

Factors affecting the survival of maritime goods transport firms in Spain

Encarnación Cordon Lagares^{a*}, Félix García Ordaz^{a*}

^a *Department of Economics, University of Huelva, Plaza de la Merced 11, 21002
Huelva, Spain*

Abstract

This paper aims to examine some challenges related to economic aspects of Spanish maritime goods transport firms. Concretely, it is focused on assessing the factors that determine Spanish shipping firms' survival.

Non-parametric and semi-parametric techniques are the basis of the empirical analysis conducted. The obtained results allow us to establish business profiles with higher survival. This paper finds that better survival prospects are presented for firms whose main type of transport is the liquid bulk, roll-on/roll-off good and container segments. Second, the legal requirements for their constitution confer greater advantages to public limited companies in comparison with other corporate forms. Finally, we find that financial strength and negotiation power with their suppliers have significant influences in this regard.

JEL classification: C41, R40, Q56

Keywords: Shipping firms, Firms survival, Maritime goods transport, Sustainability

* Corresponding authors. Tel.: +34 959 217868 (E. Cordon) +34 959 217869 (F. García).

E-mail addresses: ecordon@uhu.es e-mail: felix@uhu.es

Factors affecting the survival of maritime goods transport firms in Spain

Abstract

This paper aims to examine some challenges related to economic aspects of Spanish maritime goods transport firms. Concretely, it is focused on assessing the factors that determine Spanish shipping firms' survival.

Non-parametric and semi-parametric techniques are the basis of the empirical analysis conducted. The obtained results allow us to establish business profiles with higher survival. This paper finds that better survival prospects are presented for firms whose main type of transport is the liquid bulk, roll-on/roll-off good and container segments. Second, the legal requirements for their constitution confer greater advantages to public limited companies in comparison with other corporate forms. Finally, we find that financial strength and negotiation power with their suppliers have significant influences in this regard.

Keywords: Shipping firms, Firms survival, Maritime goods transport, Sustainability

1. Introduction

The dominant position of the world's maritime transport compared to other types of transport is evident since around 90% of the European Union's (EU) external freight trade and 40% of the intra-EU exchange of goods and passenger transport are carried by sea (Jessen and Jürgen, 2016). In this sense, the growth has occurred due to the progressive decrease in the costs of maritime transport compared to other forms of transport, the gradual reduction in the delivery times of large merchandise and the security of deliveries, among other factors. In addition, maritime goods transport has been reinforced by institutional support; this has allowed the industry to be established as a strategic sector generating added value and employment, and become eco-friendly in terms of CO2 emissions per cargo ton (Grant and Elliott, 2018).

Previous empirical studies reveal the economic, social and environmental influence of maritime transport (Kildow and McIlgorm, 2010; Niavis et al., 2017; Sislian et al., 2016). According to the World Commission of Environmental Development (WCED) (1987) sustainable development is the *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. Moreover, the 2030 Agenda and its Sustainable Development Goals have been adopted to achieve a better and sustainable future for all, with the aims of stimulating actions towards economic, environmental and social sustainability. Its implementation requires a fully integrated approach between sectors, disciplines, countries, and actors (Shulla et al., 2019).

On the other hand, the activities developed on coastal and maritime areas represent a type of an economic sector which could be considered as the 'Blue Economy' of Europe (Niavis et al., 2017). The importance of this sector is testified by the continuous effort of the European Union to further strengthen it, mostly through the implementation of the Blue Growth strategy (Ecorys, 2012). Blue growth is the European Commission's

56
57
58 strategy to further harness of potential of Europe's oceans, seas and coasts and to
59 support sustainable growth in maritime and marine sectors. In the fact, it is estimated
60 that European 'Blue Economy' generates a gross added value of about 500 billion
61 euros in an annual basis and more than 5,4 million jobs (EC, 2012).

62 Protecting oceans and maritime resources is key to achieving sustainability worldwide
63 (Halpern et al., 2008; Morrissey et al., 2011). International standards demand the
64 maritime transport industry to make significant investments in green technology,
65 including that related to emissions, waste, and ballast water treatment. These
66 investments are positive not only for the environment, but may also help to long-term
67 cost savings, such as with increased fuel efficiency.

68 Thus, oceans are the drivers of development because they lay the foundations to
69 promote a number of economic initiatives. Furthermore, coastal countries take
70 advantage of their location in terms of lower transport costs and more competitiveness
71 (Gallup et al., 1999).

