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Abstract

Shipping companies frequently outsource the management of their vessels. In this paper, we use data from Lloyd's Register Fairplay (2009) on 45,456 vessels belonging to 9,580 different shipowners to investigate the extent of outsourcing in shipping and to identify key factors affecting the likelihood of outsourcing. The results of our econometric analysis indicate that ship-owners' decisions to outsource are explained by the characteristics of the vessels in question (age, type, size) and the characteristics of the ship-owner (country of domiciliation, number of vessels). In addition, a specific country effect is identified for Greek ship-owners, which is in line with the findings of previous studies.

Ship-owners' decisions to outsource vessel management

1. Introduction

Over the last decade, outsourcing has become a predominant strategic option for firms. Eighty-two percent of logistics and supply chain managers of 60 large US manufacturers made use of third-party logistics services in 2004 (Lieb and Bentz, 2004; Langley et al., 2005). Increasingly, companies are moving into foreign markets and globalizing their supply chains and sources of materials (Anderson et al., 2010). Similarly, the outsourcing of vessel management has become an option considered by most ship-owners (Sletmo, 1989), as ship ownership and operation are complex activities for which specific expertise is needed (Drewry Shipping Consultants, 2004).

Although outsourcing is a strategic choice that is growing in importance, the extent of outsourcing and the reasons behind the adoption of an outsourcing strategy are not well documented in shipping, at least on the global level, for several reasons. First, the extent of outsourcing is generally difficult to capture, as a variety of activities can be outsourced – transport management, warehousing, distribution or even the management of the entire supply chain (Patterson et al., 2010). Second, statistics on potential “shareholding ties” among the various stakeholders involved in the provision of shipping services are not readily available, which makes the identification of the extent of outsourcing difficult (Mitroussi, 2003). Despite these difficulties, this article attempts to provide an original contribution in the form of a global analysis of the extent of vessel management outsourcing and an examination of the key factors affecting the likelihood of such outsourcing.

The remainder of this paper is organized as follows. The literature on factors that influence the decision to outsource the management of a vessel are reviewed in the next section. Section 3 presents the dataset, which covers the world fleet as of June 2009, as well as some preliminary statistics concerning the intensity of outsourcing. In Section 4, we discuss results from Probit models and estimate separate regressions for various types of vessels. We then investigate the influence of a ship-owner's country of domicile. The last section provides conclusions and suggestions for further research.

2. Literature review

Logistics outsourcing is commonly adopted by companies as a means to obtain a competitive advantage (Hoffman 2006, 2007; Quinn, 2006; Gourdin, 2006; Parashkevova, 2007; Marasco, 2008). Outsourcing provides companies with opportunities to focus on core competencies, to access best management practices and to increase competitiveness in implementing new technologies developed by third-party service providers. Furthermore, through relationship learning, outsourcing enables customers and suppliers to identify ways of removing redundant costs, improve quality and reliability, and increase speed and flexibility (Selnes and Sallis, 2003; Selviaridis et al., 2008). At the same time,

the potential for a loss of control, uncertainties about the quality of service and questions concerning the true costs of using a third party remain (Gourdin, 2006).

According to Lieb and Bentz (2004), the most frequently used third-party logistics services in 2004 were direct transportation services (67%), custom brokerage services (58%) and freight payment services (54%). Although the reasons for outsourcing these activities are often similar, differences remain in terms of the motives, extent and context within which such outsourcing takes place (Peters et al., 1998; Lieb and Benz, 2004; Silver, 2005; Tompkins, 2006; Hannon, 2007; Fugate et al., 2009). In the shipping sector, outsourcing provides access to cost-efficient factors of production, such as vessel crews, and access to the specific technical expertise of large ship management companies, which offers economies of scale, marketing and bargaining power (Sletmo, 1989; Schulte, 1989; Ebsworth, 1989; Richards, 1989; King, 1997; Gunton, 1997). Access to potential tax exemptions is another likely motive (Stopford, 2009).

Outsourcing involves both a choice with regard to the activities to outsource and the selection of an appropriate service provider to handle those activities (Anderson et al., 2010). In vessel management, outsourced activities primarily concern commercial and/or technical elements. In 2003, the management of 1,500-1,700 vessels (out of 23,000 vessels) was outsourced to technical managers, while 4,500-5,500 vessels were outsourced to specialized crew management companies (Drewry Shipping Consultants, 2004). A 6-8% increase in the fleet managed by professional ship managers is expected over the long term, mainly driven by two factors: the growth of new shipping/exporting nations without shipping expertise, and changes in traditional shipping nations that support the outsourcing of vessel management. Examples of the latter include the new generation of Greek ship-owners, who are moving away from the family "tradition" of small fleets that are managed in-house, and Japanese ship-owners who appear ready to open up to international ship managers.

Although many studies about the extent of outsourcing and the choice of third-party ship managers exist (Panayides, 2001; Panayides and Cullinane, 2002; Mitroussi, 2003, 2004a, 2004b), they have been carried out on a case-to-case basis through surveys, and they often focus on differences in behaviour between Greek and UK ship-owners. Panayides (2001) and Panayides and Cullinane's (2002) surveys of 48 ship management companies and 36 Greek and UK owners show, for instance, that the primary criteria considered by a ship-owner in the selection of a third-party ship manager is technical ability, followed by the experience and qualifications of personnel, while price is not a decisive criteria. Another motive is the need to benchmark the ship-owner's own vessel management performance. Finally, the authors suggest that outsourcing is more likely for liner shipping companies operating a large number of vessels.

