Evading Corporate Responsibilities: Evidence from the Shipping Industry*

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Abstract

I show that the maritime shipping industry – handling above 80% of global trade flows – has evolved over the past decades to systematically evade "corporate responsibilities," i.e., compliance with regulatory standards and potential tort liabilities. Shipping firms increasingly dissociated legal and ultimate ownership, fragmented assets in one-ship subsidiaries, used flags of convenience, and evaded end-of-life responsibilities with "last-voyage flags." Microeconomic tests confirm that responsibility evasion, amidst global competition, is a dominant motive behind these patterns. These findings have implications for our understanding of corporate social responsibility, of extended forms of liability, and of the "dark side" of globalization.

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1 Introduction

Recent years have been marked by growing concerns about doing business "responsibly," e.g., by taking environmental damages into account. Which corporate structure or legal system helps to better achieve this goal is a key question (Liang and Renneboog, 2017). In this paper, I study the relation between the ability to use limited liability when structuring corporate groups and corporate responsibility. To be precise upfront, I define "responsibility" as decision-taking motivated by (i) preventive decisions in day-to-day operations to avoid "disasters," (ii) compliance with regulatory standards and (iii) consideration for long-term impact, potentially at the cost of short-term profit.

Limited liability of equity holders is one of the main features of modern corporate law. While its costs and benefits are theoretically well understood, two issues remain under-explored. First, regarding costs, existing research has mostly focused on "risk-shifting" towards contractual creditors, such as lenders (Jensen and Meckling, 1976). Instead, risk-shifting towards tort creditors, such as victims of environmental damages, has been neglected. As opposed to lenders, tort creditors are not part of any contract with firms, and so cannot protect themselves via contractual clauses. Therefore, damages to tort creditors are likely to be orders of magnitudes larger than those imposed to contractual creditors. Second, the theoretical benefits of limited liability, e.g., allowing investors to hold diversified portfolios, apply primarily, if not only, to individual investors (Easterbrook and Fischel, 1996). However, parent companies also benefit from limited liability vis-à-vis subsidiaries. Together, the use of subsidiaries and the possibility to externalize tort liabilities open the possibility of massive corporate irresponsibility: socially costly activities can be located in small subsidiaries, possibly in jurisdictions with low regulation. Corporate irresponsibility is then organized by paying out any income to parent companies and liquidating subsidiaries in case of large liabilities.

In this paper, I study the evasion of corporate responsibilities within the maritime shipping industry. This industry is a good laboratory for several reasons. To begin, the shipping industry is economically relevant, as it handles 80 to 90% of global trade in goods (UNCTAD, 2019). As such, it is the backbone of globalization. Moreover, the three components of responsibility identified above are relevant: (i) "disasters" can arise from day-to-day operations, e.g., from oil or chemical spills, (ii) regulation exists but can be evaded via flags of convenience, and (iii) "long-run" risks are important, due to the recycling of large and dirty tankers or containerships. Finally, the activity of subsidiaries is arguably more observable than in other industries where responsibility evasion via small and offshore subsidiaries may also be taking place (banking, chemicals, etc.). For my tests, I collect detailed data on the ownership and operations history of all large merchant vessels that ended life over the 2000-2019 period.

I use these data to make two contributions. The first one is to document dramatic changes in the shipping industry over the past four decades, in order to systematically evade responsibilities. All three dimensions of corporate responsibility discussed above are concerned. At a broad level, the trends coincide with both the "third globalization wave" (starting in the 1980s) and with the recent rise in tort liabilities (Priest, 1991), itself associated with growing environmental concerns. That said, as a second contribution, I explore the microeconomic determinants of these trends more precisely. Empirically, causality is hard to establish, because long-term trends necessarily correlate with a number of other "time effects." For identification, I use a variety of theoretically motivated strategies, exploiting either fixed effect specifications, cross-sectional variation or plausibly exogenous sources of variation at high frequencies. These tests support the view that responsibility evasion is a major determinant of the stylized facts.

The first main fact is the increasing dissociation of ownership, which takes several forms. Most importantly, ships, which used to be owned by groups, are increasingly held by subsidiaries. In other terms, the legal and the ultimate ownership of ships are now separated. Furthermore, the amount of assets in each subsidiary is minimized, as shipping companies typically create one distinct subsidiary for each ship. In 2020, 89.97% of all registered owners of ships globally are one-ship subsidiaries. This structure allows shipping companies to insulate the parent's assets, and ships in other subsidiaries, in case a ship causes a costly damage. Consistent with the view that the dissociation of ownership is driven by liability evasion, I find that dissociation is more likely when beneficial owners hold more ships, and when damages potentially arising from these ships are either more costly or more likely: for larger ships, for older ships and for single-hull ships. For identification, I also use quasi-random variation arising from ship detentions by port authorities. Such events arguably lead companies to update their view about the liabilities that may arise from a ship. In the three months following ship detentions, I find that ships are significantly more likely to be moved to new subsidiaries.

The second fact I document relates to the evasion of regulatory standards. This is achieved by registering ships with flags of convenience, that is, jurisdictions that sell the right to use their own flag, but do not always verify the compliance of ships with international standards. Theoretically, the issue of flags of convenience is closely related to limited liability: the possibility to dissociate a corporate group into many subsidiaries also allows choosing where subsidiaries are located, and so the regulatory framework to which they are subjected. The use of flags of convenience has been booming over the past four decades. For example, for containerships, they represent 82.3% of the global tonnage in 2019, as opposed to only 19.6% in 1980. This growth of flags of convenience is not driven by selection of ships or shipping companies over time, but by active reflagging decisions: indeed, the booming use of flags of convenience is observed in regressions that include ship*beneficial owner fixed effects. The widespread use of flags of convenience implies that the world fleet is composed of older and riskier ships, which are more likely to be lost at sea. In terms of the mechanism, if regulatory evasion is a dominant force behind the adoption of flags of convenience, then it should be more likely when the need for shipping companies to cut costs is felt more strongly. Consistent with this idea, I find that the adoption of flags of convenience is more likely when freight rates are low. For further identification, I rely on events in which a company loses a ship at sea. These events are plausibly random, and suddenly tighten the financial constraints of shipping firms. I find that, in the following three months, these firms become more likely to reflag other ships, including to flags of convenience. Therefore, flags of convenience are a way to reduce costs amidst global competition. Consistent with the idea that flags of convenience are used to evade regulations, I also show that older ship fly lower-quality flags (e.g., flags of countries that have ratified fewer international conventions) and move to world areas where they are less likely to face tight inspections by port authorities.

My final results relate to the third dimension of corporate responsibility, that is, the ability to take long-term outcomes into account. Long-term responsibility is key in the shipping industry, since old ships are large and often dangerous waste. I explore two decisions related to end-of-life ships. First, I show that almost all ships globally are dismantled in poor environmental conditions after being "beached" on the shores of Bangladesh, India or Pakistan. Second, I show that a fast-growing number of shipping companies use "last-voyage flags," most likely in an attempt to hide such dirty practices: ships are sold to a third party just for the last voyage to a beaching yard. In doing so, shipping companies get paid for the value of a ship's raw materials, but do not assume any of the responsibilities associated with toxic wastes or oil residuals (which end up at sea). While last-voyage flags were close to non-existent in the early 2000s, they represented 55.2% of all end-of-life ships globally in 2019. This practice is again related to limited liability: in this case, shipping companies evade responsibilities by outsourcing dirty decisions to small limited liability third parties. In cross-sectional tests, I find that last-voyage flags are significantly more common for companies in common law jurisdictions: this is consistent with the view that judges in common law countries are more likely to take contracts seriously, and not to consider them as mere veils to hurt public interests.

Related literature. This paper is related to several strands of the literature. First, there is a literature on limited liability. So far, most of the research has focused on the costs of limited liability imposed on contractual creditors, that is, risk-shifting (see Jensen and Meckling (1976) and Biais et al. (2010) for theory and Eisdorfer (2008), Gilje (2016) and Koudijs et al. (2020) for empirical evidence). Far less studied by economists are the costs of limited liability imposed on tort creditors.[1] One

[1]There is a large legal literature on tort liabilities. In economics, there are a few papers studying

exception is Akey and Appel (2020), who show that stronger liability protection for parent companies in the US leads to higher toxic emissions by subsidiaries. Relatedly, Ringleb and Wiggins (1990) find that industries where the potential for tort liabilities increased between 1967 and 1980 (e.g., chemicals) saw more entry of small firms, either subsidiaries or subcontractors. Liabilities can also be evaded by premature dissolution, studied by Boyd and Ingberman (2003). Given these costs of limited liability, a few papers have investigated whether ex ante regulation can be a perfect substitute for ex post liability (Shavell, 1984; Kolstad et al., 1990), and find that most often it is not. Surprisingly, the literature on firms' (limited) liability has not been closely tied to the growing research on corporate social responsibility (Bénabou and Tirole, 2010; Kitzmueller and Shimshack, 2012; Ferrell et al., 2016). My paper suggests that it should.

Second, this paper is related to the literature on offshore finance and to the associated "dark side" of globalization. Most of the research has focused on the role of offshore jurisdictions for tax evasion, both for individuals (Zucman, 2013) and firms (Hines and Rice, 1994; Torslov et al., 2020). These last two papers exploit profitability differentials between firms domiciled inside or outside of tax heavens to document profit shifting to low-tax jurisdictions. O'Donovan et al. (2019) also document a role of offshore jurisdictions for tax evasion, along with corruption financing and shareholder expropriation. Aside tax evasion, I show that offshore jurisdictions have also been used massively for liability and regulatory evasion, ultimately leading to the externalization of tort damages to society. Interestingly, while Zucman (2014) documents a massive

other determinants of pollution externalities. Shapira and Zingales (2017) show that pollution decisions are taken to maximize profits given the expectations of sanctions. Shive and Forster (2020) find that pollution is more severe in listed firms with dispersed equityholders.

increase in tax evasion since the 1980s, this is exactly the period in which I document booming responsibility evasion via flags of convenience.

2 Background and data

This section provides background information on the shipping industry and describes the data sources that I use in the empirical analysis.

2.1 The shipping industry

More than 80% of the goods traded globally travel by sea, via a world fleet of 95,402 ships in 2019 (UNCTAD, 2019). While high seas are free from State sovereignty, each ship is required to fly the flag of a country.[2] In international law, a ship is considered part of the territory of the State whose flag it flies. In other terms, the flag of a ship is its nationality, and determines the national law it must comply with, including safety, labor and environmental regulations. International law establishes that there must be a "genuine link" between the ship and its flag state. For example, owners of a ship must be domiciled in the flag state and that state must effectively exercise its jurisdiction. Until recent decades, exceptions remained marginal. A ship owned by a Greek firm would almost automatically adopt the Greek flag. Therefore, it was subject to Greek regulation and considered Greek in case of litigation.

Flags of convenience are defined as states allowing foreign ships to fly their flag,

[2] High seas are defined in international law as the part of the sea beyond territorial waters and exclusive economic zones (respectively, 12 and 200 nautical miles from the coast). The principle of freedom of the high seas was first formulated in the early 17th century by Hugo Grotius (*Mare Liberum*) and has been reaffirmed in international law until recently, e.g., via the Convention on the High Seas in 1958 and the United Nations Convention on the Law of the Sea (UNCLOS) in 1982.

even in the absence of any "genuine link."[3] These countries run so-called *open registries*: conditional on paying a registration fee and on satisfying some requirements (e.g., age limits), any ship can fly the country's flag. For example, a ship owned by a Greek corporate group, with no link to Liberia (neither crew nationality nor financing, etc.), that will never stop over in Liberia, can fly the flag of Liberia – and thus be considered Liberian in international law. Flags of convenience provide a variety of benefits: tax evasion (since most of them are tax heavens or offer special fiscal treatment to foreign-owned subsidiaries), evasion of domestic regulations, concealment of ownership, etc. De facto, flags of convenience work as a market for ship nationality.[4]

Facing the risk of a race to the bottom, major countries are left with one instrument: check the compliance with desired standards of ships entering domestic ports, or preventing them from entering. The mechanism through which foreign-flagged ships can be inspected is called Port State Control (PSC). This practice is organized based on several regional Memorandums of Understanding (MoU), the most famous being the Paris MoU, which counts 26 European countries and Canada in 2020. Under a MoU, each country commits to inspect a certain fraction of ships, share inspection results with others, and detain ships that severely fall below standards.

