, to use the superior verifying technology either in court or in a private arbitration. According to the Schwartz's (1998) criterion, bankruptcy courts should have no power to execute such a stay.[10]

While a Coasian bargain could not avoid the destruction of value described above, it should avoid any additional loss of value associated with a "disorderly" liquidation. The shipping industry provides an excellent example of such additional costs, as well as the opportunity to identify and measure them empirically: a vessel arrest generates additional costs (fees to lawyers, brokers, port authorities etc.) as well as disrupting the cash flows of the vessel if the liquidation ends in a legal conflict that immobilizes the vessel. Under the Coase theorem, no such immobilization should take place: the threat of liquidation should be sufficient for E and F to coordinate a "voluntary" sale of the vessel so as to repay the debt. While one may expect that such arrests would be rare in a "normal" environment, it may be more prevalent in the chaotic environment of the shipping industry where the vessel may be on the high seas outside any jurisdiction, or may be subject to the laws of conflicting jurisdictions, either of which may undermine the debt contract. For example, E may try to avoid repossession by diverting the vessel into a "friendly" port where F's liquidation right may not be recognized.

The prospect for coordination failures increase when there are multiple lenders. Suppose that the initial investment of 30 is equally split between fixed capital funded by a bank, and working capital funded by a supplier, each secured on the firm's assets. That may lead to a creditors run akin to a Diamond and Dybvig (1984) bank run where one creditor seeks to be

[9]To put it more technically, the stay is an ex-post Kaldor-Hicks improvement but not a Pareto improvement; see footnote 6 above. From an ex-ante point of view, it is not even a Kaldor-Hicks improvement.

[10]Possibly, other state organs, c.f. the Treasury, who operate under a less restrictive mandate could consider measures such as a bailout funded by taxation. We ignore the (non trivial) question of how the Treasury would identify financial distress, for it, too, is likely to be affected by the non-verifiability of cash flows. Notice also that the economics of a stay is akin to a bailout with the cost imposed on F alone, rather than on the tax-paying population.

repaid first at the expense of other. By reference to the bank-run literature one can construct an example that even a viable, non-distressed company can be brought down by a creditors run. It is important to emphasize that the problem results not from the multiplicity of creditors per se, but from the absence of suitable priority arrangements, that would eliminate the advantage of moving first. In that respect, Jackson's (1986) "common pool" problem and the "asset grabbing" problem that it generates is a failure of contracting. As such, it also has a contractual solution: to partition and prioritize the ownership of the company's assets, transforming the company from a common pool that each stakeholder is incentivised to over-exploit to an association of stakeholders, each with his own, well defined, contingent property rights. Hence, our analysis contains, not only a quantitative test of a creditors run but, also, a detailed description of the institutional arrangements that the industry has developed to define and enforce these property rights.

A creditors run is a special case of a coordination failure. Indeed, any vessel arrest can be interpreted as a coordination failure: it is hard to conceive of any fundamental mechanism through which the stakeholders can create and share value arising from a vessel arrest and, hence, be willing to bear the associated direct or opportunity costs. As we shall see below, we use arrest, on which we have high quality data, as a proxy for all coordination failures. At the same time, it is important to recognize that arrest is not the only coordination failure that might exist in our data. For example, Myers (1977) under investment due to debt overhang is another type of coordination failure, and one on which we present some indirect evidence below. Hopefully, the stakeholders ability to bargain away arrest is a good indicator of their ability to avoid other coordination failures. It is also noteworthy that beyond a certain point, high levels of debt can push owners to such low, perhaps even negative levels of equity, that they can no longer be incentivised to participate in any Coasian bargain. They become "dysfunctional". The distinction between these two types of coordination failures is important: while a creditors run raises a strong case for a Chapter 11 kind of legal involvement, the case for such involvement in the case of a dysfunctional owner is weaker. Perhaps, the best treatment in the latter case is a speedy transfer of the assets into the hands of a more reliable owner.

There is a growing recognition that financial distress has a systemic dimension as collateral values feed back to the amount of assets in liquidation and amplify the effect of the original financial distress. Leverage and the ease of repossession are clearly a part of the causal chain. Government policies can affect the amount of value destruction: see Kiyotaki and Moore (1997), Lorenzoni (2008) or Guembel and Sussman (2015). Yet, the effect of the credit cycle on the analysis of bankruptcy law may be constrained by the following considerations. First, given collateral values, it is not clear that mandating a dilution of rights upon the creditor is a Coasian bargain that, ultimately, would be to his own advantage. Indeed, much of the welfare analysis above uses weaker measures of welfare. Second, the effect of the policy may be ambiguous: Suarez and Sussman (2007) provide examples where a "soft" bankruptcy law enhances the demand for credit, and amplifies the credit cycle. Finally, other state agencies such as central banks and treasuries, better equipped with policy tools and a superior understanding of macroeconomic data, may have an advantage over courts in implementing such a policy. [11]

3 Data

Our main data source is Lloyd's List Intelligence (henceforth LLI) originally part of Lloyd's of London, the famous syndicate of insurance underwriters.[12] 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.[13] Our sampling window begins in 1995 and ends in 2010. We focus on merchant vessels (bulk, containers, reefers and tankers) excluding passenger ships and highly specialized technical vessels (e.g. oil exploration vessels). We also exclude small vessels below 10 deadweight tons (DWT). Effectively, this is a survey of the world fleet during the sample period. The data contain information about both active and scrapped vessels. Each vessel is identified by an International Maritime Organization (IMO) number, which is attached to the body of the vessel, and remains intact when the vessel changes owner or name. Another important source is Clarkson Research Services Limited (CRSL), a shipping broker, which supplies price information for secondary market transactions. The CRSL and LLI data sets can be matched through IMO numbers. LLI also has detailed information about vessel arrest: port of the arrest, length of arrest and in many cases a short narrative describing the circumstances of the arrest. We augment this source with records of the Admiralty Marshal, the officer who executes vessel arrests in the UK. These records provide more detailed information about the direct costs of the arrest, including all the costs of keeping the vessel in port and auctioning it, as well as a description of the state and quality of the vessel provided to all potential bidders in the auction, and the value of all the bids submitted. Additional data sources are mentioned below.

[11] For a slightly different view, albeit in very exceptional circumstances, see Bolton and Rosenthal (2002) and Krozner (1998). Note, however, that the intervention in debt contracts was initiated by the executive branch, against some resistance from the judiciary.

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

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

With expanding international trade, the world's merchant fleet has grown steadily over the sample period, from 19,424 vessels in 1995 to 29,555 in 2010, an annualized growth rate of 2.8%; see Table 1. The table also reports the size of vessels (measured in deadweight tons, henceforth DWT) and their age, which are the main explanatory variables in our valuation estimates in Section 6 below. Vessel average size has increased through the sample period, but the fleet has aged slightly, increasing from 15.6 years in 1995 to 16.1 years in 2010. Since the early 2000s the industry has seen an unprecedented boom, with the Baltic Dry Index (tracking world-wide charter rates in bulk carrying, mainly raw materials such as coal or iron ore), increasing more than four times before crashing to half its 2003 level shortly after the 2008 financial crisis. As Figure 1 shows, charter rates in the tanker business[14] have gone through a similar cycle, albeit of a less erratic nature. Figure 1 also plots a price index for vessels.

[**Table 1 about here.**]

[**Figure 1 about here.**]

4 Institutional Structure

The shipping industry has used the ex-territorial nature of its assets in order to distance itself from on-shore national bankruptcy laws. As a result, financial distress is largely resolved through the enforcement of debt contracts by a nexus of private, decentralized, differentiated and competitive market institutions. To achieve an acceptable standard of law enforcement in a potentially chaotic and lawless environment, markets and contracts had to adapt. In this section we provide a detailed description of how the industry has adapted to this harsh environment. An understanding of the institutional structure is also important in the interpretation of the quantitative results that we derive in subsequent sections.

4.1 Property rights

We begin with the industry's special ownership structure. A shipping operator is typically organized as a holding company with multiple subsidiaries, each one owning a single vessel. Loans on a particular vessel may be recourse or non recourse. In the case of recourse (often called "sister ship" clauses), creditors of one company may try to grab assets in another company.

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

Where the debts are non-recourse, the creditors of one company are prevented from pursuing claims against another company. While creditors may have recourse clauses in the debt contract, most of the lending tends to be on a non-recourse basis.

The partition of vessel ownership within a holding company to separate legal entities allows a creditor to take collateral not only on the physical vessel but also on the shares of the subsidiary that own that particular vessel, referred to as a "double mortgage". We describe below how this double mortgage can, in the event of default, allow the lender to repossess a ship on the high seas without taking it into port and thereby incurring significant costs.

The registration of property rights on a vessel is made with a sovereign state. The vessel is then obliged to "fly the flag" of that sovereign. Though registration is a technicality, it is an important one since any mortgage on the vessel is registered next to the ownership. It is not unknown for owners or lenders to find that their property rights have been tampered with in low-quality flags. As a result, lenders will often stipulate the country or flag of registration in the loan agreement. Flags that have no other material connection to the vessels are known as flags of convenience. In many cases, poor and small sovereigns like the Marshall Islands treat their flags as a commercial enterprise and even outsource their management to private law firms.