Mitroussi (2003) highlights four elements that lead a ship-owner to use third-party ship managers. These factors are company size, company type (private/family or public), company age and technological change. In its investigation of the impact of these attributes, Mitroussi's survey (2004a,

2004b) of 46 Greek and 20 UK ship-owners identifies distinct profiles. For instance, while 55% of the UK based companies use third-party management companies, only 8.3% of Greek companies use the same services. Crew and technical management are the activities that are outsourced the most often, while the choice of flag of registry, maintenance and commercial matters often remains the owner's responsibility. Furthermore, the primary reason for outsourcing is flexibility, followed by access to technical expertise. In contrast, existing in-house expertise (for 98% of Greek ship-owners), the need for control (89%) and the cost of outsourcing reduce its likelihood. With regard to the latter, Drewry Shipping Consultants (2004) estimates the fee of a third-party ship manager at USD 100,000 to USD 175,000 per year and per vessel, while Justad (2008) estimates the cost at 5% of annual operating costs.

Ship-owner's characteristics also have an impact on the choice to outsource (Mitroussi, 2004b). Small and large companies outsource in similar proportions (around 16%). This similarity is explained by the need for expertise for the former and by the need for a reduction in administrative costs for the latter. The age of the company is also a significant factor. Firms controlled by at least third-generation owners are more likely to outsource. Greek family-owned companies maintain control over the majority of their vessels (86.7%), while private UK companies use third-party managers (53.9%) more extensively. Finally, 53% of owners outsource 100% of their fleet, while 26.7% of owners outsource less than 25% (Mitroussi, 2004a).

This literature review makes it clear that previous research has dealt with the identification of factors affecting the decision to outsource vessel management. However, their scope remains limited to case studies comparing Greek and UK ship-owners. Therefore, we attempt to enlarge the comparison by considering a sample of 45,456 vessels from a range of countries operating in the world fleet in 2009.

3. Data

3.1. *Lloyd's Register Fairplay database*

We investigate the extent to which ship-owners outsource the management of their vessels using the Lloyd's Register Fairplay (LRF) database. This database distinguishes between the registered owner, defined as the legal owner of the vessel as indicated on the ship's registration documents; the operator, defined as the company responsible for the commercial decisions concerning the employment of a ship; the ship manager, who is designated by the shipowner or charterer as responsible for the day-to-day running of the ship; and the technical manager, who is specifically responsible for technical operations and acts as superintendant of the ship. Information is also available on the country of domicile for the various entities and on the vessels' characteristics, such as the type, building year and size. The data extraction was undertaken in May 2009 and led to the identification of 110,384 different vessels.

We then limit our attention to the management structure of merchant vessels involved in international trade. As a consequence, we remove the “miscellaneous” category of vessels (42,906 vessels) from the original LRF sample. 34.1% of these are fishing vessels and another 28.2% are tugboats. We also exclude vessels of less than 1,000 gross tons, as these are typically not involved in international trade (classification retrieved from UNCTAD, 2009). This reduces the sample size by 21,044 observations. Finally, we drop 978 vessels for which either the owner or the manager of the vessel are unknown. Hence, our final sample comprises 45,456 vessels belonging to 9,580 different shipowners and operated by 10,186 different managers.

The sample exemplifies the complexity inherent in attempts to identify the level of outsourcing in ship management when dealing with such a large dataset. For instance, Cosco is the largest shipowner in dry bulk markets, where the two largest managing companies are Shipping Co Ltd and Cosco Bulk. In fact, a majority of Cosco’s fleet is managed by Cosco Bulk, although the two companies have different names. However, the situation is different in other sectors. In tanker markets, for example, the largest managing companies are Thome Ship Management Pte Ltd, Anglo-Eastern Ship Management and Fleet Management Ltd-HKG. These companies are usually viewed as professional ship managers that are independent of ship-owners.

The LRF database provides another example of this complex situation. The five most important managing companies in 2009 were AP Moller, Zodiac Maritime Agencies Ltd, MSC Mediterranean Shipping Co., Fleet Management Ltd-HKG and NSB Niederelbe. The numbers of vessels managed and owned by each of these companies are presented in Figure 1. Interestingly, both AP Moller and Zodiac own almost all of the vessels that they manage. However, in many publications, Zodiac is presented as one of the leading professional ship managers (Lloyd’s Ship Manager, 2003), while AP Moller is not. In contrast, MSC manages 145 vessels, 144 of which are owned by companies not registered as MSC. In fact, MSC is structured in such a way that each vessel it manages is owned by an individual company with a unique name.

Insert Figure 1 here

Similar problems occur when analysing the situation for technical managers (Figure 1). In terms of the number of vessels managed, Fleet Management Ltd-HKG is the number one company, followed by Anglo-Eastern Ship Management Ltd, Wallem Shipmanagement Ltd, Moller-Maersk A/S and Thome Ship Management Pte Ltd. Very few vessels are owned by Anglo-Eastern Ship Management or Thome Ship Management Pte Ltd, while the reverse is true for Moller-Maersk A/S and Zodiac Maritime Agencies Ltd. The latter owns 97 of the 105 vessels it manages. V. Ships, which is known as one of the leading technical management firms in shipping, is registered under various names in the LRF database (V. Ships UK or V. Ships Ltd for instance) rather than as a single entity.

These examples illustrate that the identification of independent professional ship managers is difficult, as “shareholding ties” may exist between ship-owners and managers. However, managing companies are neither systematically related to a specific owning group nor do they exclusively work for a certain group. When defining outsourcing as a situation in which the names of a vessel’s manager and owner are different, it should be kept in mind that this definition does not correspond to the industry’s typical understanding of management outsourcing to independent professional ship managers. As stated above, given the legal and operational complexities found in company structures in shipping, ship-owners often outsource the management of vessels to subsidiaries with different names. This may lead us to consider a company as a third-party manager even when it is either directly or indirectly related to the owner of the vessel. This might increase the statistics related to the proportion of outsourcing activities and make comparisons with previous studies difficult.