The operation of a ship involves a variety of agents. For our purposes, three are relevant. The company that legally owns the ship is its *registered owner*. The one ultimately benefiting from the ownership is the *beneficial owner*. The registered owner and the beneficial owner can obviously be the same entity, or the registered owner can

[3]There is considerable debate among legal scholars about the meaning of the "genuine link" principle in this context.

[4]The management of a number of open registries, including major ones (Liberia, Marshall Islands), has been delegated to private companies, themselves often located in foreign countries. For example, the registries of Liberia and Marshall Islands are managed by companies in the United States.

be a subsidiary of the beneficial owner. Finally, the ship may be operated by a third party, called the *operator*.

2.2 Data and sample description

I build my main dataset using IHS Markit's *Sea-web* data. I restrict attention to ships I can observe over their entire life, from the date they are built to the date they are either broken up or lost at sea. My sample is composed of all 1,715 merchant ships with gross tonnage above 50,000 that ceased operations during the 2000-2019 period.[5] Each ship is uniquely identified using a single IMO (International Maritime Organization) number, and can thus be tracked over time even if it changes flag, name or owners. For each ship, I retrieve the entire history of registered and beneficial owners, operators, names, flags, as well as time-invariant characteristics (year of built, ship type, hull type). Combining this information, I construct a dataset tracking the characteristics of each ship at the monthly frequency over their entire life, representing 468,701 ship-month observations. For each ship, I also collect its history of inspections and detentions from Port State Control authorities. I finally use auxiliary sources, described in Appendix A.1, to get freight rates, the number of international conventions ratified by each flag state, or other relevant variables.

Table 1 provides descriptive statistics about the sample ships. Panel A shows that tankers, bulk carriers and containerships are the most prevalent ship types, representing respectively 37.8%, 35.2% and 14.3% of observations. The average sample ship has gross tonnage of 84,100, and an average age at the end of life of 23.2 years. Panel B shows that, on average, a given ship has 2.7 flags, 2.9 names, 3.3 registered owners,

[5]Gross tonnage is a measure of the internal volume of a ship. I drop two observations corresponding to cruise ships.

3.2 beneficial owners and 3.3 operators over its life. However, there it significant cross-sectional variation: at the 90% percentile, a ship has 4 flags, 5 names, 5 registered owners, 5 beneficial owners and 5 operators over its life. Finally, the first column of Panel C shows that the two dominant flags in the data are Panama and Liberia, representing respectively 18.1% and 15.4% of all ship-month observations. These flag states, along with other flags of convenience, have become more prevalent in the last decade of the sample, as Panel C shows.

3 Dissociation of ownership and liability evasion

In this section, I document a first set of facts on the corporate structure of shipping firms. These firms have increasingly dissociated legal and ultimate ownership, using parent-subsidiary structures, while minimizing the amount of assets in each subsidiary. Beyond global trends, microeconomic tests confirm that liability evasion is a dominant force behind these facts.

3.1 Stylized facts on ownership dissociation

I start by studying the evolution of ship ownership and operations over time. Theoretically, shipping companies willing to limit potential tort liabilities can do so in three ways: (i) by using a parent-subsidiary structure, i.e., by dissociating the beneficial owner from the registered owner, (ii) by minimizing the amount of assets or net worth in each subsidiary, that is, by using one-ship subsidiaries, and (iii) by dissociating the beneficial owner of a ship from its operator.

While (i) and (ii) are consequences of the limited liability of subsidiaries, (iii) follows from the fact that, in case of damage caused by a ship, judges can seek to establish the responsibility of the operator, in addition to that of the owner. One reason is that operators take decisions that are relevant for the occurrence of accidents, e.g., the nature of the cargo (toxic or not), the routes taken (more or less dangerous), the maintenance of the ship, etc. Another one is that, faced with undercapitalized registered owners, judges have sometimes sought the responsibility of other parties, including operators.[6] Compared to a situation in which the beneficial owner and the operator are the same, which was historically often the case, there are two reasons why dissociation may be profitable. First, if operating a ship requires assets, the dissociation is a way to insulate a greater quantity of assets from potential liabilities of the ship owner. Second, the dissociation makes it more difficult to establish specific responsibilities of the owner and of the operator.

I start by describing the dissociation of ownership in the pooled sample. Panel A of Table 2 shows that the median ship spends 0% of its life with a registered owner that is the same as the beneficial owner (6% at the 75th percentile), and 27% of its life with an operator that is the same as the beneficial owner (71% at the 75th percentile). Therefore, the dissociation of ownership is widespread in the pooled sample.

Next, I study the time-series variation in the use of corporate structures aimed at limiting potential liabilities. Starting with the use of parent-subsidiary structures, I estimate

$$ROBO_{it} = \beta_1 \cdot \mathbb{1}_{\{t \in (1990,2000)\}} + \beta_2 \cdot \mathbb{1}_{\{t \in (2000,2010)\}} + \beta_3 \cdot \mathbb{1}_{\{t \in (2010,2019)\}} + FE_{i,bo} + {}_{it}, \quad (1)$$

[6] Similarly, judges can seek to establish the responsibility of charterers, who rent ships for a given voyage or for a period of time. In the famous case of the *Erika* oil spill, judges established the responsibility of the operator (*Panship management*) and of the charterer (*Total*). Unfortunately, charterers are not observed in our data.

where $ROBO_{it}$ is a dummy variable equal to one when the beneficial owner of ship i is the same as its registered owner in month t, $\mathbb{1}_{\{t\in(t_1,t_2)\}}$ is a dummy variable equal to one if month t is part of the decade between t_1 and t_2, and $FE_{i,bo}$ denotes ship*beneficial owner fixed effects. These fixed effects ensure that any identified effect is not driven by changes in the composition of ships or beneficial owners over time, but by active decisions of shipping companies. The coefficients of interest are β_1, β_2 and β_3, which measure how given ships become more or less likely to be located within subsidiaries over time.

The estimation results are presented in Panel B or Table 2, in columns (1) to (4). Several fixed effect specifications yield a consistent result: cases in which beneficial and registered owners coincide are becoming less frequent over time; relative to the pre-1990 period, most of the drop occurred in the 1990s and in the 2000s, before stabilizing at a low level. In terms of magnitudes, in the most stringent specification with ship*beneficial owner fixed effects, the proportion of ships for which beneficial and registered owners are the same is 11.0 percentage points lower than in the pre-1990s, and significant at the 1% level. The fact that this finding holds within ships and beneficial owners suggests that the dissociation results from active decisions by parent companies to move ships to subsidiaries.

Next, I show that registered owners are predominantly one-ship subsidiaries. To show this, one needs to observe the total number of ships owned by each registered owner. This is not possible with my main dataset, which restricts attention to ships observed over their entire life. Consequently, I collect additional data on all 29,691 ships with gross tonnage above 10,000 that were active globally at a given date (September 8th, 2020). For each of them, I know the registered and beneficial owners. Out of all registered owners, I find that 89.97% are one-ship structures, that is, entities legally owning more than one ship are rare. Furthermore, for each beneficial owner, I compute the ratio between the number of distinct registered owners and the number of ships ultimately owned. The distribution of this variable is displayed in Table 3. In the whole sample of beneficial owners, the median value of this ratio is one, meaning that at least half of shipping groups have as many subsidiaries as ships. The lower subpanels of Table 3 restrict the sample to beneficial owners above a certain number of ships. Among groups with at least 10 ships, the median group has 81% of one-ship subsidiaries. These results are consistent with the view that shipping companies structure to minimize the amount of assets in each subsidiary.

Finally, I examine trends in the dissociation between beneficial owners and operators. To do so, I re-estimate Equation (1), using as dependent variable a dummy variable equal to one when the operator of ship i in month t is the same as its beneficial owner. The results are displayed in Panel B of Table 2, in columns (5) to (8). Across several fixed effect specifications, I find that the dissociation between operators and beneficial owners accelerated over the past three decades, relative to the pre-1990 period. This dissociation holds within ships and beneficial owners, suggesting again that it results from active decisions by shipping companies. In the most complete specification of column (8), the share of boats for which the operator is the same as the beneficial owner is 14.8 percentage points lower in the 2010s than in the pre-1990 period.

All together, results in this section show that the shipping industry has evolved since the 1980s to increasingly dissociate legal ownership, beneficial ownership, and operations. The dissociation of activities that were historically often joint makes the establishment of responsibilities more complicated in case of damage, while minimizing the amount of assets that can be seized.

3.2 Mechanism: Liability evasion

I now study the determinants of the decision to dissociate registered owners from beneficial owners. Theoretically, the dissociation enables a corporate group to shield assets in case large liabilities arise from the operations of a single ship. Therefore, a first prediction is that, if shipping companies structure to evade potential liabilities, they should be more likely to dissociate legal from ultimate ownership when the beneficial owners has a large number of ships. This prediction, which should hold both in the cross-section of beneficial owners, and within a given beneficial owner over time, is tested by estimating

$$ROBO_{it} = \beta \cdot Ships_{bo,t} + FE_{i,bo} + \epsilon_{it}, \tag{2}$$

where $ROBO_{it}$ is the variable defined in Section 3.1, and $Ships_{bo,t}$ is the number of ships owned by the beneficial owner bo of ship i at t.

Estimation results are reported in Panel A of Table 4. In column (1), I estimate Equation (2) without any fixed effects. In the pooled sample, I find that ships in larger corporate groups are less likely to have a registered owner that is the same as its beneficial owner. This effect is significant at the 1% level. I then sequentially add ship and beneficial owner fixed effects (column 2), as well as ship*beneficial owner fixed effects, $FE_{i,bo}$ (column 3). This last specification is particularly stringent since it tests whether a given ship, during the period in which it belongs to a given group, is more likely to have dissociated beneficial and registered owners specifically at times the beneficial owner gets bigger. The estimation confirms that this is the case, again with a statistical significance at the 1% level.

A second way to test whether liability evasion is likely to be a dominant force explaining the structure of corporate groups is to study cross-section variation in the baseline effect. Theoretically, it should be the case that ships that are more likely to generate large liabilities are also more likely to be registered in distinct one-ship subsidiaries. To assess this prediction, I estimate,

$$ROBO_{it} = \beta \cdot Characteristic_i + FE_{bo,t} + \epsilon_{it}, \tag{3}$$

where *Characteristic* is a characteristic of ship i associated with the risk of creating future environmental liabilities. Furthermore, to avoid any concern arising from group-specific factors or with time trends, I include time*beneficial owner fixed effects, $FE_{bo,t}$. Therefore, I test whether, within a given shipping group in a given month, ships that are more dangerous are more likely to have distinct registered and beneficial owners.

This prediction is confirmed in Panel B of Table 4, for several characteristics. In column (1), I find that ships with larger tonnage, which arguably cause larger damages upon a sea accident, are more likely to be registered in distinct subsidiaries. In columns (2) and (3), I find that the same holds true for older ships, whose accident probability is higher (hull corrosion, etc.). Then, column (4) uses data on the technical characteristics of ships to distinguish between single-hull and double-hull ships, which is particularly relevant for oil tankers. I find that single-hull ships, which are more likely to generate oil spills, are also more likely to have distinct registered and ultimate owners. Lastly, column (5) shows that tankers – which are more likely than bulk carriers or containers to generate large oil spills – are also more likely to dissociate ownership. All together, these cross-sectional give support to the view that liability evasion is a relevant force behind long-term trends in corporate structures.

Finally, I rely on a plausibly exogenous source of variation to explain the determinants of the dissociation between ultimate and registered owners. Specifically, as explained in Section 2.1, ships face random Port State Control (PSC) inspections when stopping over in ports of countries that decide to implement some international standards. If major defects are found, ships can be detained until defects are fixed or until the shipping company commits to fix them. Detentions are severe events for a ship, for at least two reasons. First, they cause major delays to current operations. Second, detentions are typically made public, so that other harbors globally may become more suspicious about accepting the ship. In terms of responsibility, a detention is a public signal that a ship faces severe issues, and that potential liabilities arising from that ship may be high. To study the role of ship detentions, I use data on the results of PSC inspections for all sample ships, from *Sea-web*. Descriptive statistics, in Panel A of Table 5, show that, on average, a ship is detained 0.6 times over its life (and 2 times at the 90th percentile). On average ships are detained for 2.2 days (and 4 days at the 90th percentile). Nor surprisingly, detained ships are fairly old, with an average age of 16.3 years.