4.2 Legal diversity

It is not uncommon for a vessel to be registered with a flag, for the owning subsidiary to be incorporated in another country, and for the holding company to be incorporated in a third country. Sister vessels owned by the same holding company may fly a different flag, and their ownership may be incorporated elsewhere. More significantly, the loan agreement, where most of the contractual substance is specified (including the terms of repossession), will typically submit to another law, often English or American. It may, however, specify that disputes are to be resolved by, say, Singaporean arbitration. This may be done for reasons of expertise as well as expense. Then there are insurers, customers, bunkers (fuel suppliers), and other suppliers, whose contractual relationships with the operator are affected by the laws of their respective locations. Also, in the event of collision, salvage or arrest, the law of the port where the vessel is situated takes precedence. Sceptics of freedom of contracting might predict that such legal diversity would increase the incidence of coordination failures.

4.3 Arrest of vessels

An arrest followed by the repossession and sale of the vessel is the ultimate remedy that a secured creditor with a mortgage against a vessel has in order to obtain payment. We have much anecdotal evidence to indicate that banks preferred line of action is to use their right to arrest the vessel as a threat point in negotiating a workout. Unless the owner has lost all hope of recovery, it is in his best interest to accept a Coasian bargain. The data 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 pay the bank, but allowing the owner to operate his remaining, downsized, fleet. We are aware of more complicated workouts. For example, Pillarstone, a platform set up by KKR to manage the distressed shipping loans of banks, are also willing to inject cash into the distressed loans. In return, the bank, itself short of liquidity 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 that are recorded in Table 1 above, a rate of about 0.6%. Figure 2 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 2 above). The bottom (red) line also excludes the bankruptcy of Adriatic Tankers, a sizable Greek operator that went bust following a labor dispute, and some ex-soviet companies that went bankrupt with old and sub-standard fleets following the break-up of the Soviet Union. Capacity under arrest is 0.4% in bust and close to zero otherwise. The difference between the vessel arrest rate and the DWT arrest rate is the first indication that arrest is a small-scale low-quality phenomenon, an issue elaborated on, below.

[**Figure 2 about here.**]

LLI narratives[15] 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

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

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.

Table 2 classifies arrests by trigger and resolution. The classification is made on the basis of LLI narratives in conjunction with other information such as a transfer of ownership. 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 474 arrests as being definitely related to the failure to repay secured debt, as well as the wages of the crew or suppliers' claims. Of these 474 cases, 30% of the vessels are auctioned and the proceeds distributed to the creditors. 15% (of these 474) are "broken up" – industry jargon for 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 below. It is noteworthy that 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 dysfunctional owner to abandon a vessel under arrest, biasing the length of arrest statistics.

[**Table 2 about here.**]

4.4 Ports of arrest

To initiate an arrest, port authorities need to verify that the creditor has a valid contractual right to seize the vessel, execute a sale (if no settlement between debtor and creditor is reached) and distribute the proceeds among the creditors according to their priority. There are some material differences in procedures across ports. For example, some ports, such as Gibraltar, allow a sale by private treaty whereby the creditor identifies a buyer and the sale is executed without a public auction, at a price that the Admiralty Court 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 are hopelessly corrupt and inefficient and are to be avoided by creditors at all costs. In one case, it took the creditor ten years to receive the proceeds arising from an arrest and auction in a particular port in Asia.

Six countries stand out for the effectiveness of their arrest procedure: Gibraltar, Hong Kong, Singapore, South Africa, the Netherlands and the UK. As a result, there are more arrests initiated by secured creditors in these specialized ports, relative to the volume of traffic.[16] While their share in the world's cargo traffic is only 12%, these six ports have a 39% share in the arrest activity; see Table 3, which is based on our sample of 474 arrests identified as definitely related to the failure to repay debt. In contrast, in some of the world's busiest ports, such as Japan, China or the USA, the arrest volume is small relative to the volume of traffic.

[**Table 3 about here.**]

Figure 3 plots a Kaplan-Meier (non-parametric) estimate of the duration of arrest, for the six specialized ports and the other remaining ports. A log-rank test is consistent with the hypothesis that the two groups differ significantly, at the 1% level (with a chi-squared statistic of 42.92), in the duration of arrest. Noticeably, both distribution functions are affected by a long tail; even at a specialized port an arrest can, in some extreme cases, drag on for up to three years. From the LLI narrative, the impression is that such prolonged arrests may be a result of technical problems, for example, a shipyard places a vessel under arrest so as to facilitate repossession in case the owner defaults on the repair bill, or vessels are abandoned by dysfunctional owners.

[**Figure 3 about here.**]

4.5 Contract adaptability

Two contractual adaptations help creditors to direct vessels towards arrest-efficient ports: crew seniority and the double mortgage

It is often the case that default on the mortgage is accompanied by wage arrears, which aligns the interests of the mortgage holder with those of the crew: to repossess the vessel and use the revenue from the auction to pay both, often including the costs of flying the crew back home. Obviously, the mortgage holder and the crew have much to gain by acting in concert. But then, a unity of purpose does not guarantee collaboration: for the mortgage holder needs a

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

device that would allow it to commit to the crew: that once the crew sails the vessel to a port with a high standard of enforcement, the mortgage holder will pay it in full. An instrument called the the maritime lien, which is senior to the bank's mortgage serves this purpose.[17] The maritime lien also ensures that vessels are not abandoned by the crew and become a danger to other shipping.

Timing the arrest of a vessel needs to be undertaken with great care, particularly when the cargo is of high value (sometimes exceeding the value of the vessel itself). The cargo owner may also be granted a maritime lien, and as a result is, in the event of a successful claim for damages, senior to the mortgage holder. A bank that arrests a laden vessel in a port other than the vessel's destination risks litigation by the cargo's owner, where the damages are secured by the maritime lien. The iron rule in vessel arrest is, thus, to time the arrest so that the vessel is not laden. This task is facilitated by data providers that report vessel location in real time (based on GPS technology), including information about whether the vessel is laden or empty (except for ballast). We have anecdotal evidence of a bank which significantly diluted the value of their mortgage by arresting a vessel ladened with high value cargo; the delay in delivering the cargo resulted in substantial damages against the vessel, made senior to the mortgage because of a maritime lien.

A second contractual innovation is the double mortgage. In this case, the bank holds both a mortgage on the vessel and a security interest in the shares of the registered owner. The first security is on the physical asset, i.e. the vessel, and the second is, effectively, a title to the vessel (remember that the subsidiary owns no assets beside the vessel). The bank's contingent rights to repossess the shares is specified in the loan agreement. We illustrate how the arrangement works using the case of Eastwind Maritime Inc., a distressed New York based company owning, at the time, some 90 vessels.[18] Nordea, a Scandinavian bank with an extensive portfolio of maritime loans, had double mortgages on 12 Eastwind vessels. To strengthen its rights even further, the board members of these subsidiaries had pledged, at the time of loan origination, signed but undated resignation letters. Though Eastwind was delinquent, Nordea made many attempts to restructure the distressed company without repossessing the vessels. However, at some point it received news that Eastwind was about to file for bankruptcy in the US. Fearing the direct legal costs (see Bris, Welch and Zhu (2006)) as well as the dilution of their rights in

[17] This is an interesting twist on the theory of control; see Klein, Crawford and Alchian (1978) and Grossman and Hart (1986).

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

a US bankruptcy, Nordea declared Eastwind in default on June 21, 2009, dated the resignation letters of the current directors, and appointed new directors of each of the subsidiaries, who then sold the shares in the twelve ships 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 grounds that the ships belonged to the bankruptcy estate. The case was settled with Nordea paying the trustee $750k, in return for the trustee recognition that the sale of the subsidiaries was valid, implying that the old managers "lacked appropriate authority" to file for bankruptcy.[19]

Two points deserve some elaboration. First, during the sale some of the vessels were sailing the high seas. Hence, 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, not only saved significant costs but, much more importantly, it saved time. Had Nordea delayed by just a day, Eastwind would have been admitted into US bankruptcy, a stay would have been placed on the assets, and Nordea's only way of recovering payments would have been through the US bankruptcy procedure. Nordea might still have arrested a vessel, despite the automatic stay, but that might have placed Nordea in contempt of the US court.

Second, another Easwind related case demonstrates that there was substance in Nordea's concerns about the potential dilution of its rights in a US bankruptcy. Some vessels were insured in the UK. The contracts submited to English law, with clauses stating that the insurance would terminate in the event of the bankruptcy of the insured. The trustee in Chapter 7 litigated against the insurers, arguing that under US law they were obliged to extend the insurance until the bankruptcy procedures were completed. His reasoning was that without insurance vessels away from home ports would not be able to complete their voyages. While recognizing that an English court would be likely to rule in favor of the insurer, the US court ruled in favor of the trustee. The judge 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.[20] Clearly, the issue here is not operational but, rather, a matter of debt seniority. Had the insurance been terminated, the trustee would have had to use the estate money in order to buy new insurance. Forcing the British insurers to extend the contract, pooled their fees with other Eastwind debt, to be

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

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

paid according to Chapter 7 priority rules. The ruling in this case highlights the problem of jurisdictional conflict that the shipping industry has faced on a routine basis. It also shows that though the industry has managed to distance itself from national jurisdictions, it has not achieved full separation.