Another limitation of the initial dataset is related to information on the registered shipowner and the country of domicile. The registered ship-owner might actually be the true owner/manager. However, in other situations, a number of entities might be created to legally “own” the ship in order to limit potential liability, to benefit from offshore tax laws or to fulfil a ship registration requirement for specific flags. The latter is clearly the case with Panama, one of the leading countries in terms of number of registered owners and in terms of flag of registry, but not in terms of controlled fleet (UNCTAD, 2009). These shortcomings must be kept in mind when interpreting our results. Our calculations thus provide an upper bound for the outsourcing rate.

3.2. Descriptive statistics

Using the available information, we focus on several characteristics to explain the probability that a vessel will be managed by a company other than the owner: size, type (bulker/combination, container, dry cargo, offshore, passenger/ferry, reefer, roro, tanker), and age. One interesting feature of the LRF data is that it is a matched sample of owners, managers and vessel characteristics, which allows us to study the magnitude of vessel management outsourcing from various perspectives. Starting with the vessel sample of 45,456 observations, we construct two sub-samples: one at the shipowner level (9,580 observations) and one on the manager level (10,186 observations).¹ The distribution of vessels in terms of owners and managers is shown in Figure 2.

Insert Figure 2 here

The analysis highlights the fragmentation in terms of number of companies and the concentration in terms of ownership. In 2009, more than half of all owners (57.7%) owned one ship, while 91.4% owned less than 10 ships. At the same time, owners owning more than 50 vessels represented 1.2% of all owners. These owners owned 28.8% of all vessels. The largest owner was the Chinese

¹ For example, an owner with four vessels contributes four observations to the vessel sample but only one to the owner sample.

government (1,498 vessels), followed by COSCO, Mitsui OSK Lines and China Shipping Group. Vessels owned by the Chinese Government are managed by a number of small domestic shipping lines. A similar pattern holds for managers. Less than 1% of companies managed more than 50 vessels in 2009. However, these companies operated 28.8% of all vessels.

In terms of vessels,² around 50% are less than 16 years old and 30% are more than 25 years old. The mean age is 15.9 years. Of these vessels, 38.7% are less than 5,000 gross tons and 28.5% are above 25,000 gross tons. Dry cargo (24.3%), tanker (23.9%), bulker (18.2%) and container (11.3%) vessels are the most common. A closer look at the data highlights differences in the structure of the fleet by country of domicile. On average, Japanese owners operate a relatively young fleet of larger vessels. The German fleet is characterized by a predominance of containerships.³ The Chinese fleet is relatively old and small, with a high proportion of dry cargo and bulk carriers. Greek owners are active in dry bulk markets and generally operate older vessels. In terms of the number of registered owners, Panama and Greece are the two largest countries but owners in these countries are relatively small in size with 1.5 vessels on average in Panama and 5.2 in Greece. Given the importance of the Chinese government, China is the country in which the mean fleet size of owners is the highest (16.4 vessels).

Table 1 presents some statistics on the extent of outsourcing. For 55% of the vessels in our dataset, the owner differs from the manager. This is nearly twice the proportion reported by Drewry Shipping Consultants (2004) in a survey that considered only a limited number of large third-party ship managers. Our analysis includes all ship managers and subsidiaries of ship-owning companies.

Insert Table 1 here

The magnitude of the outsourcing rate is significantly influenced by a vessel's characteristics. The older the vessel, the more likely it is to be managed in-house. One explanation for this finding could be the fee charged by ship managers, which represents a burden for older vessels generating lower earnings. Another finding is that the proportion of outsourced vessels is much higher for larger vessels. Furthermore, we observe significant differences across vessel types. The management of offshore, ro-ro and tanker vessels is outsourced more often than it is for reefers and, to a lesser extent, passenger/ferry and dry cargo ships.

Figure 3 highlights the major differences in outsourcing rates by the ship-owner's country of domicile. Shipowners from the UK and Panama outsource extensively, while those from Indonesia, Russia and Greece do not. Our results for companies based in the UK and Greece are in line with Mitroussi

² Detailed results are available upon request from authors.

³ This is because of the importance of German KG partnership systems, which provide tax exemptions for investments in containerships. German vessels are, therefore, relatively younger as a result of the surge in investment for these vessels in recent years (Cariou, 2008).

(2004a). A last finding is that there is a non-linear relationship between the outsourcing rate and owner size (Figure 4). On the one hand, companies with less than two vessels outsource more than companies with three to five vessels. On the other hand, the outsourcing rate is much higher among large companies.

Insert Figure 3 here

Insert Figure 4 here

4. Econometric analysis

4.1. The determinants of outsourcing

An econometric analysis allows us to further investigate the roles played by the owners' and vessels' characteristics in determining the extent of outsourcing. We define a latent variable, DIF_{ji}^* , which indicates the propensity for a vessel i belonging to an owner j to be managed by a company other than the owner. As this latent variable is unobserved, let DIF_{ji} be a dichotomous variable such that $DIF_{ji} = 1$ when the same company owns and manages the vessel, and 0 otherwise. By definition, $DIF_{ji} = 1$ when $DIF_{ji}^* > 0$ and $DIF_{ji} = 0$ when $DIF_{ji}^* \leq 0$. The model can be expressed as:

$$DIF_{ji}^* = X_{ji}\beta + a_j + \varepsilon_{ji} \quad (1)$$

where X_{ji} is a set of explanatory variables related to both the vessels and the ship-owners, and β is a vector of associated coefficients. The term a_j picks up unobserved heterogeneity related to the ship-owner j and ε_{ji} is a vessel-specific random term. We suppose that the perturbations are normally distributed such that $a_j \sim N(0; \sigma_a^2)$ and $\varepsilon_{ji} \sim N(0;1)$. Assuming that a_j and ε_{ji} are independent, the corresponding specification is a random effect Probit model estimated using Gaussian quadrature techniques. The corresponding estimates are reported in Table 2.