I use ship detentions as a plausibly exogenous event that suddenly raises potential liabilities of the ship owner, either because he suddenly learns about major defects of the ship, or because other jurisdictions become more likely to impose severe checks on the ship. While ship detentions are in general not exogenous – they depend chiefly on maintenance efforts –, their precise timing is arguably close to random. Indeed, detailed PSC inspections concern only a fraction of all ships every period. Panel A of Table 5 confirms that even the worse ships do not face a large number of detentions over their life. Therefore, given that the exact timing of detentions is close to random, focusing on ownership changes just around these events provides arguably exogenous variation. I estimate

$$Change_{it} = \beta \cdot Detained_{it} + FE_i + FE_t + \epsilon_{it}, \quad (4)$$

where $Change_{it}$ is a dummy variable equal to one if ship i changes one key characteristic between months t and $t+3$ (flag, name, beneficial owner, registered owner or operator), and $Detained_{it}$ is a dummy variable equal to one if ship i is detained in month t. I restrict attention to within-ship variation using ship fixed effects FE_i, and control for time trends with time fixed effects, FE_t.

The estimation results are displayed in Panel B of Table 5. Across the five sets of regressions, I find that ships are significantly more likely to change key characteristics just after being detained. However, the economic magnitude of the effect differs across variables. In particular, ships are almost twice more likely to change registered owner than beneficial owner (coefficients equal to 0.017 and 0.010 respectively, in the most stringent fixed effect specification). This finding is consistent with he idea that the dissociation between legal and ultimate ownership is more likely to happen when shipping companies face detentions: some ships remain within the same group but are registered in a different subsidiary. Similarly, changes in operator are also more likely, consistent with the view that dissociating beneficial owners and operators is one possibility to evade liabilities when they suddenly loom large.

Finally, one may argue that ship owners' attempts to limit their liability is irrelevant, provided that governments require them to buy insurance. While this is generally true, it is not the case in the shipping industry, where international law recognizes an exception to standard liability rules, as further described in Appendix B. To be brief, international law is such that shipowners have the ability to limit their own responsibility to a fixed value (which depends on a ship's tonnage), regardless of the value of damages. Therefore, insurance coverage will never be greater than this limit. This derogatory regime for ship owners' liability explains that, in case of major oil spills, the total amount of damages is most often not compensated for (see Table A1).

4 Flags of convenience and regulatory evasion

I turn to another set of facts related to the second dimension of corporate responsibility, i.e., compliance with regulatory standards. I document a booming use of flags of convenience by shipping firms. Offshore jurisdictions offer a variety of benefits to shipping firms, notably the evasion of regulatory standards, which allows to cut costs. At a microeconomic level, tests confirm that the adoption of flags of convenience is more likely when freight rates are low and for more financially constrained shipping companies.

4.1 Stylized facts on flags of convenience

To document time-series patterns in the use of flags of convenience, I rely on two definitions. The first one is based on the list of flags of convenience published by the International Transport Workers' Federation (ITF). This union has been active for several decades at the global scale to oppose flags of convenience. It regularly publishes a list of such jurisdictions, which is widely cited by regulators and other industry participants. In the version I use (dated from August 2020), the list comprises 35 countries. My second definition of flags of convenience additionally includes 14 other countries running an open registry or a secondary registry but not in the ITF list.[7]

To provide a first view about the use of flags of convenience, I retrieve data from UNCTAD to plot, in Panel A of Figure 1, the share (in deadweight tons) of the world's fleet carrying a flag of convenience. Between 1980 and 2019, we see a continuous increase in the use of flags of convenience. Using the ITF definition, the percentage of the world's fleet carrying a flag of convenience rose from 30.4% to 55.1%. Based on the broader definition, this share rose even more sharply, from 42.2% to 75.4%. Thus, regardless of how flags of convenience are defined, their use has been growing considerably, to represent up to three fourth of the world's merchant fleet. Furthermore, using the broad definition of flags of convenience, Panel B of Figure 1 shows that this trend has affected all types of ships, albeit with some heterogeneity. The growing trend is most striking for countainerships, that is, the segment of the world's fleet most closely associated with global trade flows in goods. For them, the share of flags of convenience rose from 19.6% in 1980 to 82.3% in 2019. This represents a dramatic shift in the structure of the shipping industry. For oil tankers, instead, 49.1% of the world fleet was already carrying flags of convenience in 1980, and this share grew to

[7]A secondary registry is a registry managed by a traditional maritime country (e.g., France, Germany, Denmark or Norway), that allows local shipowners to do away with some requirements associated with the main registry. See Appendix A.2 for the lists of countries classified as flags of convenience based on the two definitions.

71.6% by 2019.[8]

This aggregate trend in the reliance on flags of convenience does not necessarily imply that a large fraction of ships actively reflagged over the period. Indeed, the aggregate pattern could be due to selection, e.g., because of a time-series change in leading maritime countries. If so, the pattern could be explained by the decline of ships from some nations and the growth of ships from other nations. A first step to assess this possibility is to study the percentage of their entire life that sample ships spend with a flag of convenience. The distribution of these percentages, at the ship level, is characterized in Panel A of Table 6. While some ships appear to spend their entire life either with or without flags of convenience, most ships appear to shift over their life. Using the ITF definition, the median ship spends 50% of its life with a flag of convenience. Using the broader definition of flags of convenience, this percentage rises to 83%.

To assess more formally the extent of active reflagging decisions, I re-estimate Equation (1), using as dependent variable a dummy variable equal to one when ship i flies a flag of convenience at date t. This regression is estimated with ship*beneficial owner fixed effects ($FE_{i,bo}$). These fixed effects ensure that I isolate variation within a given ship and parent company; as such, any identified effect cannot be driven by selection. The estimation results are displayed in Panel B of Table 6, using both the ITF and the broad definitions of flags of convenience (respectively, in columns 1 to 4 and 5 to 8). Across all specifications, I find that the 1990s and 2000s were two decades of active reflagging decisions, while the use of flags of convenience stabilized at

[8]The fact that a large fraction of oil tankers moved early on to flags of convenience seems to be a response by ship owners and operators to major oil spills in the 1960s and 1970s (notably the *Torrey Canyon* oil spill in 1967).

a high level in the 2010s. In the most stringent specification with ship*beneficial owner fixed effects, reliance on flags of convenience increased between 6.1 and 9.8 percentage points (depending on the definition used) in the 2010s, relative to the pre-1990 period. These differences are significant at the 1% level. These results show that the aggregate rise in flags of convenience comes, at least in part, from active reflagging decisions.[9] Therefore, this suggests the existence of economic factors that pushed ship owners or operators to seek flags of convenience.

4.2 Mechanism: Regulatory evasion

I now seek to explain the use of flags of convenience by shipping firms. Theoretically, relative to one-ship subsidiaries, the main benefit of flags of convenience is to allows cutting costs through several channels: lighter safety and environmental regulation, no manning requirements, etc. In general, the need to cut costs should be more pressing in a context of global competition: if some shipping companies start moving to flags of convenience, the optimal response for others may be to also adopt such flags. The stylized facts are telling in this respect: the booming use of flags of convenience coincides with the "third globalization wave." However, this correlation does not establish causality.

To assess more formally the hypothesis that the adoption of flags of convenience is driven by the need to reduce costs, I use two strategies. First, I estimate

$$ToFOC_{it} = \beta \cdot BalticDry_t + \gamma \cdot Age_{it} + FE_i + \epsilon_{it}, \qquad (5)$$

[9] The time-series variation observed in Figure 1 is sharper than the one estimated within ships and beneficial owners. This suggests that part of the variation is also coming from selection.

where $ToFOC_{it}$ is a dummy variable equal to one when ship i adopts a flag of convenience in month t (from a traditional flag in month $t-1$), Age_{it} is the age of ship i at date t, and FE_i is a ship fixed effect. The main independent variable, $BalticDry_t$ is the Baltic Dry Index, the most widely used measure of global freight rates.[10] Equation (5) thus directly tests whether a given ship, after controlling for age and time-invariant characteristics, is more likely to adopt a flag of convenience when freight rates are low, that is, when the need to cut costs may be stronger. The results, in Panel A of Table 7, confirm that this is the case. Across a variety of specifications, with or without ship fixed effects, and for both definitions of flags of convenience, I find that the decision to adopt flags of convenience is more likely to be taken when freight rates are low. The effect is statistically significant in three cases out of four.

My second strategy is based on the idea that reducing costs should be more valuable at times when shipping companies face severe financial constraints. While exogenous variation in financial constraints is often hard to find, due to both measurement and endogeneity problems, the shipping industry offers an ideal setup. Indeed, any loss of a ship at sea is arguably most often random (due to weather conditions and crew mistakes), and associated with a large loss for shipping companies.[11] Therefore, financial constraints should tighten following ship losses. If flags of convenience are used to cut costs, they should be particularly valuable for a shipping company following such

[10] The Baltic Dry Index is computed daily by the London-based Baltic Exchange. It averages quotes about freight rates for 20 global routes.

[11] One could argue that ship losses are partially endogenous, since they depend on maintenance expenses by the shipping company. However, maintenance efforts should determine the overall probability of accidents and not the exact timing of ship accidents – which remains arguably random. To avoid this randomness, and thus alleviate endogeneity concerns, I restrict attention in Equation (6) to flag changes occurring just around the ship loss (within three months).

losses. To assess this hypothesis, I estimate

$$ToFOC(3m)_{it} = \beta \cdot Shiploss_{bo,t} + FE_{i,bo} + FE_t + \epsilon_{it}, \quad (6)$$

where $ToFOC(3m)_{it}$ is a dummy variable equal to one if ship i adopts a flag of convenience between months t and $t+3$ (or changes other characteristics over this period), $Shiploss_{bo,t}$ is a dummy variable equal to one for ship i if another ship with the same beneficial owner *bo* is lost at sea at date t. Equation (6) further includes year fixed effects, FE_t, to control for time trends, and ship*beneficial owner fixed effects, $FE_{i,bo}$. Isolating variation within ships and beneficial owners allows me to focus on the explicit decision by shipping companies to reflag ships, separately from other decisions (e.g., selling ships to other groups). I restrict the sample to ships owned by beneficial owners experiencing at least one ship loss over the sample period.

The estimation results, in Panel B of Table 7, show that, following a ship loss, beneficial owners are more likely to reflag other ships (column 1), and to move to flags of convenience, as measured by the ITF definition (column 2). These results are significant at the 10% level. Using the broader definition of flags of convenience, the effect is not significant, possibly due to the lack of statistical power.[12] Changes in ship name and operator, while also more likely, are also not statistically significant (columns 4 and 5). Overall, ship losses within one group seem to affect mostly the decision to reflag other ships, consistent with the view that alternative flags may be used to alleviate suddenly higher financial constraints.

Next, it needs to be formally demonstrated that, as ships are reflagged, the quality

[12] Given the prevalence of flags of convenience, as measured by the broad definition, I observe few events in which a ship transitions from a traditional flag to a flag of convenience.

of the new flag is lower than that of the old flag. The measure of flag quality I use is the raw number of international maritime conventions ratified by each flag state as of August 2020, as obtained from the International Maritime Organization (IMO). I further classify all international conventions signed under the guidance of the IMO in five categories: conventions providing global context for the shipping industry, and those respectively related to the environment, liabilities, technical standards or checks, and workers.[13] Panel A of Table 8 shows that there is considerable heterogeneity in the number of conventions ratified by flag states. For example, for conventions related to the environment, some countries have ratified all 8 conventions, while others have not ratified a single one. I use these variables to estimate

$$Quality_{if} = \sum_{c=0}^{4} \beta_c \cdot FlagNumber_{n-c} + FE_i + \epsilon_{if}, \tag{7}$$

where $Quality_{if}$ is a measure of the quality of flag state f, flied by ship i, and where $FlagNumber_{n-c}$ is a dummy variable equal to one when for the last flag of ship i (denoted n) or for any of its preceding flags from $n-1$ to $n-4$. Finally, I always include ship fixed effects, FE_i, in order to isolate within-ship variation. I estimate the regression on the entire sample of ships, regardless of the number of flags they fly over their life.