4.6 Leverage in the Shipping Industry

Shipping is commonly believed to be one of the most highly-levered industries in the world with a low cost of debt financing. A study by Drobetz et al. (2012) finds that "debt has traditionally been the most important source of external financing in the maritime industry...More than 80 % of all external funding needs in the shipping industry were traditionally covered by debt finance." The study reports leverage ratios of large listed shipping companies as being close to twice as high as a sample of other industrial firms. For a sample spanning a period from 1992 to 2010, they report leverage ratios of 41% compared with 25% for other firms.

We use COMPUSTAT (North America and Global) to estimate the cost of financing. Specifically, we compare the interest rates on a sample of 5,981 shipping loans with 10,219 other transportation loans. The interest rate in shipping is 7.04% compared with 8.16% in other transportation industries, although leverage in shipping is higher at 40.2% compared with 35.2% in transportation. Although, asset tangibility is slightly higher in shipping (61.8% compared with 56.4%), we do not find it explains the higher leverage or lower interest rates. [21]

In addition to our analysis of leverage and interest rate at the firm level, we also collect vessel level data from the accounts of 27 subsidiaries (registered in several flags of convenience); see Table 4. [22] The average loan to value ratio, at the inception of the loan, was as high as 65% (median 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.

In summary, the shipping industry has both high leverage and a relatively low cost of financing. This is consistent with the view that creditor rights are well protected notwithstanding the exposure of the industry to potential coordination failures and fire sales.

[21] We regress the interest rate on firm level controls such as leverage, asset tangibility and an indicator variable for whether the firm belongs to the shipping industry. We find that low interest rates in shipping are not explained by high levels of tangibility.

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

[**Table 4 about here.**]

5 Creditor runs and other coordination failures

As already noted above, we use the arrest rate as a proxy for coordination failures. The arrest rate is low, but it is not negligeable. It is important, however, to better understand the nature of the coordination failure: is it a creditors run resulting from Jackson's (1986) common pool problem, or something more akin to our "dysfunctional owner".

To motivate our test, consider the Eastwind case once again. The top line in Figure 4 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 our dysfunctionality hypothesis. Over the entire cycle, Eastwind divested some 1.5 million DWT, while the capacity under arrest amounted to some 0.2 million DWT-years. Hence, on average, 13% of the downsized capacity was immobilized for one year. 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 well below 100%. This finding is not consistent with standard theories of a creditors run, whereby creditors driven by a first-mover advantage would grab any asset that has not already been seized by another creditor. It is consistent, however, with the view that once property rights are efficiently allocated to different mortgages and properly prioritizing all other creditors, coordination failures do not occur because no creditor can "jump the queue" by grabbing an asset.[23]

[**Figure 4 about here.**]

Next, we extend the insight derived from Eastwind's decline (namely Figure 4) to the entire sample. Since we lack financial data, we identify financial distress using ownership data at the holding company level: basically, we identify distress with downsizing. Formally, company i is

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

classified as distressed, in year y, if it has downsized by 50% (or more) relative to peak capacity during the previous five years:[24]

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

where $capacity_{i,y}$ denotes the capacity of holding company i in year y, measured in DWT. Once year y is defined as distressed, all of the previous five years are also defined as distressed. Sequentially distressed years are unified into a single "distress episode". The maximum capacity over the entire episode is defined as $peak\_capacity_i$ (notice that it no longer has a y index, only an i index) and $trough\_capacity_i$ is defined similarly.[25] A company with a distress episode is defined as "bust" if the distressed episode ends with the holding company disappearing from the ownership register. To correctly identify bust episodes we apply an additional test: so to qualify as bust the company should either have at least two years of distress (this is to exclude cases of a sudden drop in capacity lasting only one year) or at least one vessel arrest. Hence, if a company disappears from the ownership register without being defined as in financial distress beforehand, it is not considered "bust". For example, a company that changed its name, with or without merging with another firm, would not be classified by the filter as either distressed or bust.[26]

Our filter yields $3,063$ distress episodes. Measuring the distressed capacity in terms of DWT-years, the unconditional probability of distress is 13.2% (2,040 over 14,300). Measured in vessel years, the probability of distress is slightly higher. Of these distressed episodes, $1,103$ or 36%, (namely 1,103 divided by 3,063) went bust (see Table 5, Panels A and B). The probability of bust conditional on distress is 13.4% (273 divided by 2,040) when capacity is measured in DWT-

[24] Missing values are replaced by zeros.

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

[26] 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 21 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. The 26 companies have on average more than four times the average number of ships held by companies in the distress sample, less than 4. This suggests that a considerable number of our distressed sample are small unlisted shipping companies that are not commented upon in the press.

years (see pannels B and C). The difference between the two probabilities reflects a higher bust rate among companies with smaller vessels.

Table 5 also reports the arrest rates along the cycle of distress. The unconditional probability of arrest is just 0.21% (see Panel A) which is consistent with Figure 2 above. Conditional on distress, the arrest rate increases to 1.29% when capacity is measured in vessel years but only 0.69% when capacity is measured in DWT-years (see Panel B). The difference reflects the smaller size of arrested vessels. Conditional on bust, the arrest rate increases significantly: 6.19% when capacity is measured in vessel years and 3.29% when capacity is measured in DWT-years (see Panel C). At the same time, it is quite clear that arrest is a small vessel phenomenon: while the unconditional vessel size is 37,226 DWT, conditional on bust the average size of an arrested vessel is only 18,173 DWT (see Panels A and C respectively).

[**Table 5 about here.**]

The main insight from the previous analysis is that arrest is a relatively unusual event, with a likelihood that is increasing modestly upon distress, and then dramatically upon bust. To further analyse this issue we try to estimate the arrest rate per unit of downsizing. More specifically, we define $\Delta capacity_i$ as the difference between $peak\_capacity_i$ and $trough\_capacity_i$, while $imob_i$ is the aggregate amount of capacity under arrest over the entire duration of a distressed episode i (same definition as in Table 5). Notice that $\Delta capacity$ is measured in DWT while $imob$ is measured in DWT years. $Dbust$ is a dummy variable that receives a value of 1 if the distress episode ends in a bust and 0 otherwise. We normalize both magnitudes by $peak\_capacity_i$. Notice that the main explanatory variable is the percentage change in the holding company company's fleet size, namely its downsizing during the distress episode. Since, by definition, downsizing in bust is 100%, γ has the interpretation of a dummy slope.

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

Results are reported in Table 6 below. The first column reports the simple regression with $\frac{\Delta capacity_i}{peak\_capacity_i}$, but without $Dbust$. The second and the third columns report, respectively, the results using subsamples of non-bust and bust companies. The coefficient in column 3 should be interpreted as follows: the arrest rate per DWT in bust is close to 27%. The result is statistically significant at the 1% level. A similar magnitude is reported in column 4. This evidence is consistent with the hypothesis that bust companies have a weaker incentive to cooperate with their creditors in minimizing the loss of value in financial distress, because the debtor is often very far out of the money in terms of the value of their equity interest.

[Table 6 about here.]

In column 4 of Table 6, we find that the $\frac{\Delta capacity_i}{peak\_capacity_i} \times (1 - Dbust_i)$ coefficient is not statistically different from zero, and that arrests are largely driven by companies which are bust. The same conclusion can also be drawn from the subsample regression results in columns 2 and 3. This finding is consistent with the hypothesis that surviving companies, even when in financial distress, have an incentive to cooperate with their secured creditors.

5.1 Vessel Arrests: Dysfunctional owners or coordination failures?

The dysfunctional owner interpretation of the results in Table 6 above can be challenged on the following grounds: perhaps, at least some of our bust companies were economically viable, pushed to insolvency by a creditors run. To test this hypothesis we draw, again, on the insight presented in Figure 4 above, tracking Eastwind's decline: that an arrest rate well below 100%, throughout the cycle, is not consistent with standard theories of a creditors run. The reason is that 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 extend the argument to the entire sample using the distress episodes identified above. Denote the daily capacity (under arrest) on day d of episode i by $capacity_{d,i}$ ($imob_{d,i}$) and denote as $daily\_arrest\_rate_{d,i}$ the ratio of $imob_{d,i}$ over $capacity_{d,i}$. For each distress episode that ended in bust, we scan the entire cycle to identify the maximum daily arrest rate, $max\,\{daily\_arrest\_rate_{d,i}\}_d$. Arguably, we are less interested in high arrest rates that took place close to the end of the cycle of distress, when virtually the entire fleet is likely to have been sold off. For example, towards the end of the cycle the fleet has only one vessel left, and that vessel is under arrest; therefore the arrest rate at this point is 100%, but it makes no sense to classify the episode as a creditors run. Hence, we truncate the series $\{daily\_arrest\_rate_{d,t}\}$ at the point where $capacity_{d,i}$ is 25% of $peak\_capacity_i$. We also truncate the series at 15%, instead of 25%, of peak capacity as a robustness check. The results are reported in Table 7 below. In addition, we report the $mean\,\{daily\_arrest\_rate_{d,t}\}$ averaged over a 91 day window around the maximum, to account for a situation where the arrest rate is very high but for only a very short period. Of 1176 bust episodes[27], 870 had no arrests at all; therefore this is consistent with an absence of coordination failures. For another 97 (18 + 23 + 35 + 12 + 0) we can reject the hypothesis of a creditors run on the grounds that the arrest rate peaked below 100%. We can reject the creditors run hypothesis for 167 once we tighten the conditions, requiring a 100% daily arrest rate averaged over an extended period of 91 days instead of a single day. That leaves us 209 suspected runs for a maximum daily arrest rate and 139 for the one averaged over 91 days.