Insert Table 2 here

We first control only for vessel characteristics (column 1 of Table 2). The probability of having a vessel managed by a company different than the owner depends, to a great extent, on the age of a vessel. The profile is non-linear in this respect. Compared to the reference category of vessels less than five years old, the probability of outsourcing management is reduced by 20 points for vessels older than 35 years, while it increases by 10 points when the vessel is between 15 and 24 years of age. Outsourcing is more likely for larger vessels, especially those between 10,000 and 50,000 gt. Our

findings may be explained by the impact of the fees charged by ship managers, which are often set in proportion to operating costs and, therefore, increase with size and age. Finally, outsourcing is more likely for offshore, tanker and, to a lesser extent, dry cargo and container vessels, while the reverse pattern holds for reefer and passenger/ferry vessels.

We add the owner's country of domicile and fleet size as covariates in column 2 of Table 2. Notably, the addition of the owners' characteristics does not significantly change previous estimates on the influence of vessel characteristics. Owners registered in the UK, Panama, Norway and Germany outsource more often. Conversely, owners from Indonesia, Russia and Greece are more likely to manage vessels in-house, with the probability increasing by more than 60 points. Our econometric estimates confirm findings from Panayides and Cullinane (2002), Mitroussi (2003, 2004a, 2004b) and Drewry Shipping Consultants (2004). Although outsourcing is significantly different from one country to another, our results also indicate that this is not solely the result of differences in fleet structures, as we control for age, size and type of vessels in our regressions.

A non-linear pattern between the propensity to outsource and the size of the ownership is also evident. Compared with owners of a fleet of only one or two vessels, the probability of having a vessel managed in-house increases by nearly 20% when the fleet encompasses between three and five vessels. This probability decreases as the size of the owner's fleet grows. As indicated by Mitroussi (2004b), various factors may explain this result. Smaller companies may need technical expertise, while medium-size companies may need a way of benchmarking their own management performance. Finally, the high marginal effect for larger companies is the result of the over-representation of container lines among firms operating more than 25 vessels, as they are characterised by higher outsourcing rates (Panayides and Cullinane, 2002).

In Table 3, we estimate separate regressions for three types of vessels with high rates of outsourcing: container (57.6%), dry cargo/bulker (54.3%) and tanker (60.1%) vessels. Our main results are the following. First, we observe a weak correlation between the probability of outsourcing and the size of a vessel. Most coefficients for the quintile of gross tons for each vessel category are not significant. There is no clear relationship between age and outsourcing, except for dry cargo/bulker vessels. For this category, vessels from 5 to 30 years of age are, on average, outsourced more often.

Insert Table 3 here

Second, we observe that the owner's country of domicile has a strong influence. Norwegian, Chinese, US, Panamanian and Dutch ship-owners outsource more than Greek shipowners. For dry cargo/bulker vessels, owners registered in Indonesia, Greece and South Korea manage their vessels in-house more often. In tanker markets, US and Chinese ship-owners outsource more often than owners registered in Indonesia, Turkey, Greece and Russia.

Third, mixed results emerge in relation to owner's size. On the one hand, the probability of outsourcing increases by more than 15% for dry cargo/bulker and tanker companies with more than 25 vessels, while containerships are more likely to be outsourced when the owner's fleet numbers one or two vessels. The importance of ship funds in the container business may explain the high rate of outsourcing for smaller owners without expertise and critical size.

4.2. Cross-country differences in outsourcing

As discussed previously, a ship-owner's decision to outsource the management of a vessel involves a set of characteristics related to both the vessel and the owner. Among the latter, the country of registration for a ship-owner's domicile is a decisive factor (Drewry Shipping Consultants 2004; Mitroussi 2003, 2004a, 2004b; Panayides and Cullinane 2002). This element is the focus of this section, although the limitations related to registered ship-owners and the true nationality of owners should be kept in mind.

When considering two countries of ownership, we study whether differences in observed country outsourcing rates may be explained by either the structure of fleet by country or by other factors, such as the way companies registered in that country operate. Let us first consider the latent unobserved variable $SAME^*$. Denoting A and B as two different countries, the difference $SAME_A^* - SAME_B^* = X_A\beta_A - X_B\beta_B$ may be expressed as:

$$SAME_A^* - SAME_B^* = (X_A - X_B)\beta_A + X_B(\beta_A - \beta_B) \quad (2)$$

This Oaxaca-Blinder decomposition (Oaxaca and Ranson, 1994), which is applicable for continuous dependant variables, indicates that the total difference $SAME_A^* - SAME_B^*$ may be expressed as the sum of two terms. The first, $(X_A - X_B)\beta_A$, is the difference in the structure of each group in terms of observable characteristics. The second, $X_B(\beta_A - \beta_B)$, is the difference in the returns to the covariates. One difficulty is the fact that our dependent variable, $SAME$, is not continuous but discrete. We thus rely on a decomposition of the difference in probability in the first moment (Yun, 2004). Let $\Pr(SAME_A) = \Phi(X_A\beta_A)$ and $\Pr(SAME_B) = \Phi(X_B\beta_B)$ be the probability of having a vessel owned and managed by the same company in a country A and in a country B , respectively, with $\Phi(\cdot)$ as the univariate distribution function. After denoting the mean probabilities in each country from a Probit model as $\bar{P}_A = \bar{P}(SAME_A)$ and $\bar{P}_B = \bar{P}(SAME_B)$, the difference is:

$$\bar{P}_A - \bar{P}_B = [\overline{\Phi(X_A\beta_A)} - \overline{\Phi(X_B\beta_A)}] + [\overline{\Phi(X_B\beta_A)} - \overline{\Phi(X_B\beta_B)}] \quad (3)$$