The estimation results are presented in Panel B of Table 8. Across the specifications in columns (1), (3), (5), (7) and (9), I find that flag quality monotonically drops as ships change flag, and it does so across all five dimensions: as they age, ships move

[13] The list of conventions in each category is summarized in Appendix A.3. My classification is based on the main purpose of conventions, as reflect in their title or preamble. Some conventions may touch upon several matters, e.g., technical standards and the environment. A sixth category of conventions, related to passengers, has been excluded since it is largely irrelevant for merchant shipping.

to jurisdictions with looser regulation. To better assess which dimensions of flags are particularly sought, I re-estimate Equation 7 after controlling for the percentage of all conventions signed by each flag. The results, in columns (2), (4), (6), (8) and (10) show that most of the variation disappears. This means that countries doing poorly in one dimension (e.g., protection of the environment) also tend to do poorly in other dimensions (e.g., protection of workers). This makes it hard to precisely distinguish which characteristics are relevant. That said, some variation remains: at the end of their life (i.e., for the last two flags), shipping companies seek flag states that have ratified fewer conventions related to the global shipping context, to the protection of the environment and to the protection of workers.

One question that arises nonetheless is why shipowners do not choose the least-regulated flags already at the beginning of ships' life. The reason is that the probability of Port State Control (PSC) inspections depends on a flag's quality. For young ships, which are unlikely to suffer from major defects, satisfying higher technical standards is not very difficult, while the time lost during port state control inspections is arguably more costly. As ship quality drops with age, maintenance costs can become too large relative to the the cost of time lost during inspections. Shipowners thus find it optimal to re-flag in jurisdictions with lower standards. This is consistent with the life cycle patterns in Panel B of Table 8. Thus, flags of convenience are the main way to move away from costly regulations as ships age.

Finally, when adopting some of the lowest-quality flags, at the end of their life, ships may not be able anymore to access ports with the most stringent PSC inspections, or only at a high risk of detention. The optimal response of ship owners may be to move these ships in areas with no or lighter inspections. To provide evidence that this is the case, I report in Table 9 the percentage of the global fleet voyaging in several areas as of September 2020, as a function of ship age.[14] I find strong patterns consistent with a life cycle of voyage areas: among ships with age below 10 years, 33.6% are in the Far East, 4.3% are in the US West Coast, and 4.3% are in Australasia; among ships above 20 years, these percentages fall to 22.3%, 2.0% and 1.7% respectively. Thus, these areas concentrate young ships. Instead, three areas concentrate older ships: the Mediterranean, South East Asia, and the Gulf - Red Sea - India area. In these areas, the share of the world fleet below the age of ten years is respectively 6.1%, 9.7% and 10.6%, and rises to 13.1%, 17.7% and 15.9% for ships above the age of 20 years.[15] Consequently, I also find large differences in average ship age across areas: some have an average age below 10 years, while the average age is close to 15 years for other areas (column 6).

5 Long-term responsibilities and last-voyage flags

I finally turn to the third dimension of corporate responsibility, namely, the ability to take long-term sustainability into account. I find that very few ships are recycled cleanly, but that there is a booming use of "last-voyage flags" to conceal dirty practices. This practice, which is more frequent for owners and operators in common law countries, allows escaping growing regulatory and reputational pressures.

[14] Specifically, for all ships with gross tonnage above 10,000, I retrieve data on their "last seen area" on September 16th and on September 24th, 2020. I restrict attention to ships that were in the same area at both dates. This leaves me with 17,984 ships.

[15] Part of these patterns could potentially be explained by selection rather than by within-ship change in voyage areas. Ideally, one would need to exploit within-ship variation, and thus to obtain data on the location of ships over their life. While these data can in principle be compiled from AIS (automatic identification system) data, I have not been able to access them so far.

5.1 Stylized facts on last-voyage flags

Due to their large size and to their activities (e.g., transport of oil or chemicals), merchant vessels reaching the end of their life raise significant concerns about recycling: an old ship that is at either abandoned or at risk of loss is a major risk for both the environment and workers.[16] In this context, the dominant practice for end-of-life ships is the highly controversial "beaching": a ship is deliberately laid ashore on a beach, where local workers dismantle the vessel to collect raw materials. The three leading places for ship beaching worldwide are Chittagong (Bangladesh), Alang (India) and Gadani (Pakistan), which together represented close to 90% of the tonnage dismanteled globally in 2019. Beaching raises issues for the security of workers (several deaths each year), and for the environment (toxic waste released at sea, etc.). In my sample, with few exceptions, all ships were dismantled in one of the above countries, as Panel A of Table 10 shows.[17] This situation leads to increasing pressure by some governments and NGOs for clean ship recycling.[18]

End-of-life ships require two decisions to be taken by shipping companies: (i) whether ships are beached or not, and (ii) whether beaching is legally done by shipping

[16]Ships abandoned at the end of their life with unpaid crew members on board are unfortunately common. A famous example is that of the *Rhosus*, abandoned by its owner in 2014 in the port of Beirut with a highly dangerous cargo, which caused the catastrophic 2020 Beirut explosion (180 deaths, 6,000 injured, and the destruction of a large part of the city). Information about the abandonment of seafarers is provided by the International Labour Organization (link).

[17]China used to be active in the market for beaching and ship breaking at the beginning of the sample period. By the end of the sample period, China has banned the import of old ships, in large part due to their destructive impact on the environment. Regarding the ship broken up in the United Kingdom, it does not correspond to a decision to go for clean recycling, but to a ship that was lost along the UK shores (*MSC Napoli*).

[18]For example, from 31 December 2018, commercial vessels with gross tonnage above 500 flagged in the European Union must be recycled in safe and environmentally sound ship recycling facilities. A European List of approved ship recycling facilities is published. Regarding reputation, a number of environmental organizations (e.g., NGO Shipbreaking Platform) wage campaigns against owners and operators heavily engaged in beaching. These campaigns can have consequences: for example, in 2018, several leading shipping companies, including Evergreen, have been excluded from the Norwegian Government Pension Fund Global due to their beaching practices.

companies themselves or outsourced to third-parties. While all ships I observe are dismantled in environmentally unsound or dubious conditions, corporate structure can be used to conceal these practices. Indeed, I now document that, in response to this novel environment, a practice called "last-voyage flags" has developed: ships change owners, names and flags specifically for their last-voyage to beaching yards. On the one hand, some flags of convenience have specialized in offering light flag registration standards for last voyages. On the other hand, some companies (so-called "cash buyers") specialize in buying end-of-life ships from shipping companies. Beaching it thus outsourced from shipping companies facing public scrutiny to smaller limited liability companies that operate out-of-sight. Shipping companies dealing with these cash buyers can then claim they did not know ships would be beached.[19] The market for outsourcing ships to cash buyers transforms a waste that would be a cost to its owner (due to high costs of clean recycling) into a source of profit (value of the raw materials), while externalizing environmental damages.

Empirically, I measure last-voyage flags as ships changing flags in the last three months before being broken up. In my sample of ships, I observe 504 ships using last-voyage flags, out of 1,674, that is, 30.1%.[20] However, this number hides significant time-series variation, as Panel A of Figure 2 illustrates. Specifically, while last-voyage flags were almost non-existent in the early 2000s (4.9% and 0% of ships broken respectively in 2000 and 2005), their usage has grown dramatically to become the dominant practice: 63.6% of ships broken in 2018 and 55.2% in 2019. Panel B further shows that the six most-popular last-voyage flags are primarily flags that did not exist in the

[19]This is for example the case of Evergreen, following the event discussed in footnote 18.

[20]Figure A1, which plots the number of flag changes in the 24 months before ships are broken up shows that most flag changes occur exactly in the month ships are broken up (274 events) or in the month just before (160 events).

early 2000. The most striking example is the one of Palau, an island with a population below 20,000 inhabitants and a capital city below 300 inhabitants. Its ship registry represents less than 0.001% of the world fleet, but 59.5% of last-voyage flags in 2019. In other terms, it is likely that this registry has been created specifically with the purpose of allowing shipping companies to evade end-of-life responsibilities.

For the evasion of responsibilities to be complete, it needs to be that last-voyage flags are associated with changes in ownership and operator at the end of ships' life. I test whether this is the case by computing correlations between last-voyage flags and changes in ship name, beneficial owner, registered owner and operator in the last three months before ships are broken up. These correlations, reported in Panel B of Table 10 are all high – most often above 50% – and all statistically significant at the 1% level. Therefore, it is indeed the case that there are significant changes in the ownership structure of boats just before the end of their life.

Finally, I provide formal evidence that the quality of last-voyage flags is significantly lower than previous flags. To do so, I use two measures of flag quality. The first one is the ratio of all ship detentions over all ship inspections under the Paris Memorandum of Understanding (MOU) over the period from 2008 to 2018.[21] The second one is the total number of ratified IMO conventions (see Section 4.2), across all convention types. Descriptive statistics in Panel A of Table 11 show significant variation across countries: flag states at the 10th (resp. 90th) percentile have a ratio of detentions to inspections of 1% (resp. 16%) and have ratified 4 (resp. 42) international conventions. Using these data, I re-estimate equation Equation (7) after interacting $FlagNumber_{n-c}$ with a dummy variable equal to one for ships i that use a last-voyage flag.

[21]The website of the Paris MOU does not provide complete data before 2008.

The results are displayed in Panel B of Table 11, where Equation (7) is estimated separately for ships that have two, three, four, five and six flags over their life. Across specifications and for both measures of quality, I find a large and statistically significant (at the 1% level) drop in quality for the last flag: shipping companies turn to flags with worse detention records, and fewer ratified conventions. However, the drop in flag quality is an order of magnitude larger for ships using last-voyage flags, as opposed to ships that do not. These findings are consistent with the view that low-quality flags of convenience are particularly valuable for risky ships at the end of their life. Last-voyage flags cater to shipowners attempting to evade potential responsibilities, regulations or reputation issued associated with end-of-life ships.

5.2 Mechanism: Evasion of long-term responsibilities

In this last section, I seek to explain both beaching and last-voyage flag decisions. Theoretically, if shipowners could costlessly dissolve one-ship subsidiaries after beaching a ship, beaching would not be a concern for them, and there would be no need to use last-voyage flags. However, ship beaching can be costly for a parent company for two reasons: either because of regulatory or NGO pressure in its own country, or because of corporate social responsibility (CSR) concerns at the group level.[22] When either of these two concerns is present, groups have incentives either to avoid unsafe beaching, or to conceal beaching using last-voyage flags. Thus, in order to explain end-of-life decisions by shipping companies, one needs variation either in regulatory pressure or in CSR concerns.

[22] Starting from 31 December 2018, large commercial vessels flying the flag of an EU member state must be recycled in approved facilities. The fact that this regulation applies at the flag level considerably limits its scope.

In my analysis, I rely on two such proxies. First, I obtain a country-level measure of "government effectiveness" from the World Bank. This variable, further described in Appendix A.1, measures in particular the commitment of governments to implement policies, such as environmental policies. Second, I use a country-level dummy variable by LaPorta et al. (2008) measuring whether a country has common law origins or not. The use of this variable is motivated by Liang and Renneboog (2017), who find that legal origins are the most important determinant of firms' incentives to engage in CSR in a global context. In my setup, legal origins are likely to be particularly relevant: As argued by LaPorta et al. (2008), courts in common law countries respect "the freedom of contract, including the ability of judges to interpret contracts without a reference to public interest." Last-voyage flags result precisely from contracts that can be interpreted either literally as transferring ship ownership and responsibility, or as a mere veil to hurt public interest.