72 The maritime industry is characterized by a tendency towards the integration of
73 services, vertically and horizontally (Frémont 2009; Van de Voorde and Vanellander
74 2009; Dragomir, 2011, among other).

75 Despite the strength of maritime transport, firms constantly face threats in this
76 globalized and competitive sector, which endanger its survival.

77 This research aims to analyse the survival of Spanish maritime transport firms. Thus,
78 the economic sustainability of the study is explored in terms of sustainability of the firm
79 since the analysis focuses on the economic survival as a core part of the sustainability.
80 Maritime transportation is very important for Spain due to its location and the
81 infrastructure of its ports. It is an important source of employment that involves a large
82 number of companies and has a very important influence to the economy. Although
83 the studies on firm survival in the maritime transport sector are relevant, most of these
84 papers mainly focus on descriptive analysis with respect to the short-term dynamics of
85 the main macromagnitudes of the international maritime trade. By providing
86 longitudinal data at the microdata level, semi-parametric and non-parametric survival
87 analysis methods can be implemented.

88 Previous studies on survival analysis of firms carried out by Evans (1987); Hall (1987);
89 Dunne, Roberts, and Samuelson (1988); Audrestch and Mahmood (1995); and
90 Audretsch (1995) focused on the study of manufacturing companies in the United
91 States; and Mata et al. (1995) on the analysis of manufacturing firms in Portugal.

92 The fundamental objective of this study is to analyse the key aspects that influence the
93 survival of maritime transport firms, with special attention given to the type of goods
94 being transported, the corporate form of the enterprise, the average time period for
95 charging customers and paying suppliers, economic profitability, the solvency ratio and
96 the availability of aid in the form of subsidies.

97 The innovation of this research lies in different aspects, the first of which is the fact that
98 there is no other study focused on the factors affecting the exit decisions of shipping
99 companies using the survival analysis methodology. The use of this technique is
100 extended in fields such as health sciences and industrial organization, but has rarely
101 been applied to the transport economics. Moreover, the data set used in this analysis
102 has never been analysed before to estimate the survival probability of transport
103 companies.

111
112
113 One of the benefits of the SABI database is that it provides individualized financial and
114 economic data of each company as well as information about their location and their
115 internationalization level. Furthermore, a balance sheet information and other company
116 features are available.

117
118 The rest of this document follows this structure: Section 2 includes a short description
119 of the dynamics of the maritime transport of goods in Spain. Section 3 analyses
120 information and the data and discusses the survival analysis methodology. Section 4
121 presents the findings and, finally, Section 5 states the main conclusions that are
122 reached in this study.

123 124 125 **2. Description of the maritime transport of goods in Spain**

127 Europe is one of the main maritime hubs in the world with 329 key seaports along its
128 coastline. Almost 90% of the EU's outward goods trade is seaborne, which accounts
129 for around one-third of the global merchant fleet. In terms of value, the external
130 maritime transport trade in 2017 was 892.1 billion euros in the case of exports (47.5%)
131 and 986.2 billion euros in the case of imports (53.1%). In terms of weight, the external
132 maritime transport trade was 561.3 million tonnes in the case of exports (80.4%) and
133 1286.7 million tonnes in the case of imports (73.8%) (Eurostat database). In 2016, the
134 maritime transport sector in the EU-28 employed approximately 176.2 thousand people
135 and the amount of sea transport firms was 11,460 enterprises.

136
137 Nevertheless, the crisis of 2007 caused a drastic reduction in the transport volumes in
138 2009 at a time when a wave of newly built vessels was beginning to enter the industry.
139 Furthermore, in recent decades, larger vessels are being built to benefit from
140 economies of scale and profit from technological advances, and horizontal alliances
141 and agreements are being formed to better exploit them.

142 Spain has six ports in terms of freight traffic, some of which are major EU-28 seaports.
143 Algeciras, Valencia, Barcelona, Cartagena, Tarragona, Bilbao, and Huelva are 5th, 8th,
144 13th, 22th, 26th, 27th and 29th among the EU-28 (83.5, 60.1, 49.7, 34.5, 33.4, 32.6, and
145 32.2 tonnes, respectively) (Source: Eurostat (2017)).

146 Regarding the number of enterprises in the Spanish maritime freight transport, 57% of
147 companies are legally limited liability companies while approximately 25% of them are
148 public limited companies. Moreover, 42% of the Spanish maritime transport companies
149 that deal in merchandise do not have salaried workers and only 6.36% have more than
150 100 workers (Fig. 1)¹.