The first term in Equation 3 reflects differences in vessels' characteristics, while the second term measures the differences from covariates. We apply these estimations to a cross-country comparison of Japan, Germany, China, Greece, USA and Norway, the six largest countries in which owners are registered. The estimates are reported in Table 4.

Insert Table 4 here

Let us first consider the case of Japan and Germany, the two largest countries in terms of shipowners with 4,003 and 3,897 vessels registered, respectively. The rates of outsourcing are 66% and 53%, respectively. The total difference in probability is, therefore, equal to 13 points. The decomposition shows that 53.8% (0.070/0.130) of this difference is due to the fact that vessels in the two countries have different characteristics, while the rest (46.2%) is explained by a country-specific effect.

A global analysis of results leads to the following conclusions. First, there are limited differences in the outsourcing rate among countries in many cases. For instance, the gap is close to zero when comparing the US and Japan, Japan and Norway, and Norway and the US. Second, the probability of outsourcing is often explained by differences in a country's fleet structure. For instance, for the US-China comparison, the difference in the outsourcing rate is 16.4%, but 93.3% of this gap stems from differences in covariates. In fact, the result is mainly explained by the number of offshore vessels operated by US owners, which is presumably influenced by US laws on maritime operations and cabotage (e.g., the Jones Act) and by the number of large ship-owners in China. This similarity in outsourcing rates is, therefore, more explained by a specialisation in different market segments than by a similarity in ship-owners' outsourcing behaviour.

Third, we observe a difference between Greek ship-owners and ship-owners from other countries. This difference in the outsourcing rate reaches more than 50% with China. Furthermore, the component stemming from differences in the structure of the fleet is extremely low at 7.4% for Japan-Greece, 1.6% for Germany-Greece and 15.6% for China-Greece. In other words, Greek ship-owners have a lower propensity to outsource the management of their vessels, a feature mostly explained by a country-specific effect. These findings are in accordance with the previous contributions of Mitroussi (2003, 2004a, 2004b) and Panayides and Cullinane's (2002) on differences in the rate of outsourcing between Greek and UK shipping companies.

5. Conclusion

Different behaviours are evident in this analysis of ship-owners' decisions to outsource the management of a vessel. These differences are explained by characteristics related to the vessel (age, type, size) and to the owner (country of domicile and size). Such differences have been stressed in former studies and are confirmed in this paper. The novelty of our contribution is that we consider a much larger sample of data to investigate these issues although limitations arising from the composition of the LRF dataset should be kept in mind.

This paper offers suggestions for further studies. The first is the need for better identification of the links between ship-owners and ship management companies, which would provide a more accurate means for comparing our estimates with former studies focusing on outsourcing to third-party ship managers. A second possibility would be to increase the number of parameters considered. Some factors, such as the history of a company (Panayides, 2001; Mitroussi, 2004b) and the ways in which the decision to outsource changes over time, could be investigated. The latter issue is worth studying over periods during which a financial or shipping crisis is likely to affect the level of outsourcing and have an effect on company performance. This effect is likely to be magnified for companies serving global markets (Gourdin, 2006, p. 241). A final possible extension of this study would be to compare our results with the extent and forms of outsourcing observed in other industries (Marasco, 2008).

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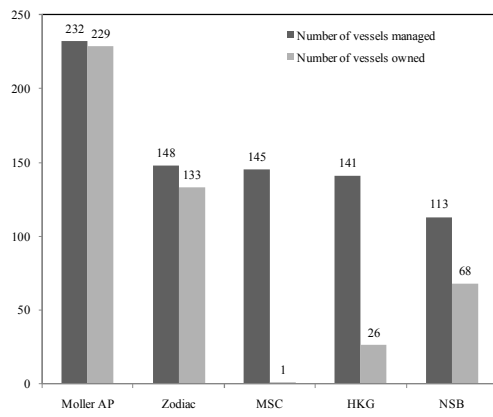
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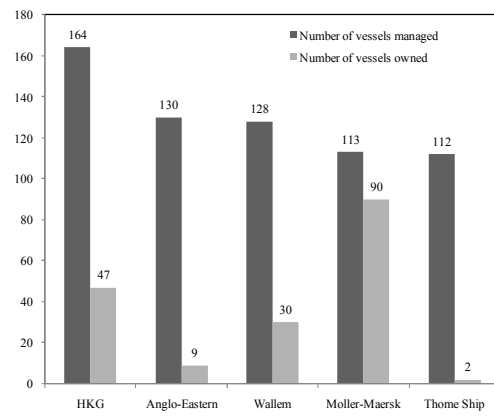
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Figure 1. Number of vessels managed and owned by the top-five managers and technical managers, 2009
A. By managers