First of all, regarding beaching decisions, as discussed previously, there is very limited heterogeneity since almost all ships end up beached on the shores of Bangladesh, India or Pakistan. That said, there may be some heterogeneity in environmental outcomes, depending on the specific recycling yard that is chosen in these countries. To measure yard cleanliness, I rely on data from *ClassNK*, a Japanese classification society that issues statements of compliance to yards meeting criteria established by international conventions on ship recycling.[23] Statements of compliance have been issued to 38 yards, mostly in India. While I call these yards "clean," there is debate about their cleanliness: they are not approved under EU standards, and some refuse

[23] A classification society is a company that assess compliance of ships and other maritime infrastructures with international standards. In this case, the specific standards are those set by the Hong Kong International Convention for the safe and environmentally sound recycling of ships, signed in 2009. This convention has not yet entered into force, due to a too low number of signing countries.

access to NGOs monitoring shipbreaking. In my sample, as shown in Panel A of Table 12, 17% of ships have been recycled in these "clean" yards.

In Panel B of Table 12, I regress a dummy variable equal to one when a ship is recycled cleanly on characteristics of the country of either the beneficial owner or the operator 12 months before the ship is broken.[24] These country characteristics are either a common law dummy variable or the government effectiveness measure. Across specifications, I find that "clean" recycling is hard to predict. The only significant effect is for ship operators located in countries with high government effectiveness: ships operated by these firms tend to go slightly more for "clean" recycling. That said, the difficulty to explain "clean" recycling is most likely due to the fact that there is very little genuinely clean recycling.

As a last step, Panel C of Table 12 reproduces the same regression, but with a dummy equal to one for ships using last-voyage flags as dependent variable. Given the lack of heterogeneity is recycling practices, the results are surprising. Indeed, similar beaching practices – even after including recycling yard fixed effects – are dealt with differently in common law and civil law countries: the use of last-voyage flags is significantly more likely when either the beneficial owner or the operator is in a common law country. This is consistent with the view that common law environments may lead to more attempts to conceal responsibilities via contracts that are mere veils. Finally, I also find that operators in countries with higher government effectiveness use last-voyage flags to a lower extent, but the economic magnitude of the effect is smaller.

[24] I do not keep the last beneficial owner or operator precisely to avoid cases when ownership characteristics change a few months before the ship is broken.

6 Conclusion

This paper shows that the maritime shipping industry, which constitutes the infrastructure of the last globalization wave, has evolved over the past four decades to systematically evade responsibilities. The shipping industry came to rely almost exclusively on dissociated legal and ultimate owners, on one ship subsidiaries, on flags of convenience, and on last-voyage flags. A number of tests confirm that liability and regulatory evasion, in a context of global competition and growing environmental concerns, are dominant forces behind these patterns. An open question is whether similar forces are at play in other industries where the activity of offshore subsidiaries may be less observable.

These findings have a variety of implications. First, they highlight a downside of globalization: the drop in transportation costs was partly achieved via the evasion of shipowners' responsibilities, including environmental liabilities. In the terminology by Rodrik (1997), globalization may have gone "too far." Second, my results raise questions about the use of limited liability in parent-subsidiary relationships, particularly for tort liabilities. Indeed, limited liability enables group owners to externalize damages to society. The associated costs are more severe that those generated by standard risk-shifting, since tort creditors are not contractual creditors. Based on a similar reasoning, some legal scholars have challenged the use of limited liability for torts (Hansmann and Kraakman, 1991) or for fully-owned subsidiaries (Blumberg, 1986). Raising the issue of extended liability is especially important given that ex post liability and ex ante regulation are not perfect substitutes (Kolstad et al., 1990). Finally, the facts that I document call for more careful definitions and measures of corporate social responsibility (CSR). The debates on CSR cannot abstract from concrete liabilities and regulations that may be evaded or masked through networks of (potentially offshore) subsidiaries.

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Table 1 – Description of the sample of ships

This table provides descriptive statistics on the sample of ships. The sample is composed of all ships with gross tonnage over 50,000 that were either broken up or lost at sea between 2000 and 2019. Panel A shows a breakdown by type of ships and gives basic statistics about their gross tonnage and age at the end of life. Panel B shows statistics on the number of flags, names, registered owners, beneficial owners and operators over the life of the sample ships. There is one observation per ship. Panel C lists the top-10 flags in the whole sample, as well as over the 2010-2019 period. Percentages of observations are computed over all ship-month observations.

Panel A: Sample of ships

		Gross tonnage (in Th.)		Age at end of life	
	Obs.	Mean	Std.	Mean	Std.
Bulk Carrier	603	84.9	21.9	23.0	4.0
Containership	245	57.4	7.2	19.4	5.1
Gas Carrier	20	73.4	15.3	36.3	5.1
Ro-Ro and Car Carrier	47	55.0	4.7	27.0	6.7
Tanker	649	94.5	46.2	22.8	3.5
Other	151	89.8	37.4	28.7	7.6
All types	1,715	84.1	35.7	23.2	5.3

Panel B: Flag and ownership over ship life

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Number of flags	1	2	2.7	2	3	4	10	1,715
Number of names	1	2	2.9	3	4	5	10	1,715
Number of registered owners	2	2	3.3	3	4	5	9	1,715
Number of beneficial owners	1	2	3.2	3	4	5	12	1,715
Number of operators	1	2	3.3	3	4	5	10	1,715

Panel C: Top-10 flags and end-of-life flags

Whole sample (monthly)		2010-2019 (monthly))	
Flag	% Obs.	Flag	% Obs.
Panama	0.181	Panama	0.220
Liberia	0.154	Liberia	0.157
Japan	0.054	Marshall Islands	0.072
Singapore	0.054	Singapore	0.063
Bahamas	0.053	Hong Kong, China	0.051
Greece	0.051	Bahamas	0.050
Norway (Nis)	0.042	Korea, South	0.047
Hong Kong, China	0.036	Greece	0.038
Marshall Islands	0.033	Norway (Nis)	0.024
United States Of America	0.031	Germany	0.023
Top-10	0.690	Top-10	0.745

Table 2 – The growth of ownership via one-ship subsidiaries

This table provides evidence on the growth of ship ownership via one-ship subsidiaries. Panel A reports moments of the distribution of the fraction of months spent by each sample boat over its entire life with either the registered owner being the same as the beneficial owner, the operator being the same as the beneficial owner, or all three being identical. There is one observation per ship. Panel B regresses a dummy variable equal to one when the registered owner of a ship is the same as its beneficial owner (columns 1 to 3) or when its operator is the same as its beneficial owner (columns 4 to 6), on dummy variables equal to one when the current date is the 1990, the 2000 or the 2010 decade. The constant corresponds to the pre-1990 period. Observations are at the ship-month level and span the entire life of each sample ship. Beneficial owner, ship and beneficial owner*ship fixed effects are included in some specifications. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
% of months in which a ship has:								
Reg. owner = Benef. owner	0	0	0.11	0	0.06	0.51	1	1,632
Operator = Benef. owner	0	0	0.37	0.27	0.71	0.99	1	1,633
Reg. owner = Benef. owner = Operator	0	0	0.07	0	0	0.29	1	1,617

Panel B: Time-series variation

	Dependent variable: Registered owner is same as beneficial owner				Dependent variable: Operator is same as beneficial owner			
1990 Decade	-0.116***	-0.095***	-0.084***	-0.058***	-0.099***	-0.089***	-0.064***	-0.029***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)
2000 Decade	-0.180***	-0.147***	-0.148***	-0.104***	-0.197***	-0.199***	-0.159***	-0.121***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)
2010 Decade	-0.161***	-0.145***	-0.144***	-0.110***	-0.239***	-0.231***	-0.190***	-0.148***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)
Constant	0.267***	0.244***	0.240***	0.208***	0.546***	0.542***	0.508***	0.471***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)
Benef. owner FE	No	Yes	Yes	No	No	Yes	Yes	No
Ship FE	No	No	Yes	No	No	No	Yes	No
Ben. own.*Ship FE	No	No	No	Yes	No	No	No	Yes
R^2	0.022	0.578	0.557	0.848	0.015	0.564	0.544	0.845
Obs.	350,300	350,292	350,266	350,189	300,672	300,662	300,638	300,550

Table 3 – The use of one-ship subsidiaries

This table describes the use of one-ship subsidiaries by shipping companies as of the September 8th, 2020. The sample comprises all 29,691 ships with gross tonnage above 10,000 globally. Each subpanel reports moments of the distribution of the number of ships ultimately owned by beneficial owners, as well as the ratio of the number of registered owners over the number of ships for each beneficial owner. Observations are the beneficial owner level. Subpanel are respectively for all beneficial owners, and for beneficial owners with more than one ship, 10 ships and 20 ships.

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Whole sample of beneficial owners								
Number of ships ultimately owned	1	1	9.09	3	8	21	344	2,871
Number of registered owners / Number of ships	0.25	0.50	0.80	1	1	1	1	2,871
Beneficial owners with more than 1 ship								
Number of ships ultimately owned	2	3	12.39	5	12	30	344	2,041
Number of registered owners / Number of ships	0.2	0.44	0.71	0.91	1	1	1	2,041
Beneficial owners with more than 10 ships								
Number of ships ultimately owned	12	14	32.37	21	37	62	344	585
Number of registered owners / Number of ships	0.10	0.23	0.64	0.81	1	1	1	585
Beneficial owners with more than 20 ships								
Number of ships ultimately owned	23	27	49.95	36	54	92	344	296
Number of registered owners / Number of ships	0.09	0.20	0.63	0.81	1	1	1	296

Table 4 – Explaining ownership via one-ship subsidiaries

This table provides evidence on the determinants of ship ownership via one-ship subsidiaries. Panel A explores the role of the number of ships ultimately owned by the beneficial owner. It regresses a dummy variable equal to one when the registered owner of a ship is the same as its beneficial owner on the number of ships ultimately owned by the beneficial owner at date t. Ship, beneficial owner, and ship $*$ beneficial owner fixed effects are included in some specifications. Panel B explores the role of several ship characteristics, including gross tonnage, ship age, a dummy equal to one when the ship has a single hull, and a dummy if the ship is an oil tanker. Beneficial owner $*$ time fixed effects are included. Observations in both panels are at the ship-month level and span the entire life of each sample ship. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Regressions based on fleet size

	Dependent variable: Registered owner is same as beneficial owner		
Number of ships ultimately owned at t	-0.062***	-0.182***	-0.069***
	(0.006)	(0.007)	(0.007)
Ship FE	No	Yes	No
Beneficial owner FE	No	Yes	No
Ship $*$ Beneficial owner FE	No	No	Yes
R^2	0.001	0.780	0.845
Obs.	350,300	350,262	350,189

Panel B: Regressions based on ship characteristics

	Dependent variable: Registered owner is same as beneficial owner				
Gross tonnage	-0.004**				
	(0.002)				
Age above 25 years		-0.019***			
		(0.003)			
Age above 30 years			-0.058***		
			(0.008)		
Single hull				-0.014***	
				(0.002)	
Tanker					-0.022***
					(0.001)
Beneficial owner $*$ Time FE	Yes	Yes	Yes	Yes	Yes
R^2	0.669	0.669	0.669	0.811	0.670
Obs.	293,804	293,804	293,804	118,353	293,804

Table 5 – Explaining ownership changes with ship detentions

This table provides evidence on the relation between ship detentions and ownership changes. Ship detentions occur when ships fail to meet random security checks imposed under Port State Control (PSC) mechanisms. Panel A reports moments of the distribution of several variables related to ship detentions: the number of detentions per ship in my sample, the number of days of detention, and the age of detained ships (in years). Panel B regresses a dummy variable equal to one when ships experience a change in characteristic (either flag, name, beneficial owner, registered owner or operator) within the next three month on a dummy variable equal to one if they are detained in month t. Observations are at the ship-month level and span the entire life of each sample ship. Ship, year and age fixed effects are included in some specifications. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Number of detentions / ship	0	0	0.6	0	1	2	7	1,716
Number of days of detention	1	1	2.2	1	2	4	61	922
Age of detained ships (in years)	8	12	16.3	17	21	24	38	1,105

Panel B: Explaining changes in ship characteristics within 3 months of detention

	Change in beneficial owner		Change in registered owner		Change in operator	
Detained	0.015***	0.010*	0.025***	0.017***	0.025***	0.014**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes
R^2	0.017	0.026	0.015	0.023	0.017	0.026
Obs.	165,889	165,889	165,889	165,889	165,889	165,889

	Change in flag		Change in name	
Detained	0.015***	0.008*	0.018***	0.011**
	(0.005)	(0.005)	(0.005)	(0.005)
Ship FE	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
R^2	0.013	0.021	0.017	0.022
Obs.	165,889	165,889	165,889	165,889