A closer look, however, reveals that in 189 cases out of the 209 cases the companies had, at that stage of their decline, only one vessel left; we exclude a run in these cases. Hence, we conclude that there is sufficient evidence to exclude a creditor's run for 98% or 99% of all bust episodes. Only in $1\% - 2\%$ of bust episodes are we unable to reject the possibility that the bust was caused by a coordination failure; in all other cases, the dysfunctional owner provides a more plausible explanation. We further examine the average number of vessels owned by companies with an arrest rate below 100%. For example, companies with an arrest rate between 40%-60%, have on average 3 vessels. We suspect that arrest rates averaging 1.5 vessels are more likely to be associated with companies that are in virtual liquidation than with coordination failures. This result is likely to be a direct consequence of the fact that contractual rights on individual ships are well defined, with a mortgage holder on a particular ship, and a maritime lien for claims by the crew.

[**Table 7 about here.**]

5.2 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 8: the median period for which the vessel was immobilized for was 71 days or about two months (much lower than the sample mean). The median direct costs of arrest are 8% of the sale price. Consistent with the

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

observation that arrested vessels tend to be small, the average sale value of a vessel is only $1 million, compared with an average value of ships sold of $9 million dollars for our entire sample. The costs of immobilization are not small particularly when account is taken that they do not include the loss of any income forgone during arrest.

[**Table 8 about here.**]

6 Correcting the Fire Sale Discount For Unobserved Maintenance

LLI's arrest narratives, which we have used in order to classify arrests by trigger and resolution (see Table 2 above), make frequent references to the poor technical condition of arrested vessels: "auxiliary engines and boiler trouble", "ingress of water into engine-room; hull in bad condition; cargo holds water contaminated", "cracks in hull", "survey revealed unseaworthiness", "bottom damage requiring considerable steel renewal" etc. These descriptions suggest that one aspect of Myers (1977) underinvestment problem is poor maintenance of assets. They also suggest that the standard technique of measuring the fire sale discount, pioneered by Pulvino (1998) may be biased as it takes into account assets observed characteristics that affect the quality 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.

6.1 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:

$$log(Price)_{it} = \beta_t + \beta X_{it} + \epsilon_{it} \tag{3}$$

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 the appendix. The results are reported in column 1 of Table 9. An R^2 of 88% indicates that the predicted ship price from the hedonic model can serve as a good benchmark. Notice that a Block transaction is priced 3.3% higher than an ordinary transaction.

A key innovation of our analysis is that 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.[28]

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 up to that age. Furthermore, we define the economic life expectancy of a vessel at a give age as:

$$L_i(Age) = (1-\lambda_i(Age)) \cdot \lambda_i(Age+1) + (1-\lambda_i(Age)) \cdot (1-\lambda_i(Age+1)) \cdot \lambda_i(Age+2) \cdot 2 + ... \tag{4}$$

Using the above method, we calculate the life expectancy and hazard rate separately for both the arrested and non-arrested groups. It should be noted that in calculating the hazard rate, we pool all ships together irrespective of their type. We find that for a ship at any given age, the probability of an instantaneous breakup, i.e. hazard rate, is higher for arrested ships relative to non-arrested ships, as plotted in Figure 5. In robustness tests, we estimate a cox proportional hazard model that allows us to partially control for the characteristics of ships. The results are qualitatively very similar. The relevant methodology is described briefly in the appendix.

[**Figure 5 about here.**]

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

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 forced to be sold, to derive the fire sale discount on arrested ships.

In Table 10 we report the price discount on various categories of ship transactions. In column 1 (without quality correction, QC) we examine the fire sale discount on arrested ships and find that, on average, arrested ships are sold at a discount of 25.9% relative to normal ship transactions. These estimates are quite similar to those that have been reported in Pulvino (1998), at least for the period when the industry is distressed. In column 2, where we control for the quality of the ship by adding life expectancy of ships, this discount reduces to 13.4%, 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. [29] It is important to note that the difference in quality is not correlated with the length of a vessel's immobilization period in port, suggesting that the under-maintenance effect does not occur post arrest.

In columns 3 and 4, we calculate the fire sale discount on ships that are all sold by distressed owners, whether they have gone bust or not. The variable "Distressed" is an indicator variable that takes on a value of 1 if the firm has undergone a 50% decline in capacity in the last 5 years and is 0 otherwise (same definition as in section 5). We find the raw fire sale discount for distressed owners to be 4.1% and it drops slightly to 3.5% when we control for quality.[30]

The small quality discount suggests that under-maintenance does not seem to be a significant issue for sales of ships which belong to distressed owners but which are not arrested. In columns 5 and 6, we include both the arrest and the distress indicator variables in our regressions and find that virtually the entire quality discount is driven by arrested ships. The overall discount

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

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

for arrested ships decreases from 26.1% to 12.1% when one controls for the quality of ships. The fire sale discount for distressed ships is around 3.3% and is mostly unaffected by any quality correction. The implication is that distressed owners do not skimp on maintenance, possibly because they they have a stronger belief in the potential for recovery and there is value in trying to sell their ships in an orderly fashion.

[**Table 10 about here.**]

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

6.2 Other determinants of the fire sale discount

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

[**Figure 6 about here.**]

In Table 11, we report the price weighted fire sale discount. In columns 1 and 2, the price weighting reduces the entire fire sale discount to only 5.1% and it is not statistically significant. In columns 3 and 4, we conduct additional cross-sectional tests to investigate the heterogeneity in the fire-sale discount documented above. This test examines how the fire-sale discount varies with institutional differences such as the quality of the ports. We expect that the low quality of a country's jurisdiction will add some additional costs that the buyer of the vessel might face following the sale, such as higher port charges, payments to suppliers and crew, and any side payments (bribes) to officials. An arrested ship can be sold within six weeks of the arrest in an efficient port while the period of immobilization may take years in an inefficient port (average days of arrest are 213 for corrupt ports and 142 for less corrupt ports). For this purpose, we use a country corruption index described below. We would expect the fire sale discount of the arrested ship to be positively correlated with the corruption index. For a corruption index, we use the one devised by La Porta, Lopez-de-Silanes, Shleifer and Vishny (1999) which has a range from 0 to 10.

We split the data regarding arrested ships into two sub samples, depending on whether they were arrested in high or low corruption countries. A cutoff of 7.9 was used to separate the two samples, and provides the following two groups of countries. The high corruption countries include: the Bahamas, Chile, Cyprus, Greece, India, Italy, Malaysia, Malta, Mexico, Panama, Sri Lanka, Trinidad and Tobago, Turkey and Venezuela. The low corruption countries include: Australia, Belgium, Canada, Denmark, France, Germany, Gibraltar, Holland, Hong Kong, Israel, Japan, Montenegro, the Netherlands, the Antilles, South Africa, Singapore, Tahiti, the UK and the US. As can be seen in Table 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 3 and 4). In columns 5 and 6, we redo the analysis, but this time we run a price weighted regression instead. We find that while there is a fire sale discount in the high corruption ports, the fire sale discount virtually disappears (3.7% and is not statistically significant) in low corruption ports.

We also compare the fire sale discount for sales of arrested ships with the discount for ships sold by distressed owners. In Table 11, we recorded the price weighted fire sale discount at 5.1 percent for arrested ships; this is very similar in magnitude with the value weighted discount of 3.2 percent for distressed ships (after the deduction of the under maintenance effect). Their similarity suggests that the cost of a delay in the sale of arrested ships is small. We may have expected the residual component i.e. the liquidity component to have been larger for arrested ships because the forced cash auction might have accelerated the sale and this would be expected to reduce the number of bidders and the auction price compared with distressed sales where more patience can be exercised in the sale process. The small discount attributable to illiquidity may be less surprising given that the auctions of arrested ships take place in an international marketplace and the information on bids is circulated to potential buyers electronically. Below we report the median number of bidders for a sample of auctions that is consistent with this observation.

[**Table 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 in Pulvino (1998). On decomposing the fire sale discount, we find that about half of this discount is due to quality differences between arrested and non-arrested ships. Furthermore, the discount seems to be concentrated in lower valued ships. A value weighted regression estimate further reduces the discount to roughly 5%, and as low as 3.7% if the forced sales are confined to low corruption ports. The empirical evidence on fire sales sheds some light on the analytical framework described in Section 2. There we argued that fire sales might be the result of a liquidity discount which could be mitigated by a bankruptcy procedure with an automatic stay so as to overcome co-ordination problems among creditors. The evidence in this section suggests that the value of an automatic stay is quite limited because the implied liquidity component of the fire sale discount in cash auctions is quite similar to those for sales by distressed companies. The lack of a liquidity discount is also consistent with the evidence in earlier sections that coordination failures are largely absent from this industry and therefore are not the triggers for arrests.