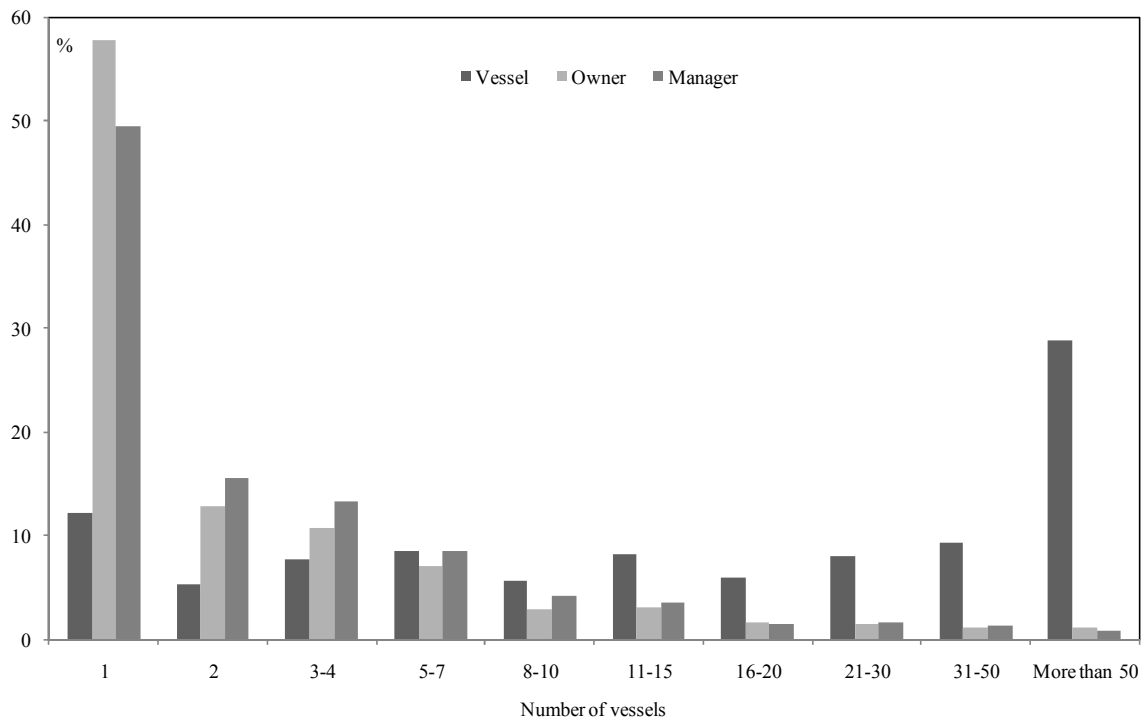


B. By technical managers



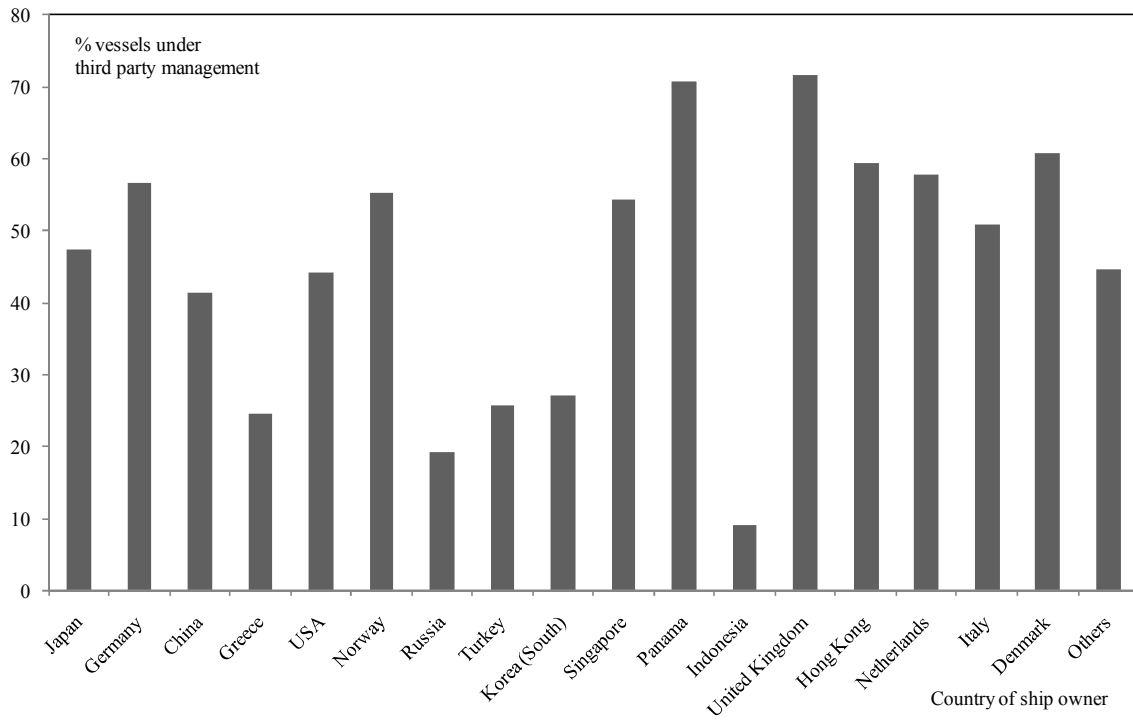
Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Figure 2. Distribution of vessels, owners and managers by fleet size, 2009