Table 6 – The growth of flags of convenience

This table provides evidence on the growth of flags of convenience. Panel A reports moments of the distribution of the fraction of months spent by each sample boat over its entire life with a flag of convenience, using two definitions of flags of convenience. The first one ("ITF definition") considers as flags of convenience all countries listed as such by the International Transport Workers' Federation (ITF) in 2020. The second one ("Broad definition") additionally includes several countries running an open registry, but not on the ITF list (see Appendix A.2). There is one observation per ship. Panel B regresses a dummy variable equal to one when the ship is registered in a flag of convenience based on the ITF definition (columns 1 to 3) or on the broad definition (columns 4 to 6), on dummy variables equal to one when the current date is the 1990, the 2000 or the 2010 decade. The constant corresponds to the pre-1990 period. Observations are at the ship-month level and span the entire life of each sample ship. Beneficial owner, ship and beneficial owner*ship fixed effects are included in some specifications. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
% of months in which a ship has a flag of convenience								
ITF definition	0	0.14	0.51	0.50	0.94	1	1	1,715
Broad definition	0.02	0.34	0.67	0.83	1	1	1	1,715

Panel B: Time-series variation

	Dependent variable: Flag of convenience dummy							
	ITF definition				Broad definition			
1990 Decade	0.092***	0.079***	0.116***	0.023***	0.128***	0.084***	0.110***	0.039***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
2000 Decade	0.174***	0.123***	0.209***	0.047***	0.234***	0.156***	0.200***	0.089***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
2010 Decade	0.185***	0.137***	0.227***	0.061***	0.226***	0.154***	0.189***	0.098***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.373***	0.409***	0.346***	0.473***	0.490***	0.559***	0.514***	0.612***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Benef. owner FE	No	Yes	Yes	No	No	Yes	Yes	No
Ship FE	No	No	Yes	No	No	No	Yes	No
Benef. owner*Ship FE	No	No	No	Yes	No	No	No	Yes
R^2	0.017	0.488	0.586	0.835	0.031	0.514	0.626	0.852
Obs.	468,701	386,425	468,701	386,243	468,701	386,425	468,701	386,243

Table 7 – Explaining the adoption of flags of convenience

This table provides evidence on the determinants of the adoption of flags of convenience, using two definitions of flags of convenience. The first one ("ITF definition") considers as flags of convenience all countries listed as such by the International Transport Workers' Federation (ITF) in 2020. The second one ("Broad definition") additionally includes several countries running an open registry, but not on the ITF list (see Appendix A.2). Panel A regresses a dummy variable equal to one in month t for a ship when it adopts a flag of convenience (and its preceding flag is not a flag of convenience) on the Baltic Dry Index. The Baltic Dry Index is a benchmark measure of global freight rates, that I normalize by 100,000, for readability of the coefficients. Observations are at the ship-month level and span the entire life of each sample ship. Ship fixed effects are included in some specifications, and a ship age control in all specifications. Panel B regresses a dummy variable equal to one for a ship in month t if it changes flag (to any flag or to a flag of convenience), name or operator within the next 3 months on a dummy variable equal to one at t if another ship owned by the same beneficial owner is lost at sea in that month. Observations are at the ship-month level and span the entire life of ships whose beneficial owners experience at least one loss at sea over the sample period. Ship and years fixed effects, as well as a ship age control, are included in all specifications. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: As a function of freight rates

	Dependent variable: Dummy for change to flag of convenience			
	ITF definition		Broad definition	
Baltic Dry Index	-0.118**	-0.070	-0.230***	-0.172***
	(0.043)	(0.044)	(0.054)	(0.047)
Ship age control	Yes	Yes	Yes	Yes
Ship FE	No	Yes	No	Yes
R^2	0.001	0.007	0.001	0.008
Obs.	227,758	227,757	227,758	227,757

Panel B: Following ship losses

	Dependent variable: Dummy for change in				
	Flag				
		To flag of convenience			
	To any flag	ITF def.	Broad def.	Name	Operator
Ship loss at t	0.009*	0.005*	0.001	0.007	0.008
	(0.005)	(0.003)	(0.003)	(0.005)	(0.006)
Ship*Benef. owner FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2	0.058	0.046	0.049	0.059	0.061
Obs.	104,083	104,083	104,083	104,083	104,083

Table 8 – Flag characteristics over ship life

This table provides evidence on the degradation of flag characteristics over ship life. To assess flags across five dimensions, I first classify international conventions signed under the guidance of the International Maritime Organization (IMO) into five categories: context, environment, liability, technical, workers (see Appendix A.3). I then count the number conventions of each type signed by each flag state. Panel A reports moments of the cross-country distribution for these counts. Panel B regresses the share of conventions of each type ratified by a flag state on dummy variables equal to one the last flag and for the flags $n-1$ to $n-4$. Observations are at the ship-flag level. Ship fixed effects are included in all specifications, and a variable measuring the share of ratified conventions of any type (denoted Contr. tot.) is included as a control in some specification. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics on ratified conventions

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Context	2	6	9.2	10	13	15	17	189
Environment	0	4	4.7	5	7	8	8	189
Liability	0	1	4.2	4	7	9	11	189
Technical	0	2	3.6	4	5	6	6	189
Workers	0	3	3.2	4	4	5	6	189

Panel B: Within-ship regressions

	Dependent variable: Share of ratified conventions by type									
	Context		Environment		Liability		Technical		Workers	
Last flag	-0.165***	-0.017*	-0.075***	-0.012	-0.184***	0.039**	-0.153***	-0.004	-0.062***	-0.001
	(0.018)	(0.010)	(0.013)	(0.011)	(0.027)	(0.015)	(0.019)	(0.012)	(0.011)	(0.009)
Flag $n-1$	-0.071***	-0.011	-0.047***	-0.022**	-0.055**	0.034**	-0.041**	0.019	-0.043***	-0.019**
	(0.018)	(0.010)	(0.013)	(0.011)	(0.027)	(0.015)	(0.019)	(0.011)	(0.011)	(0.009)
Flag $n-2$	-0.047**	-0.009	-0.019	-0.003	-0.043	0.014	-0.024	0.014	-0.026**	-0.010
	(0.018)	(0.010)	(0.013)	(0.011)	(0.028)	(0.015)	(0.019)	(0.011)	(0.011)	(0.009)
Flag $n-3$	-0.034*	-0.015	-0.015	-0.007	-0.002	0.026	-0.004	0.014	-0.016	-0.008
	(0.019)	(0.010)	(0.013)	(0.011)	(0.028)	(0.016)	(0.020)	(0.012)	(0.011)	(0.009)
Flag $n-4$	-0.015	-0.012	-0.008	-0.007	0.021	0.025	0.005	0.007	-0.011	-0.009
	(0.020)	(0.011)	(0.014)	(0.012)	(0.030)	(0.017)	(0.021)	(0.013)	(0.012)	(0.010)
Contr. tot.	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.422	0.827	0.396	0.545	0.445	0.825	0.444	0.792	0.112	0.588
Obs.	3,826	3,826	3,826	3,826	3,826	3,826	3,826	3,826	3,826	3,826

Table 9 – Voyage area as a function of age

This table reports the share of the global merchant fleet (all ships with gross tonnage over 10,000) active in several areas of the world as of September 2020, separately for ships with age below or equal to 10 years, between 10 and 15 years, between 15 and 20 years, and strictly above 20 years. The sample is restricted to ships that were observed in the same area on September 16th and on September 24th, 2020. Column (5) reports the difference between columns (4) and (1). Column (6) reports the average age of ships observed in each area.

	(1)	(2)	(3)	(4)		
	$\leq$ 10y	(10y; 15y]	(15y; 20y]	> 20y	Diff (4)-(1)	Avg. age
Australasia	0.043	0.036	0.021	0.017	-0.026	9.9
Caribbean	0.006	0.011	0.006	0.005	-0.001	12.0
East Coast South America	0.072	0.055	0.042	0.051	-0.021	11.2
East and South Africa	0.019	0.016	0.011	0.013	-0.005	10.9
Far East	0.336	0.258	0.241	0.223	-0.113	10.8
Gulf - Red Sea - India	0.106	0.136	0.180	0.159	0.052	13.3
Mediterranean	0.061	0.102	0.133	0.131	0.069	14.9
South East Asia	0.097	0.123	0.151	0.177	0.080	14.0
UK - Continent - Baltic	0.099	0.113	0.099	0.098	-0.000	11.9
US East Coast	0.010	0.012	0.010	0.011	0.000	13.4
US Gulf	0.033	0.030	0.013	0.013	-0.019	9.8
US West Coast	0.043	0.039	0.027	0.020	-0.023	10.3
West Africa	0.047	0.050	0.049	0.045	-0.001	12.3
West Coast South America	0.016	0.011	0.008	0.008	-0.008	9.7

Table 10 – Description of last-voyage flags

This table describes ship breaking countries and end-of-life flags. Panel A lists the top 10 ship breaking countries over the whole sample period, as well as end-of-life flags over both the whole sample period and the years 2018-2019. End-of-life flags are all the flags flied by ships on their arrival to a ship breaking yard, whether it is a last-voyage flag or not. Panel B reports pairwise correlations between the use of last-voyages flags and other changes of characteristics at the ship level. Last-voyage flags are measured by a change of flag in the three month preceding the arrival at a recycling yard. Other characteristics include a change of name, of beneficial owner, of registered owner or of operator over the same three-month period. There is one observation for each of the 1,674 sample ships that were broken up over the period from 2000 to 2019. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Ship breaking countries and last-voyage flags

Ship breaking countries Whole sample		End-of-life flags Whole sample		End-of-life flags 2018-2019	
Country	% Obs.	Country	% Obs.	Country	% Obs.
Bangladesh	41.59	Panama	17.49	Palau	34.56
India	21.06	Liberia	13.18	Comoros	19.35
Pakistan	19.41	Comoros	10.32	Panama	12.44
China	16.52	Palau	6.71	St Kitts & Nevis	6.45
Turkey	1.24	St Kitts & Nevis	6.71	Marshall Islands	5.53
Malaysia	0.06	Marshall Islands	5.07	Liberia	5.07
United Kingdom	0.06	Bahamas	3.85	South Korea	3.69
British Virgin Islands	0.06	Malta	3.38	Singapore	2.30
		Singapore	3.15	Bahamas	1.38
		Hong Kong	2.74	Niue	1.38
Top-8	100	Top-10	72.59	Top-10	92.17

Panel B: Correlation of last-voyage changes

	In last 3 month:			
	Change flag	Change name	Change benef. owner	Change reg. owner
Change name	0.830***			
Change benef. owner	0.403***	0.358***		
Change reg. owner	0.539***	0.481***	0.697***	
Change operator	0.529***	0.518***	0.634***	0.867***

Table 11 – The degradation of flag quality over ship life

This table provides evidence on the degradation of flag quality over ship life. Panel A reports moments of the distribution of the two variables used to measure flag quality. The first one is the ratio of ship detentions over ship inspections conducted under the Paris Memorandum of Understanding (MOU) over the period from 2008 to 2018, for each given flag. The second one is the number of international maritime conventions ratified by the flag state as of August 2020, as obtained from the International Maritime Organization (IMO). Panel B regresses either of the measures of flag quality (respectively in columns 1 to 5 and 6 to 10) on dummy variables equal to one the last flag and for the flags $n-1$ to $n-4$. The dummy corresponding to the last flag is further interacted with a dummy variable equal to one for ships using a last-voyage flag (defined as a flag change within the last three months before being broken up). Regressions in columns 1 and 6 (respectively, 2 and 7, 3 and 8, 4 and 9, and 5 and 10) are estimated in the sample of ships with only 2 flags (respectively, 3, 4, 5, and 6) over their entire life. Observations are at the ship-flag level. Ship fixed effects are included in all specifications. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Detentions over inspections	0.01	0.01	0.06	0.03	0.10	0.16	0.38	92
Number of ratified conventions	4	18	25.7	27	35	42	49	189