6.3 Auctions

An important result in this paper is that auctions of arrested ships result in low fire sale discounts after corrections for under-maintenance and for low quality ports. A key issue here is how efficient the auction process is in high quality ports. One aspect of efficiency is the number of bidders for a vessel that is being auctioned. Using the same hand-collected sample of UK auctions used in Table 8, 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. This may reflect the small sample. However, the spread between the top two bidders is quite significant: 24% on average.

[**Table 13 about here.**]

6.4 Discussion of recent Chapter 11 shipping bankruptcies

Since 2011 there have been approximately ten shipping companies that have filed for Chapter 11 protection. The majority have been non-US companies with virtually no assets in the US, for example, Genco Shipping and Marco Polo Seatrade.[31] It might be argued that such filings represent a breakdown of bargaining and therefore a violation (or limitation) of freedom of contracting.

It appears that this spate of filings is the result of macroeconomic conditions: The US financial crisis, followed by the Eurozone crisis and a consequent collapse of shipping charter rates. The result is an industry facing economic distress with severe overcapacity. It might be argued that these industry conditions provide an important justification for Chapter 11, in the

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

spirit of Shleifer and Vishny (1992), cited earlier, where industry distress is predicted to result in fire sales of assets. They would argue that Chapter 11 would slow down asset sales and diminish the probability that sales of ships would be sold to inferior users of those assets.

However, in all the ten companies that filed for Chapter 11, only those companies that filed with creditor support succeeded in maintaining the company as a going concern. Those companies that filed without creditor support were liquidated in Chapter 11 (see 'Creditor Support Essential for Smooth Sailing in Shipping Restructurings').[32] In a separate article, the author writes, 'Those [companies] that were unable to negotiate prearranged restructuring agreements with their lenders have typically failed in their renegotiation efforts'.[33] 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.[34]

An important and more disturbing bankruptcy (in August 2016), is that of Hanjin shipping, 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 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 bankrutpcy, 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 possible and even

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

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

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

likely that significant costs were imposed on various stakeholders, particularly the cargo owners. The bankruptcy was precipitated by a refusal of Hanjin's shareholders and main creditor banks to re-negotiate an out of court restructuring. It is entirely possible that an automatic stay and debtor in possession financing may have avoided some of the costs to Hanjin's creditors and customers. However, it was largely the unplanned nature of the bankruptcy that precipitated the crisis and contributed to the costs.[35] The case raises the important question, not so much as to whether state sponsored bankruptcy codes are desireable, we believe they are, but rather whether they should be made mandatory or optional.

We view Hanjin as a dysfunctional owner which lost the capacity to operate effectively, including the ability to strike a Coasian bargain with its creditors. We recognize that, due to its size, Hanjin may have imposed large costs on third parties. As a result, it might have been desirable for the government to pursue a bailout through the Treasury, as in the case of GM in the US. An important advantage of public policy executed through the department of the Treasury is that it is less likely to create a legal precedent in bankruptcy procedures and therefore should not affect the treatment of "conventional" cases of financial distress. It is not clear that such cases provide a justification for mandating Chapter 11 as a mechanism for dealing with these unprecedented distressed events.

7 Evidence from the Airline Industry

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. This is relevant to Pulvino's (1998) results for aircraft sales made by airlines who have sought protection under Chapter 7 of the US bankruptcy code. It might be thought that under maintenance is less of a problem for aircraft than for ships because there is stricter monitoring of aircraft safety by the FAA. That ignores two potential issues. First, a large part of the cost of an aircraft is the fitting out of the aircraft and little to do with safety. Second, the FAA sets minimum standards for aircraft safety. Airlines are free to set maintenance levels above those minimum targets. Discussions with an aviation expert suggest there are areas of maintenance and refurbishment of aircraft which can be postponed or costs reduced without endangering aircraft safety.[36] The result is to increase future downtime, thereby decreasing the flying hours available for the aircraft.

[35]See "Lessons Learned From Hanjin Shipping's Bankruptcy, Peter S. Goodman, Law 360

[36]For example, worn out or defective parts may be replaced with second hand rather than new parts, and refurbishments may be postponed.

There is a strong documented link between discretionary maintenance and flying hours lost for aircraft of different ages. Decker (2000) states: "As aircraft age, the increase in unscheduled maintenance associated with scheduled inspections also requires a great deal more maintenance downtime. Both detract from the availability of the aircraft for flight operations." He provides data showing that aircraft availability drops from 95% of capacity for aircraft between 15 and 20 years of age to an average of 70% at age 25 and, 55% at age 30.[37] Given that the bankrupt airline has probably been in financial distress for some time, we might expect greater downtime for aircraft sold by bankrupt airlines, compared with those aircraft owned by solvent airlines. To address the under maintenance issue, we replicate for aircraft the hazard rate analysis for ships. We use two data sets: one on aircraft utilization, obtained from FlightGlobal, a leading producer of aviation market information; this contains not only the ownership and characteristics of each commercial aircraft from 1990 to 2014, but also detailed information on the monthly utilization rates (flying hours) of aircraft. The other database includes bankruptcy data from the UCLA-LoPucki Bankruptcy Research Database. We match the operator of each aircraft to the companies that have filed for Chapter 11 bankruptcy.

We first estimate the conditional life expectancy of aircraft operated by bankrupt and non-bankrupt airlines. As shown in Figure 7, the probability of an instant breakup conditional on a given age, i.e. hazard rate, is in general higher for the aircraft operated by companies in Chapter 11 compared with the non-bankruptcy group, particularly for older aircraft, as reflected in the vertical distance between the two curves. For example, for an aircraft in the non-bankrupt group with an age of twenty years, the probability of being scrapped in the next period is around 2% percent lower than for the aircraft operated in Chapter 11. An alternative way of expressing this is, that aircraft owned by bankrupt operators have an older effective age than those aircraft operated by non bankrupt owners.[38] We find that the quality correction in the aircraft industry (with Chapter 11) is quite similar (roughly 12%) to that in the shipping industry.

The evidence is suggestive that aircraft belonging to bust companies may have suffered from under maintenance that affected their second hand prices compared with similar aircraft of solvent airlines. Pulvino (1998) acknowledges the issue of quality differences in aircraft values and the challenge of controlling for it. He provides several tests of quality but none of them are direct. [39] The issue of quality is also raised by Campbell, Giglio and Pathak (2011) with respect

[37]See article by Bill de Decker in Conklin & de Decker, March 2000.

[38]A similar pattern is obtained in Figure 8, which fits a Cox proportional hazard model to the data.

[39]Using a sample of just eleven aircraft, he compares the appraised values (generated by an appraisal firm) with the actual sales prices, where the difference is designated as a fire sale discount; the magnitudes is no smaller than those from his hedonic regression. He interprets this as evidence that quality differences are not driving

to domestic real estate. They state that: "this confirms the suspicion that much of the estimated price effect is not directly related to the urgency of the sale, but results from unobserved poor maintenance."

[**Figure 7 about here.**]

[**Figure 8 about here.**]

Since we do not have the price data for second-hand aircraft, we conduct our analysis alternately using productivity measures, including the utilization rate of an aircraft. Any under-maintenance or inferior quality due to distress and bankruptcy should be reflected in the future utilization of the aircraft. We take the average flying hours per month in a given year as the main measure for an aircraft's productivity. The other measure is monthly average cycles, where a cycle is defined as one takeoff and landing of an aircraft, in a given year. To study how distress affects an aircraft's future utilization, we estimate the following equation

$$log(Hours\ or\ Cycles)_{it} = \beta_t + \beta_{TypeXAge} + \beta_{Opertator} + \gamma Bankruptcy_{it} + \beta X_{it} + \epsilon_{it} \qquad (5)$$

where $log(Hours\ or\ Cycles)_{it}$ denotes the log of average monthly hours or cycles (round-trip) by aircraft i in year t. β_t denotes year fixed effects. $\beta_{TypeXAge}$ and $\beta_{Operator}$ account for type-age and operator fixed effects. X_{it} denotes a vector of controls, including fleet size of the operator and liquidity/market thickness of the aircraft (proxied by number of same type aircraft operating at year t). Our variable of interest, $Bankruptcy_{it}$, equals one if aircraft i was ever operated by a company that filed for Chapter 11 in the years preceding the current year t, i.e. the aircraft was exposed to bankruptcy due to the entry into Chapter 11 of its operator.

The regression results are displayed in Table 14. From columns (1) and (3), we find that on average, the monthly flying hours drops by more than 12% for aircraft that were operated by companies that entered Chapter 11. The effect is highly significant at the 1% level. If we

his estimates of the fire sale discount. However, the sample is small and the appraiser's values are likely to be noisy estimates of sales prices. He also provides another test using sales/leaseback agreements, based on the key assumption that price differences at inception of the sales/leaseback transactions only depend on borrowers' credit risk and not on aircraft quality. He finds large (20%) differences in prices between credit constrained and unconstrained airlines and interprets this as a fire sale discount unaffected by the quality difference of the asset. However, it is possible, even likely, that credit quality is correlated with the asset quality and maintenance and therefore the price at inception may confound the two effects. There is an analogy here with the sub prime financing of cars, where the interest charge reflects both the credit quality of the borrower as well as the maintenance effect. Defaults are often associated with poor maintenance and abandonment, with consequently low recovery rates.

change the measure of utilization to log of cycles, the direction and the magnitude of this effect barely changes. In columns (5) and (6), we examine the dynamics by including dummies for (0-2 years), (3-5 years), and (6 years or more) after the bankruptcy exposure. Importantly, the negative effect due to bankruptcy does not go away even after six years. The magnitude remains significant and economically large, suggesting a fundamental difference between aircraft with bankruptcy exposure and those without.