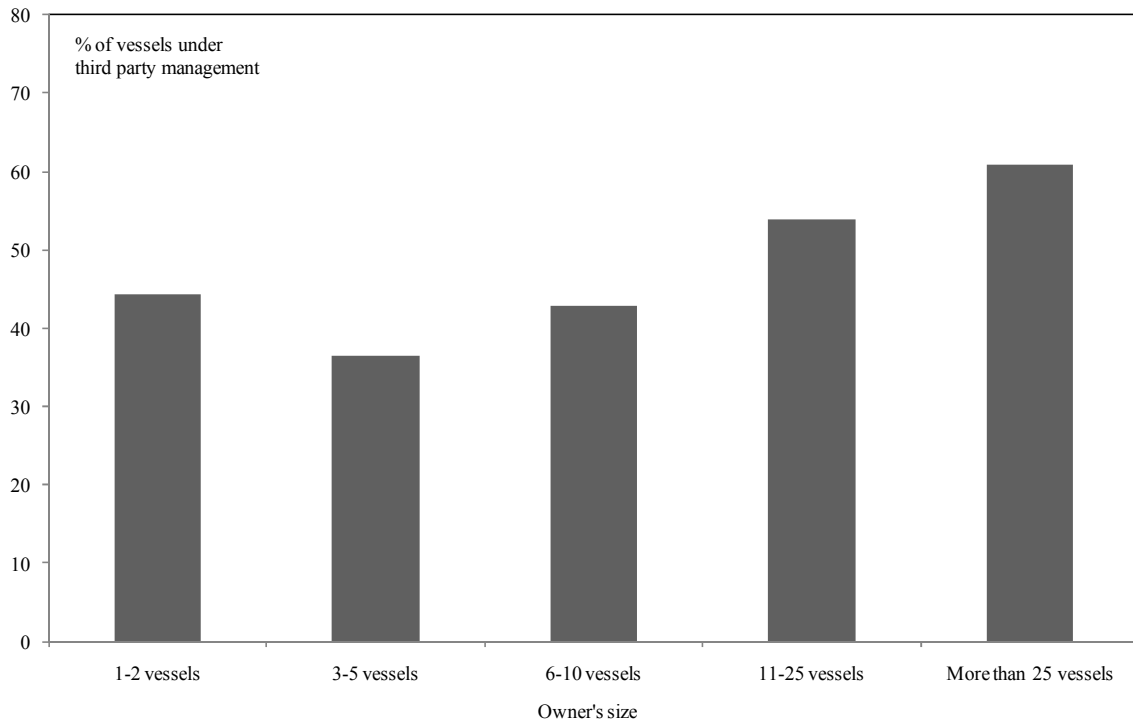
Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Figure 3. Outsourcing rate by country of ship-owner registration, 2009



Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Figure 4. Outsourcing rate by owner size



Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Table 1. Ownership structure by vessel characteristics 2009 (45,456 vessels)

Variables		Distribution (in %)	Owner \neq manager (in %)
Age	0-4	27.2	56.9
	5-9	12.3	60.7
	10-14	11.9	59.4
	15-19	9.3	56.5
	20-24	9.3	55.3
	25-29	12.7	52.5
	30-34	9.2	50.2
Size (gt)	35 and more	8.2	39.1
	1,000-4,999	38.7	47.0
	5,000-9,999	14.5	55.3
	10,000-24,999	18.3	59.5
	25,000-49,999	17.1	60.8
Type	50,000 and more	11.4	64.4
	Bulker / combination	18.2	54.3
	Container	11.3	57.6
	Dry cargo	24.3	47.9
	Offshore	9.1	64.6
	Pass./Ferry	5.0	46.2
	Reefer	3.8	40.5
	Roro	4.4	61.5
Tanker	23.9	60.1	
All		100.0	54.8

Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Table 2. Probability of having a vessel with the same owner and manager, 2009

Variables		(1)		(2)	
		coef.	t-value	coef.	t-value
Constant		-0.699	-10.24	-0.645	-7.50
Age	0-4	Ref		Ref	
	5-9	0.140***	3.79	0.136***	3.66
	10-14	0.181***	4.68	0.180***	4.65
	15-19	0.239***	5.26	0.259***	5.70
	20-24	0.254***	5.26	0.302***	6.26
	25-29	0.084*	1.83	0.143***	3.13
	30-34	-0.036	-0.68	0.023	0.44
	35 and more	-0.583***	-9.85	-0.517***	-8.72
Size (gt)	1,000-4,999	Ref		Ref	
	5,000-9,999	0.250***	6.09	0.190***	4.62
	10,000-24,999	0.377***	8.47	0.282***	6.36
	25,000-49,999	0.427***	8.32	0.314***	6.15
	50,000 and more	0.200***	3.59	0.088	1.60
Type of ship	Bulker / combination	Ref		Ref	
	Container	0.156***	2.88	0.080	1.48
	Dry cargo	0.139***	2.73	0.137***	2.69
	Offshore	0.738***	8.83	0.590***	7.10
	Pass./Ferry	-0.219**	-2.45	0.201**	-2.26
	Reefer	-0.505***	-5.01	-0.423***	-4.20
	Roro	-0.071	-1.06	-0.109	-1.62
	Tanker	0.394***	8.38	0.380***	8.14
Owner's country	Japan			0.069	0.38
	Germany			0.671***	3.05
	China			-0.398	-1.60
	Greece			-1.872***	-10.61
	USA			0.074	0.33
	Norway			0.922***	3.98
	Russia			-1.963***	-10.81
	Turkey			-1.479***	-8.02
	Korea (South)			-1.393***	-6.27
	Singapore			0.606**	2.47
	Panama			2.037***	12.48
	Indonesia			-3.301***	-13.93
	United Kingdom			2.264***	8.00
	Hong Kong			0.995***	4.73
	Netherlands			0.965***	3.33
	Italy			0.297	0.91
	Denmark			1.216***	3.37
	Others			Ref	
Owner's size	1-2 vessels			Ref	
	3-5 vessels			-0.488***	-4.44
	6-10 vessels			-0.151	-0.97
	11-25 vessels			0.892***	4.82
	More than 25 vessels			1.736***	10.17
Number of vessels		45,456		45,456	
Number of owners		9,580		9,580	
Log likelihood		-16,564.5		-16,059.6	

Source: Author's calculation based on Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Note: Estimates from random effect Probit models. Significance levels are 1% (***), 5% (**) and 10% (*).