Panel B: Within-ship regressions

	Dependent variable:									
	Ratio of detention over inspections					Number of ratified conventions				
Last flag	0.009***	0.018***	0.017***	0.024***	0.018***	-0.893*	-2.050***	-2.635***	-4.641***	-2.746**
	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)	(0.477)	(0.440)	(0.561)	(0.790)	(1.143)
Last flag ·	0.102***	0.093***	0.093***	0.093***	0.084***	-7.416***	-8.329***	-8.537***	-8.160***	-10.061***
Last voy.	(0.004)	(0.003)	(0.003)	(0.004)	(0.007)	(0.811)	(0.668)	(0.744)	(0.983)	(1.477)
Flag $n-1$		-0.001	0.005**	0.012***	0.007		-0.523	-1.381***	-2.918***	-2.477**
		(0.002)	(0.002)	(0.003)	(0.004)		(0.375)	(0.463)	(0.643)	(0.980)
Flag $n-2$			0.001	0.006**	0.001			-1.103**	-1.501**	-0.047
			(0.002)	(0.003)	(0.004)			(0.470)	(0.636)	(1.006)
Flag $n-3$				0.003	0.000				-1.910***	0.419
				(0.003)	(0.004)				(0.652)	(0.990)
Flag $n-4$					-0.002					-0.397
					(0.004)					(1.034)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.838	0.750	0.735	0.732	0.673	0.656	0.563	0.486	0.526	0.522
Obs.	762	1,153	1,057	635	306	746	1,137	1,012	608	288

Table 12 – Explaining clean recycling and last-voyage flags

This table provides evidence on the determinants of clean recycling and last-voyage flags. Panel A reports moments of the distribution of ship characteristics. Observations are at the ship level. Panel B regresses a dummy variable equal to one when a ship is recycled cleanly on either dummy variables equal to one when its beneficial owner or operator are in a common law country, or on a measure of government effectiveness in the country of the beneficial owner or operator (described in Appendix A.1). All specifications include fixed effects for the year in which the ship is broken up, and some specifications include recycling country fixed effects. Panel C is similar to Panel B, but with a dummy variable equal to one when a ship uses a last-voyage flag as a dependent variable, and recycling yard fixed effects instead of recycling country fixed effects. Observations in Panels B and C are at the ship level. Standard errors are reported in parentheses. *, ** and *** denote respectively statistical significance at the 10%, 5% and 1% confidence levels.

Panel A: Descriptive statistics

	10th	25th	Mean	Median	75th	90th	Max.	Obs.
Last-voyage flag	0	0	0.30	0	1	1	1	1,674
Clean recycling - Narrow measure	0	0	0.17	0	0	1	1	980
Common law - Benef. owner	0	0	0.33	0	1	1	1	1,149
Common law - Operator	0	0	0.39	0	1	1	1	1,490
Gov. effectiveness - Benef. owner	0.28	0.34	0.95	1.18	1.57	1.85	2.23	1,090
Gov. effectiveness - Operator	0.01	0.34	0.86	0.55	1.59	2.04	2.23	1,417

Panel B: Explaining clean recycling

	Dependent variable: Clean recycling dummy							
Common law - Benef. owner	-0.019	-0.024						
	(0.031)	(0.026)						
Common law - Operator			0.013	0.004				
			(0.027)	(0.022)				
Gov. effect. - Benef. owner					0.033	0.010		
					(0.023)	(0.019)		
Gov. effect. - Operator							0.062***	0.026**
							(0.015)	(0.012)
Recycling country FE	No	Yes	No	Yes	No	Yes	No	Yes
Year broken FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.066	0.373	0.049	0.369	0.072	0.384	0.057	0.395
Obs.	654	654	873	873	616	616	825	825

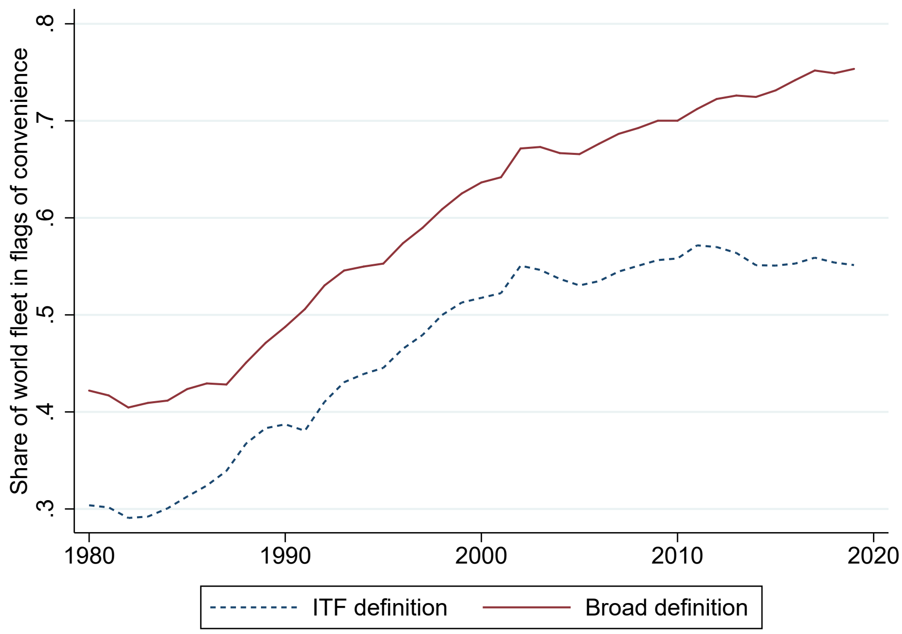
Panel C: Explaining last-voyage flags

	Dependent variable: Last-voyage flag dummy							
Common law - Benef. owner	0.155***	0.112***						
	(0.025)	(0.027)						
Common law - Operator			0.198***	0.183***				
			(0.022)	(0.024)				
Gov. effect. - Benef. owner					0.028	0.041**		
					(0.017)	(0.019)		
Gov. effect. - Operator							-0.039***	-0.026*
							(0.013)	(0.014)
Recycling yard FE	No	Yes	No	Yes	No	Yes	No	Yes
Year broken FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.120	0.280	0.180	0.324	0.096	0.282	0.163	0.309
Obs.	1,149	1,055	1,490	1,395	1,090	998	1,417	1,320

Figure 1 – The growth of flags of convenience

This figure illustrates the growth of flags of convenience in the shipping industry over the period from 1980 to 2019. Panel A plots the share of the world fleet (in deadweight tons) carrying a flag of convenience, using two definitions of flags of convenience. The first one ("ITF definition") considers as flags of convenience all countries listed as such by the International Transport Workers' Federation (ITF) in 2020. The second one ("Broad definition") additionally includes several countries running an open registry, but not on the ITF list (see Appendix A.2). Panel B plots the share of the world fleet (in deadweight tons) carrying a flag of convenience (using the broad definition) for four ship types: bulk carriers, containerships, oil tankers and others. Data, described in Appendix A.1, are from UNCTAD.

Panel A: Total fleet



Panel B: By ship type

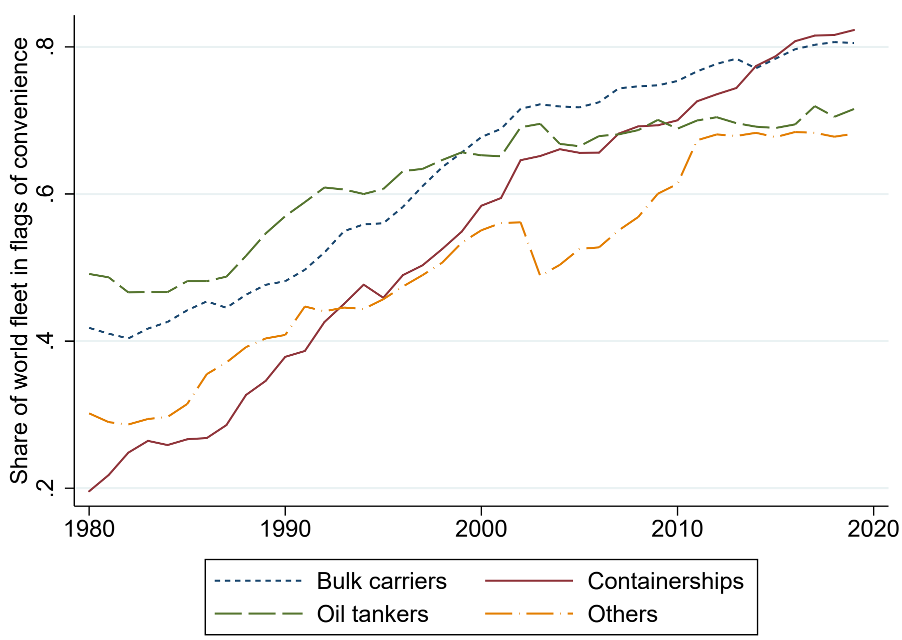
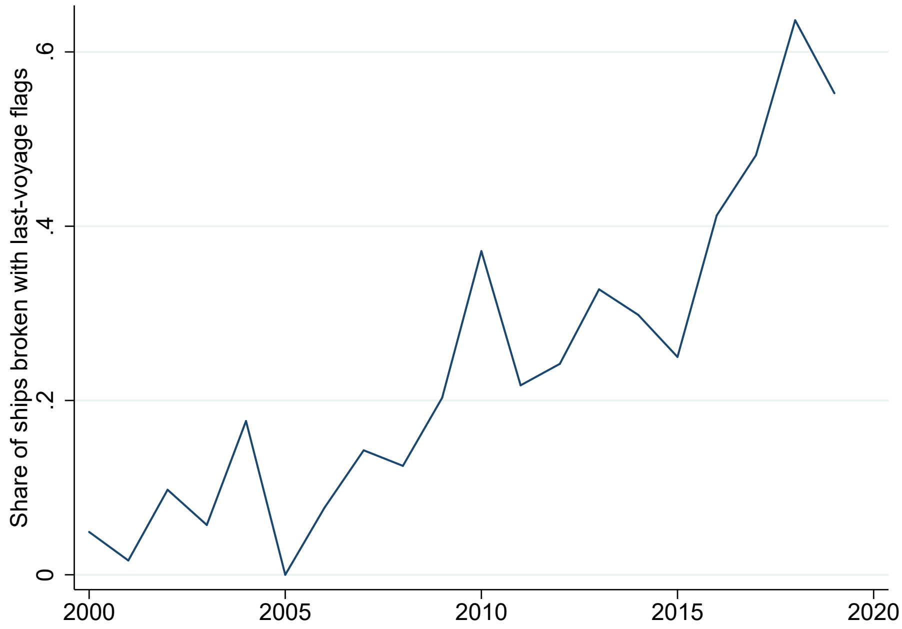


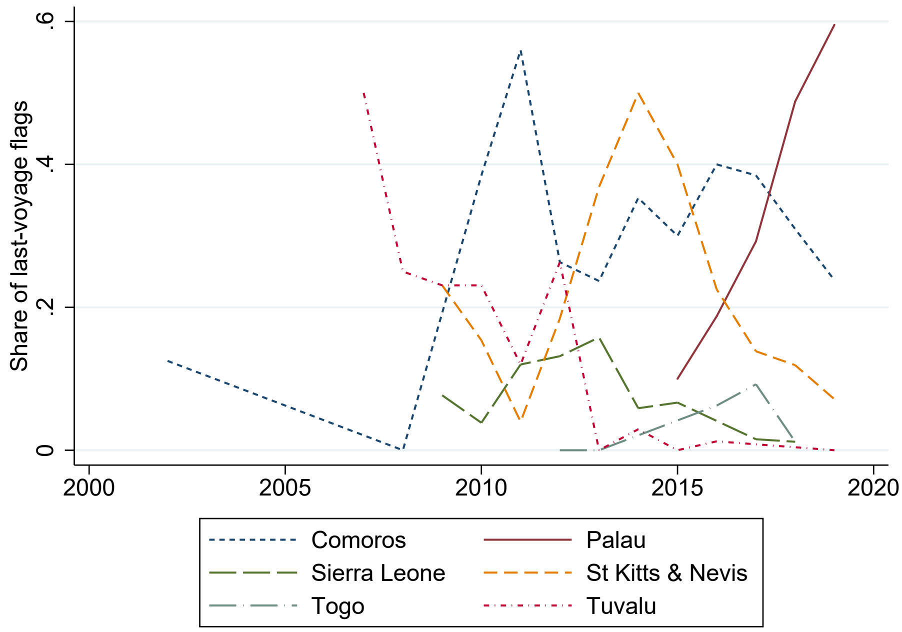
Figure 2 – The growth of last-voyage flags

This figure illustrates the growth of last-voyage flags in the shipping industry over the period from 2000 to 2019. The sample is composed of all ships with gross tonnage over 50,000 that were broken up over this period. Panel A plots the yearly share of broken ships using last-voyage flags. Last-voyage flags are measured by a change of flag in the three month preceding the arrival at a recycling yard. Panel B plots the yearly share of the most popular last-voyage flags (Comoros, Palau, Sierra Leone, St Kitts & Nevis, Togo and Tuvalu), as a proportion of all last-voyage flags.