Both pieces of analysis strongly suggest that there is an under-maintenance effect for aircraft operated by distressed airlines which will, following our shipping analysis, affect any interpretation of the raw fire sale discount.

[**Table 14 about here.**]

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

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

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

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

A few comments are worth highlighting. First, it should be noted that we are not running a horse race between freedom of contracting and Chapter 11. In fact, freedom of contracting could potentially include off the shelf procedures like Chapter 11. Second, we are not making any efficiency claims here.[40] Chapter 11 was introduced based on the rationale that absent such a reorganization mechanism, we would witness severe coordination problems and large fire-sale discounts. There was also a concern that innovation in contracts would be slow under a freedom of contracting regime because of free rider problems. We find that such fears are largely misplaced at least for the shipping industry. That being said, we do believe that state sponsored bankruptcy procedures have a role to play. In particular, such procedures have the potential for solving free rider problems associated with contractual innovation. But we question whether procedures be made mandatory as they provide legal restrictions to contracting.

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

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

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A Appendix: Vessel-related Variables

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

B Appendix: Life Expectancy Estimates from Cox Regression

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

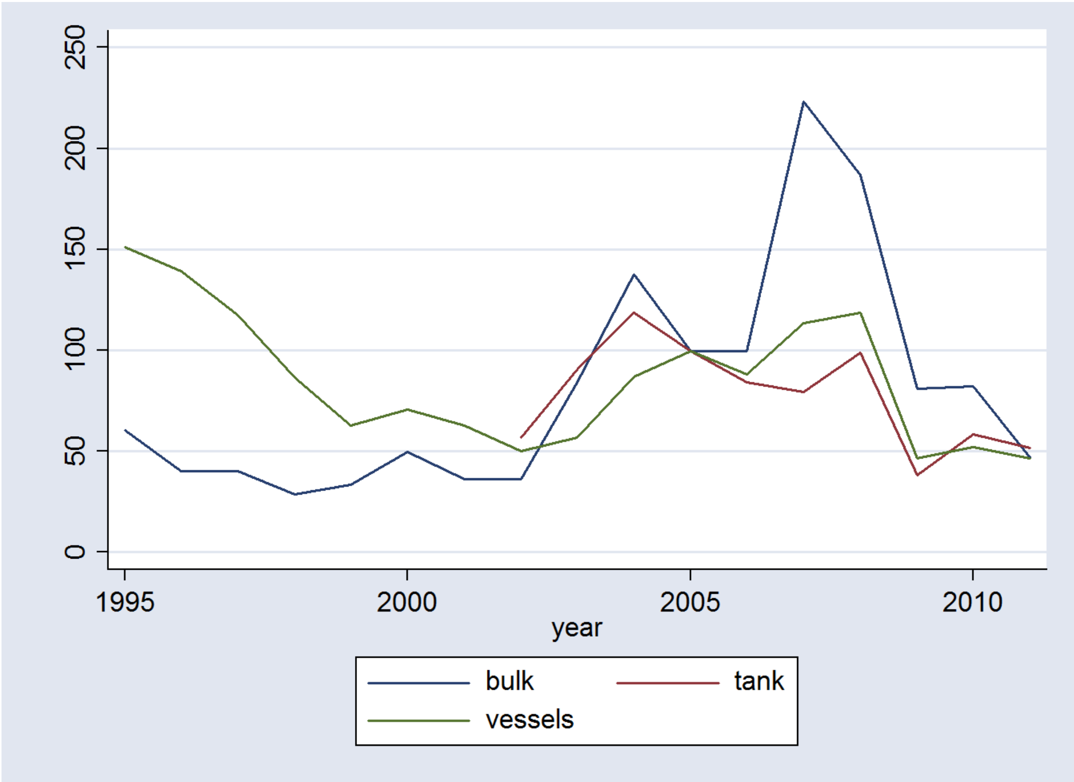

Figure 1: Charter Rates and Vessel Price Indexes, $P_{2005} = 100$. In this figure, we show the charter rates in the tanker and bulk rate businesses and the price indexes of vessels from 1995 to 2011.

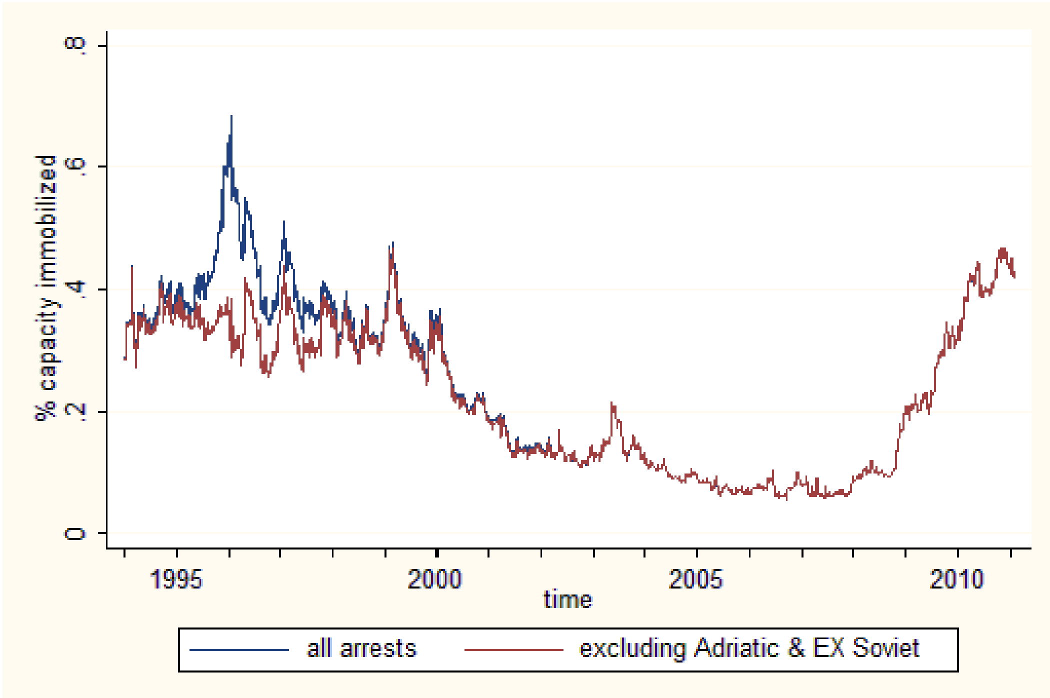

Figure 2: Immobilized Capacity as a Percentage of Total Capacity. In this figure, we track the amount of immobilized capacity as a percentage of total industry capacity, measured in DWT. The bottom (red) line also excludes the bankruptcy of Adriatic Tankers and some ex-soviet companies that went bankrupt with old and sub-standard fleets following the break-up of the Soviet Union.

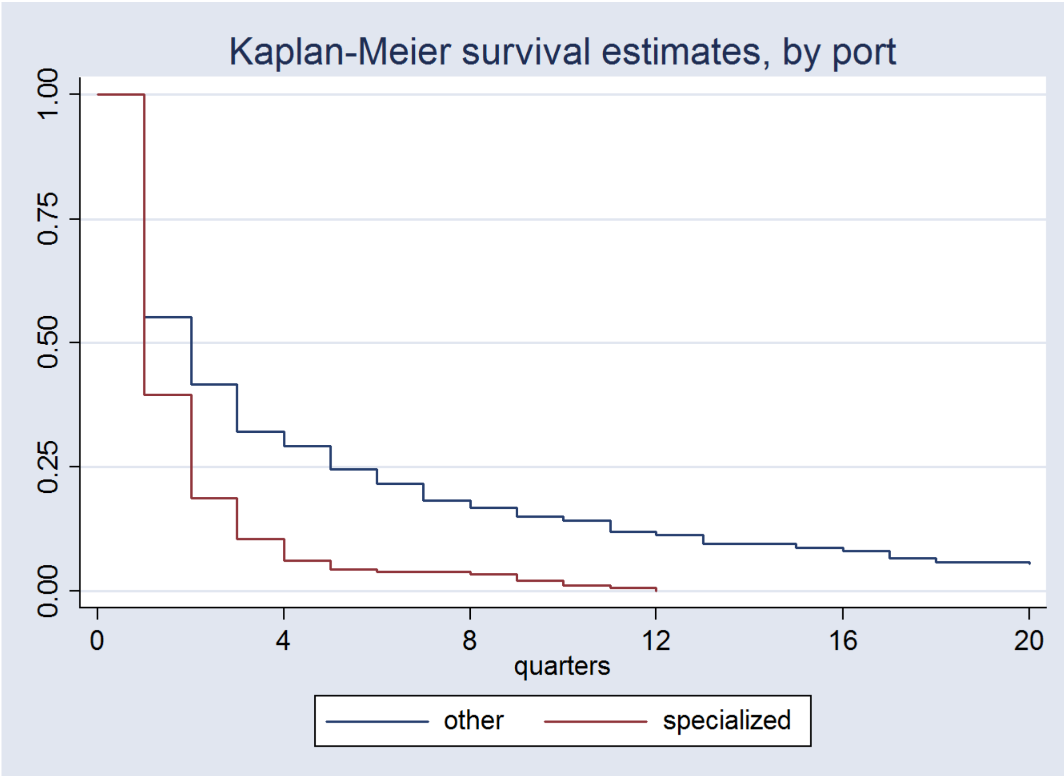

Figure 3: Duration of Arrest in Specialized and Other Ports. In this figure, we plot a Kaplan-Meier (non-parametric) estimate of the duration of arrest, for the six specialized ports and the other remaining ports.