Table 3. Probability of outsourcing the management of a vessel by vessel type, 2009

Variables	(1)		(2)		(3)	
	Container		Dry cargo and bulker		Tanker	
	coef.	t-value	coef.	t-value	coef.	t-value
Constant	0.247	1.20	-0.408***	-3.56	0.105	1.03
Age	Ref		Ref		Ref	
0-4	0.064	0.68	0.187***	3.10	0.040	0.62
5-9	0.094	0.72	0.253***	3.60	0.045	0.58
10-14	0.023	0.16	0.218***	2.79	0.038	0.41
15-19	0.299*	1.80	0.242***	3.15	-0.095	-1.07
20-24	0.159	0.98	0.210***	2.87	-0.112	-1.27
25-29	0.259	1.03	0.133*	1.69	-0.135	-1.21
30-34	-0.555**	-2.20	-0.064	-0.70	-0.526***	-4.57
35 and more	Ref		Ref		Ref	
Size (gt)	0.193*	1.74	0.146**	2.35	0.056	0.81
Quintile 1	0.196	1.31	0.190**	2.18	0.231***	2.86
Quintile 2	0.235	1.41	0.150	1.24	0.176	1.64
Quintile 3	0.153	0.76	0.180	1.31	0.322***	2.75
Quintile 4	0.369	1.23	0.352**	2.29	0.058	0.45
Quintile 5	0.005	0.02	-0.193	-1.04	-0.030	-0.12
Owner's country	1.263***	3.25	0.827***	2.70	0.550***	2.78
Japan	-1.218***	-2.90	-0.744***	-4.78	-0.902***	-4.24
Germany	1.275***	3.19	0.638***	2.83	0.734***	3.12
China	1.497***	3.45	0.405*	1.69	0.137	0.49
Greece	-0.967	-1.25	-0.333*	-1.77	-0.734**	-2.56
USA	0.782*	1.76	-0.469***	-3.65	-0.992***	-4.29
Norway	-0.502	-1.25	-0.564***	-3.47	-0.761***	-3.76
Russia	-0.076	-0.12	0.257	1.21	-0.460	-1.56
Turkey	1.261***	4.76	0.235**	1.99	0.306**	2.09
Korea (South)	-0.862***	-2.84	-1.103***	-6.75	-1.125***	-4.66
Singapore	-0.682	-1.06	0.217	0.82	0.507	1.45
Panama	0.616	1.37	0.190	1.34	-0.016	-0.07
Indonesia	1.268***	3.00	0.059	0.21	-0.492*	-1.82
United Kingdom	0.282	0.39	0.141	0.58	-0.363	-1.39
Hong Kong	-0.274	-0.97	0.355	1.50	-0.913**	-2.56
Netherlands	Ref		Ref		Ref	
Italy	Ref		Ref		Ref	
Denmark	Ref		Ref		Ref	
Others	Ref		Ref		Ref	
Owner's size	Ref		Ref		Ref	
1-2 vessels	-0.734***	-3.72	-0.137**	-2.44	-0.209**	-2.46
3-5 vessels	-0.581***	-2.80	-0.124	-1.61	0.084	0.89
6-10 vessels	-0.403**	-2.00	0.056	0.63	0.210**	2.02
11-25 vessels	-0.316*	-1.74	0.410***	3.00	0.480***	4.11
More than 25 vessels						
Number of vessels	5,147		19,320		10,844	
Number of owners	915		5,145		2,300	
Log likelihood	-3,035.1		-11,647.1		-6,201.9	

Source: Author's calculation from Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Note: Estimates from Probit models with standard errors adjusted for vessels' clusters. Significance levels are 1% (***), 5% (**), and 10% (*).

Table 4. Decomposition of differences in outsourcing rates, 2009

Country		Japan	Germany	China	Greece	US	Norway
Japan	Total difference	-	0.130	-0.190	0.379	-0.026	-0.013
	Dif. in characteristics	-	0.070	-0.165	0.028	0.117	0.030
	Dif. in returns	-	0.060	-0.025	0.351	-0.143	-0.043
Germany	Total difference		-	-0.320	0.249	-0.156	-0.143
	Dif. in characteristics		-	-0.070	0.004	0.127	0.135
	Dif. in returns		-	-0.250	0.245	-0.283	-0.278
China	Total difference			-	0.569	0.164	0.177
	Dif. in characteristics			-	0.089	0.153	0.076
	Dif. in returns			-	0.480	0.011	0.101
Greece	Total difference				-	-0.405	-0.392
	Dif. in characteristics				-	0.091	0.003
	Dif. in returns				-	-0.496	-0.395
USA	Total difference					-	0.013
	Dif. in characteristics					-	-0.015
	Dif. in returns					-	0.028
Norway	Total difference						-
	Dif. in characteristics						-
	Dif. in returns						-

Source: Author's calculation from Lloyd's Register Fairplay – World Shipping Encyclopaedia (June 2009)

Note: Results from decomposition analysis. The country of reference is in row. For instance, the outsourcing rate is 13% higher in Japan than in Germany. 7 points are explained by differences in characteristics and the 6 remaining points by differences in returns to these characteristics.