Panel A: Share of last-voyage flags within all broken ships



Panel B: Share of specific flags within last-voyage flags



Online appendix

A Data and construction of variables

This appendix provides additional details on the data and on the construction of the variables.

A.1 Auxiliary datasets

In addition to IHS Markit' *Sea-web* data, I use a few other datasets that I describe briefly in the section:

- **UNCTAD Handbook of statistics**: From the UNCTAD (United Nations Conference on Trade and Development), I obtain yearly data on the world merchant fleet from 1980 to 2019. This contains a breakdown of the world fleet by flag state and by ship type, either by number of ships or by gross tonnage.

- **GISIS**: From the GISIS (Global Integrated Shipping Information System) database, run by the IMO, I collect data on the status of treaties. Specifically, for each flag state, I collect data on all treaties that have been ratified and the date at which the treaty came into force in the country. There are 54 treaties and 189 flag states, yielding 10,206 country-treaty observations.

- **Paris Memorandum of Understanding (MoU)**: From the website of the Paris MoU, I obtain the yearly performance lists (white, grey and black lists) from 2010 to 2019 (link). I use the raw data on inspections and detentions by flag state to compute one measure of flag quality, the ratio of detentions over inspections.

- **Thompson Reuters Eikon**: From Thompson Reuters Eikon, I obtain a time series of the Baltic Dry Index (ticker: *BADI*) at a daily frequency over the period from January 2001 to December 2019.

- **Legal origins**: From the website of Andrei Shleifer, I download the latest version of LaPorta et al. (2008)'s dataset on countries' legal origins (link). I consider as common law countries all those with UK legal origins. Countries with all other legal origins (French, German, Scandinavian and Socialist) are considered to be civil law countries.

- **World bank**: I download the dataset on World Governance Indicators (link), and keep the 2018 value of the variable called "government effectiveness." This variable is defined as follows by the World Bank: "Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies".
- **ClassNK**: From the website of the Japanese classification society ClassNK, I obtain the list of ship recycling yard that had received a statement of compliance with the Hong Kong Convention (Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009) as of March 2020 (link).

A.2 Definition of flags of convenience

I use two definitions of flags of convenience. The first one ("ITF definition") is based on the list published by the International Transport Workers' Federation as of August 17th, 2020 on their website (link). This list is composed of the following countries:

> Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cambodia, Cayman Islands, Comoros, Curacao, Cyprus, Equatorial Guinea, Faroe Islands, French International Ship Registry (FIS), German International Ship Registry (GIS), Georgia, Gibraltar, Honduras, Jamaica, Lebanon, Liberia, Malta, Madeira, Marshall Islands, Mauritius, Moldova, Mongolia, Myanmar, North Korea, Panama, Sao Tome and Principe, St Vincent, Sri Lanka, Tonga, Vanuatu.

The second definition ("Broad definition") additionally includes other countries running an open ship registry:

Denmark (DIS), Kiribati, Niue, Norway (NIS), Palau, Spain (CSR), St Kitts & Nevis, Tanzania (Zanzibar), Tuvalu, French Antarctic Territory, Isle Of Man, Netherlands Antilles, Hong Kong, Singapore.

While the inclusion of a few other countries in the broad definition of flags of convenience may be debatable, their economic significance within the world fleet is negligible.

A.3 Classification of international conventions

From the website of the International Maritime Organization (IMO), I obtain the list of all 53 international conventions signed under the guidance this institution. I classify them in six categories:

- **Context**: Convention on the International Regulations for Preventing Collisions at Sea, 1972 (*COLREG 1972*), Convention on Facilitation of International Maritime Traffic (*FAL 1965*), 1991 amendments to the IMO Convention which were adopted by the Assembly of the Organization on 7 November 1991 by resolution A.724(17) (*IMO AMEND-91*), 1993 amendments to the IMO Convention which were adopted by the Assembly of the Organization on 4 November 1993 by resolution A.735(18) (*IMO AMEND-93*), Convention on the International Maritime Organization (*IMO CONVENTION*), *IMSO AMEND-98*, Convention on the International Mobile Satellite Organization (*IMSO C 1976*), International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (*INTERVENTION 1969*), Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil (*INTERVENTION PROT 1973*), International Convention on Oil Pollution Preparedness, Response and Co-operation (*OPRC 1990*), Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances (*OPRC/HNS 2000*), International Convention on Salvage (*SALVAGE 1989*), International Convention on Maritime Search and Rescue (*SAR 1979*), Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (*SUA 1988*), Protocol of 2005 to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (*SUA 2005*), Protocol for the

Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (*SUA PROT 1988*), Protocol of 2005 to the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf (*SUA PROT 2005*).

- **Environment**: Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (*LC 1972*), 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (*LC PROT 1996*), Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships (*MARPOL 1973/1978*), Annex III to MARPOL 73/78 (*MARPOL ANNEX III*), Annex IV to MARPOL 73/78 (*MARPOL ANNEX IV*), Annex V to MARPOL 73/78 (*MARPOL ANNEX V*), Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (*MARPOL PROT 1997*), Nairobi International Convention on the Removal of Wrecks (*NAIROBI WRC 2007*).

- **Liability**: International Convention on Civil Liability for Bunker Oil Pollution Damage (*BUNKERS 2001*), International Convention on Civil Liability for Oil Pollution Damage (*CLC 1969*), Protocol to the International Convention on Civil Liability for Oil Pollution Damage (*CLC PROT 1976*), Protocol of 1992 to amend the International Convention on Civil Liability for Oil Pollution Damage (*CLC PROT 1992*), International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (*FUND 1971*), Protocol to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (*FUND PROT 1976*), Protocol of 1992 to amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (*FUND PROT 1992*), Protocol of 2003 to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (*FUND PROT 2003*), Convention on Limitation of Liability for Maritime Claims (*LLMC 1976*), Protocol of 1996 to amend the Convention on Limitation of Liability for Maritime Claims (*LLMC PROT 1996*), Convention relating to Civil

Liability in the Field of Maritime Carriage of Nuclear Material (*NUCLEAR 1971*).

- **Technical**: International Convention on the Control of Harmful Anti-Fouling Systems on Ships (*AFS 2001*), International Convention for the Control and Management of Ships' Ballast Water and Sediments (*BWM 2004*), International Convention for Safe Containers (*CSC 1972*), International Convention on Load Lines (*LL 1966*), Protocol of 1988 relating to the International Convention on Load Lines (*LL PROT 1988*), International Convention on Tonnage Measurement of Ships (*TONNAGE 1969*).

- **Workers**: International Convention for the Safety of Life at Sea (*SOLAS 1974*), Protocol of 1978 relating to the International Convention for the Safety of Life at Sea (*SOLAS PROT 1978*), Protocol of 1988 relating to the International Convention for the Safety of Life at Sea (*SOLAS PROT 1988*), Agreement concerning specific stability requirements for ro-ro passenger ships undertaking regular scheduled international voyages between or to or from designated ports in North West Europe and the Baltic Sea (*SOLAS AGR 1996*), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (*STCW 1978*), International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (*STCW-F 1995*).

- **Passengers**: Athens Convention relating to the Carriage of Passengers and their Luggage by Sea (*PAL 1974*), Protocol to the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea (*PAL PROT 1976*), Protocol of 2002 to the Athens Convention relating to the Carriage of Passengers and their Luggage by Sea (*PAL PROT 2002*), Protocol on Space Requirements for Special Trade Passenger Ships (*SPACE STP 1973*), Special Trade Passenger Ships Agreement (*STP 1971*).

In the empirical analysis, I disregard conventions related to passengers, since they are not directly relevant for merchant shipping.

B Limitation of liability for maritime claims

The ability of shipowners to limit their responsibility has an history of several centuries and long antedates the emergence of limited liability for other corporations (Donovan, 1978). While this practice is known from the 11th century, it seems to have developed along with long-term trade during the Middle Ages. For early trade, the common practice was for shipowners to accompany their vessels, and thus to be involved in day-to-day operations. This naturally put a limit on the number of ships a given owner could operate. It is likely that the specific regime allowing shipowners to limit their liability was implemented to allow shipowners not to accompany vessels anymore, and thus to operate larger fleets. Typically, absentee shipowners were able to discharge (under some conditions) all liabilities by surrendering their interests in a vessel. The practice became part of most jurisdictions in the 16th and 17th century, as trade was booming. Limiting the liability of domestic shipowners was then seen as a way to build up strong merchant fleets. As such, it is closely linked to the then-prevailing mercantilist view of political economy. Since then, the limitation of shipowners' liability has been constantly reaffirmed, and made its way to international law from the beginning of the 20th century (*Limitation Convention 1924*). Following World War II, the principle was part of the International Convention relating to the Limitation of the Liability of Owners of Seagoing Ships 1957 (*Limitation Convention 1957*), of the Convention on Limitation of Liability for Maritime Claims 1976 (*LLMC 1976*) and of its 1996 Protocol (*LLMC 1996*).

Under the 1976 Convention, shipowners may limit their liability, except if "it is proved that the loss resulted from his personal act or omission, committed with the intent to cause such a loss, or recklessly and with knowledge that such loss would probably result." The limitation of liability means that shipowners have no incentive to insure above the limit. Relative to the 1957 Convention, the 1976 Convention raises the amount of the limit. Limits are computed based on the tonnage of each ship, and are specified for two types of claims: claims for loss of life or personal injury and property claims. The 1996 Protocol further raises the limits and introduces a "tacit acceptance" mechanism to update these limits. As of September 2020, the *LLMC 1976* has been signed by 56 states, and the *LLMC 1996* by 61 states. Table A1 illustrates cases of oil spills during which shipowners have been able to limit their liability, and the to compensate victims for only a part of the damages.

The rationale for such limits in the current environment is questionable. Indeed, in the medieval context where these limits appear, they were mainly transferring risks between contractual parties in shipping contracts (e.g., the shipowner and the owner of the cargo), not between shipowners and tort creditors. On the one hand, this exception to liability laws could be seen a way to share risks in the absence of well-developed insurance markets, and in the absence of limited liability statutes for corporations. On the other hand, because these exceptions were mainly shifting risks to contractual parties, these parties could correct potential inefficiencies by adjusting other contractual terms (e.g., by asking for lower freight rates). Once tort liabilities become much larger - in the second half of the 20th century, due to environmental concerns - the picture changes completely. Indeed, tort creditors cannot protect themselves against this "forced" risk sharing. Furthermore, the contractual space (e.g., insurance markets) is now much deeper than in the Middle Ages, so that the need for derogatory laws is doubtful. For these reasons, some legal scholars have called for the end of shipowners' limitation of liability (Faure and Hui, 2008).

Table A1 – Shipowners' limitation of liability

This table provides examples of major examples of oil spills during which shipowners were able to limit their financial liability. This table is adapted from Faure and Hui (2008).

Ship	Year	Available compensation (in millon USD)	Damage caused (in millon USD)
Tanio	1980	43.9	62.6
Haven	1991	62.5	71.6
Aegean Sea	1992	63.5	115
Braer	1993	86.9	89.2
Nakhodka	1997	196.3	215.6
Erika	1999	200	450
Prestige	2002	200	877

Figure A1 – Timing of end-of-life flag changes

This figures counts the number of flag changes in the month in which the sample ships are broken up (denoted T), and in the 24 preceding months. The sample is composed of all ships with gross tonnage over 50,000 that were broken up over the period from 2000 to 2019. Vertical bars correspond to date $t = T - 3$ (dashed line) and $t = T$ (solid line).