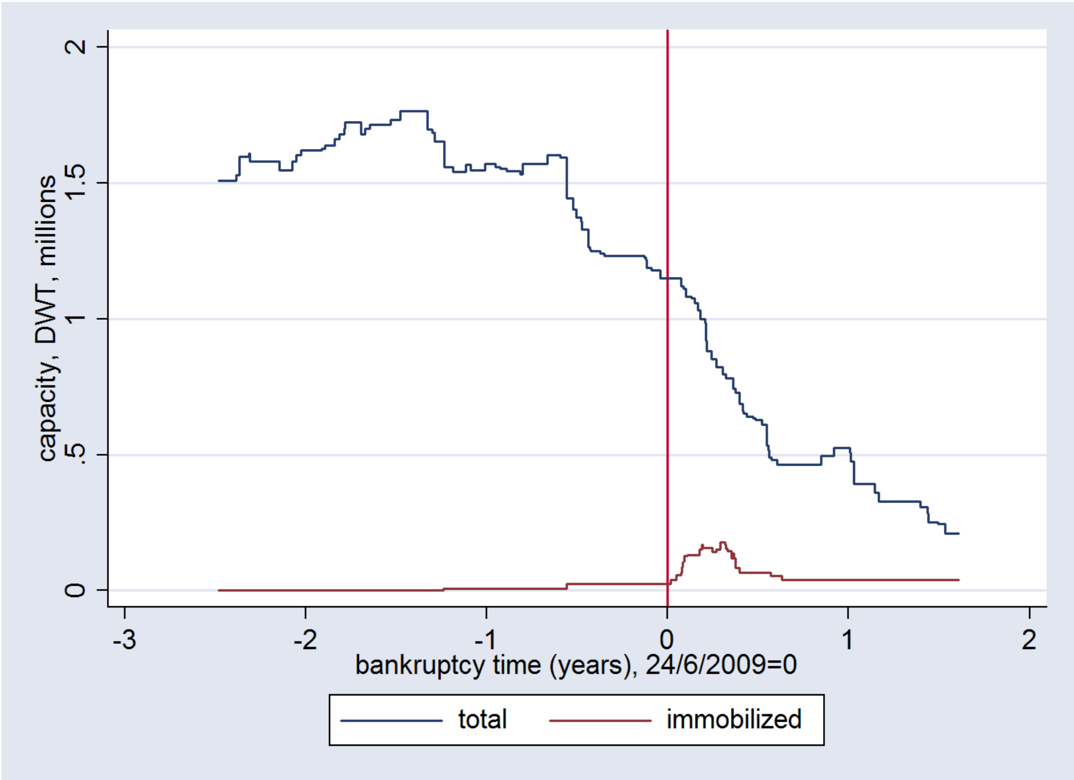

Figure 4: Eastwind's Cycle of Distress. In this figure, we track Eastwind's cycle of distress on a daily frequency. The top (blue) line tracks the company's total capacity (in millions of DWTs) while the bottom (red) line tracks capacity that is immobilized due to arrest.

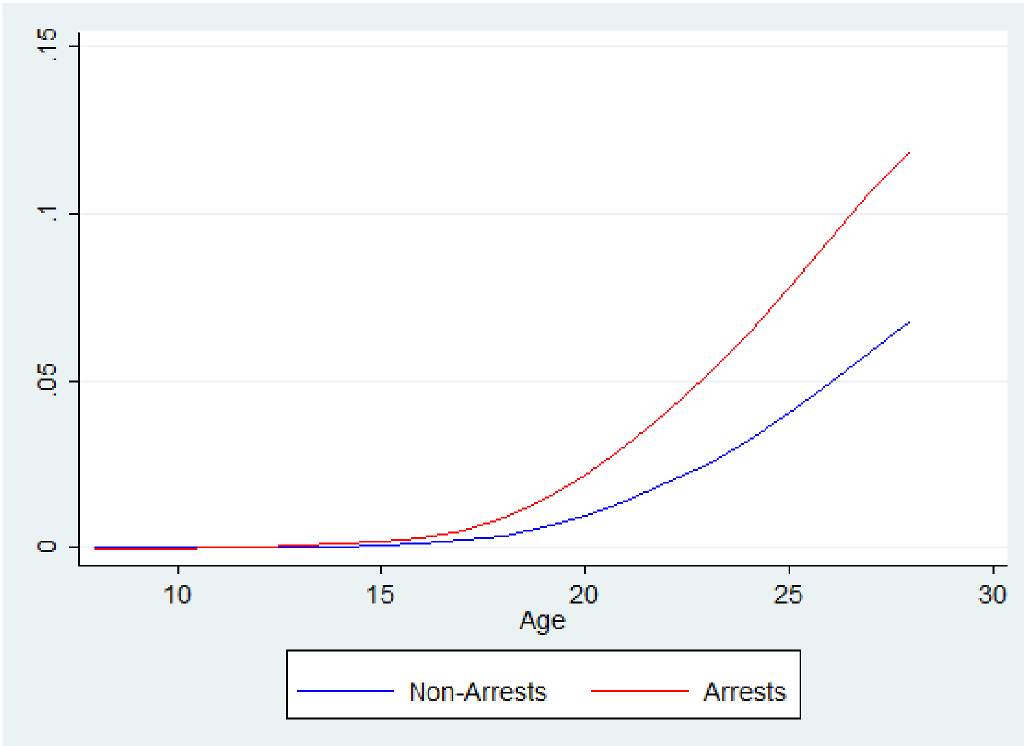

Figure 5: Hazard Rate for Arrested and Non-arrested Vessels. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the arrested (red/top line) and non-arrested (blue/bottom) vessels at any given age.

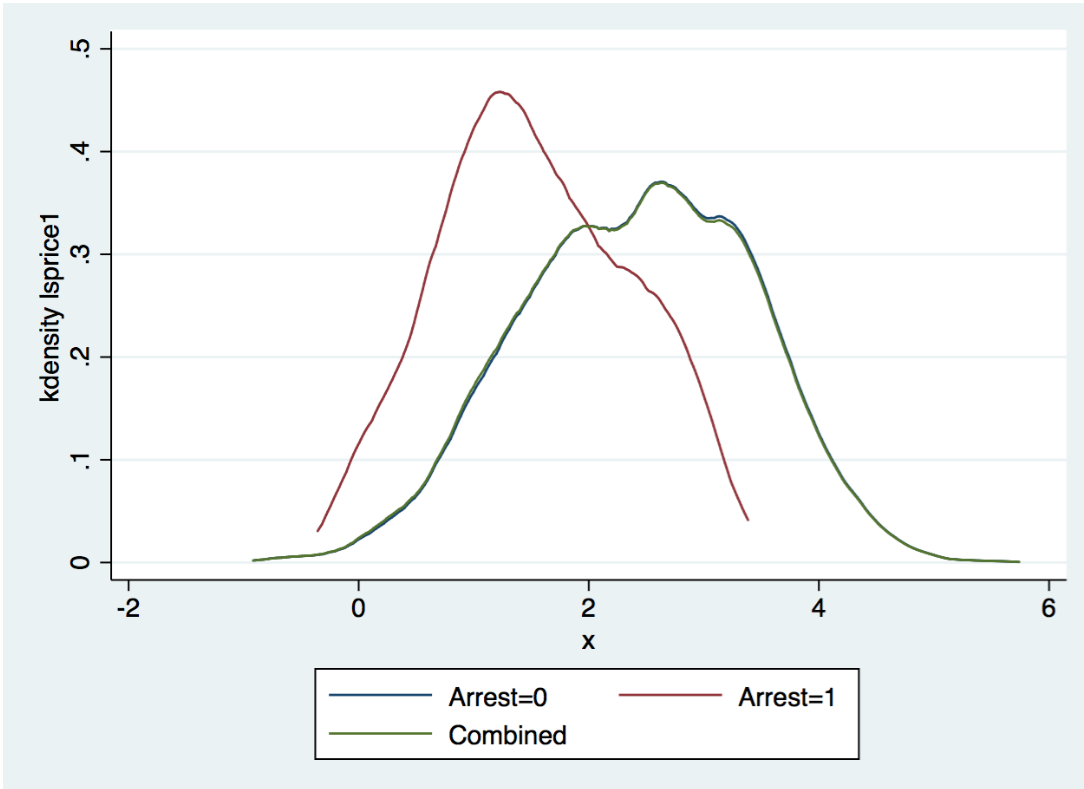

Figure 6: Value Distribution of Arrested and Non-arrested Ships. In this figure, we plot distribution of natural logarithm of values (lsprice1) of ships sold under arrest and those sold privately. The value distribution for the combined sample of arrested and non-arrested ships is also plotted.

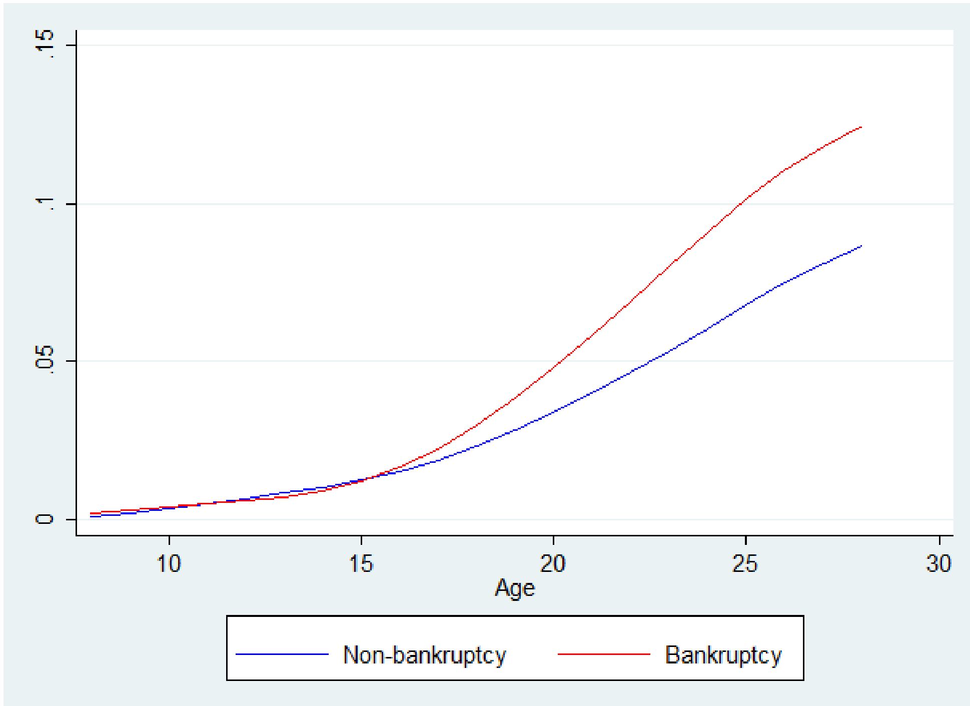

Figure 7: Hazard Rate for Bankruptcy and Non-bankruptcy Aircrafts. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the bankruptcy (red/top line) and non-bankruptcy (blue/bottom) aircraft of any given age.

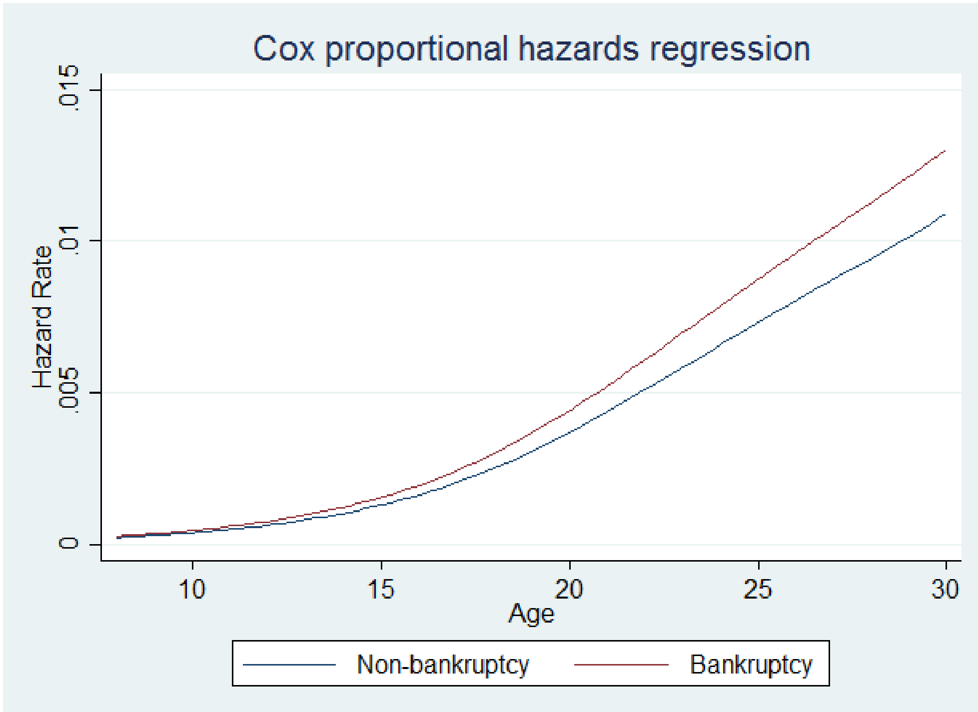

Figure 8: Hazard Rate for Bankruptcy and Non-bankruptcy Aircrafts. In this figure, we plot the probability of a breakup, i.e. hazard rate, for the bankruptcy (red/top line) and non-bankruptcy (blue/bottom) aircraft of any given age by estimating a cox proportional hazard model.

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

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

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

Table 2: Arrests, by trigger and resolution

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

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

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

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

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

Table 4: Funding data for twenty seven vessels

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

	mean	median	min	max
maturity (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	1.75

Table 5: Capacity under arrest, by outcome

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

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

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

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

Table 6: The determinants of arrested capacity

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

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

Table 7: The distribution of the maximum daily arrest rate

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

	$max\{daily\_arrest\_rate_{d,i}\}_d$		$mean\{daily\_arrest\_rate_{d,i}\}_{max\pm45d}$	
	frequency	percentage	frequency	percentage
0	870	74	870	74
(0,20%)	18	1.5	55	4.7
[20%,40%)	23	2	25	2.1
[40%,60%)	35	3	40	3.4
[60%,80%)	12	1	22	1.9
[80%,100%)	9	0.8	25	2.1
100%	209	17.8	139	11.8
excluding single vessels	20	1.7	12	1
Sum	1176	100	1176	100

Table 8: 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 9: Hedonic Model, with and without quality correction

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

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

Table 10: Second Stage: Difference between the actual price and the imputed price

This table reports the results from the second stage which regresses the price discount (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. Columns 3 and 4 use *Distressed* as the explanatory variable, without and with quality correction (QC) respectively. Columns 5 and 6 include both *Arrested* and *Distressed* as the explanatory variables, without and with quality correction (QC) respectively. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

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

Table 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. Columns 2, 5 and 6 shows results from price weighted regressions while columns 1, 3 and 4 impose no weighting. Columns 1 and 2 represent the full sample. Columns 3 and 4 (or 5 and 6) split the sample into high corruption and low corruption ports. All the regressions in this table include quality correction (With QC) in the first stage. Quality correction means including life expectancy as an explanatory variable in the first stage hedonic regression. Standard errors are reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

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

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

This table reports the results from the second stage which regresses 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) W/O QC Good Time	(2) W/O QC Bad Time	(3) W/O QC Interaction	(4) With QC Good Time	(5) With QC Bad Time	(6) With QC Interaction
Arrested	-0.167***	-0.281***	-0.167***	-0.045	-0.165***	-0.045
	(0.057)	(0.041)	(0.057)	(0.056)	(0.042)	(0.056)
Arrest×Bad			-0.114*			-0.12*
			(0.069)			(0.069)
Observations	5373	4054	9427	5373	4054	9427
Adjusted R^2	0.002	0.022	0.012	0.000	0.008	0.004

Table 13: Auction data from UK ports

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

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

Table 14: Productivity of Aircraft and Bankruptcy History

The table shows how productivity of aircraft is affected by their operators' Chapter 11 bankruptcy. The regression results are obtained from estimating equation 5. *Bankruptcy* is an indicator which equals to 1 if the aircraft was ever exposed to a Chapter 11 bankruptcy event. The dependent variable in columns (1), (3) and (5) is log of average monthly flying hours in a given year. In columns (2), (4) and (6), the dependent variable is log of average monthly cycles in a given year. Standard errors clustered by aircraft types are denoted in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	ln(Hours)	ln(Cycles)	ln(Hours)	ln(Cycles)	ln(Hours)	ln(Cycles)
Bankruptcy	-0.124***	-0.110***	-0.127***	-0.116***		
	(0.040)	(0.041)	(0.038)	(0.039)		
Bankruptcy					-0.161**	-0.122*
(year 0 to +2)					(0.070)	(0.067)
Bankruptcy					-0.085***	-0.088**
(year +3 to +5)					(0.032)	(0.044)
Bankruptcy					-0.112*	-0.134**
(year +6 onwards)					(0.066)	(0.056)
ln(Fleet Size)			-0.039	-0.055	-0.040	-0.055
			(0.042)	(0.040)	(0.042)	(0.039)
ln(# of same type aircraft)			0.088	0.065	0.089	0.065
			(0.077)	(0.071)	(0.078)	(0.072)
Time FE	YES	YES	YES	YES	YES	YES
Type X Age FE	YES	YES	YES	YES	YES	YES
Operator FE	YES	YES	YES	YES	YES	YES
Adj R-squared	0.619	0.624	0.619	0.624	0.619	0.624
Observations	173230	173230	173230	173230	173230	173230

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