151
152
153
154
155
156
157
158
159
160 ¹ It should be noted that dates are from the Instituto Nacional de Estadística (INE), and these do not
161 equal those of Spanish Shipowners' Association (ANAVE).
162

166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220

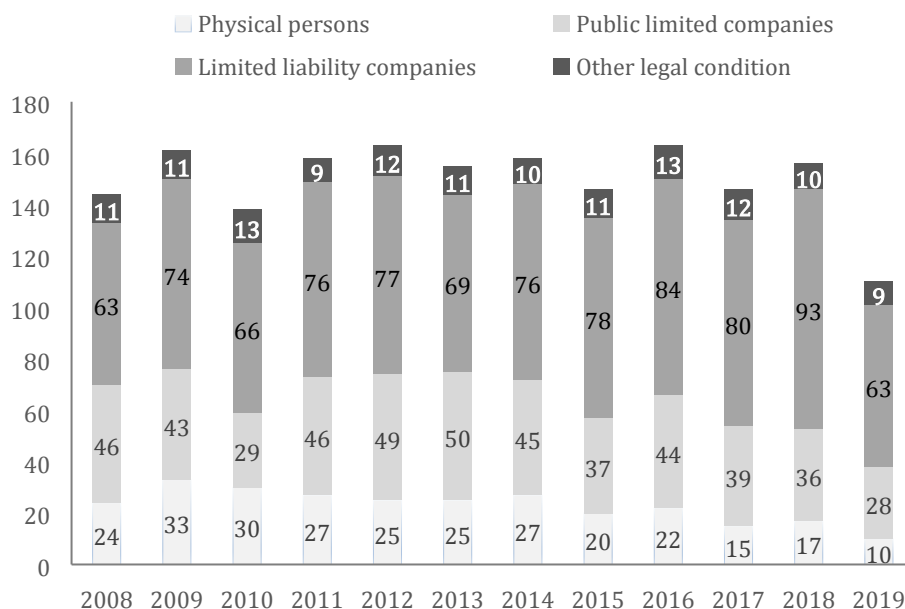


Fig. 1. Number of enterprises in the Spanish maritime freight transport industry by legal condition, 2008-2019
Source: Instituto Nacional de Estadística (INE)

Fig. 2 shows the evolution of maritime freight transport in the Spanish state-owned port system. We find that a total of 563.6 million tonnes of assets were traded in 2018, which represents a growth of 36.6% compared to 2009. It shows that, in general, the sector has successfully overcome the global economic crisis that started in 2007. Moreover, the reduction in maritime traffic in 2008 that was caused by the crisis affected the industry for very few years².

² In 2016, the EU port authorities are comprised of 87% public ownership, 6% private ownership and 7% mixed public-private ownership.

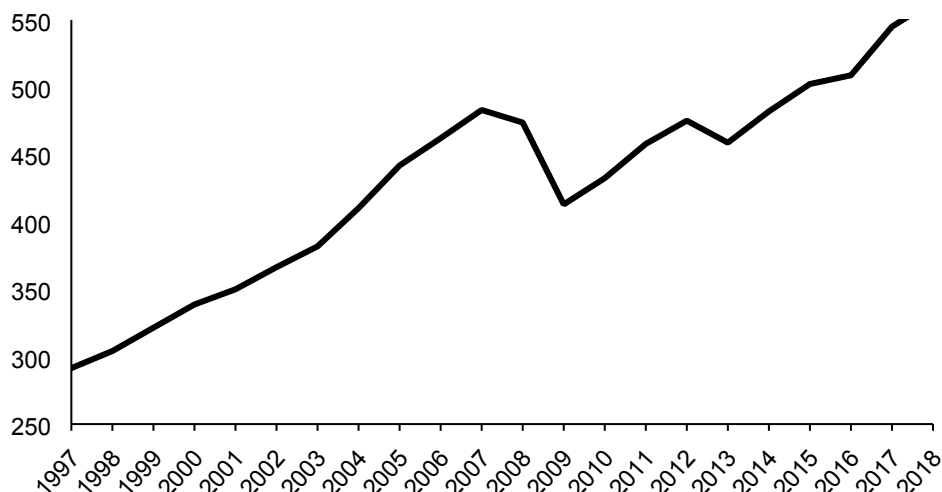


Fig. 2. Maritime freight transport evolution (million tonnes), 1997-2018
Source: Ministerio de Fomento

Regarding the evolution of maritime goods transport based on the type of cargo, two clearly differentiated phases that are marked by the economic and financial crisis of 2007-2009 stand out. In fact, prior to the crisis, all goods transport experienced sustained growth. However, these growths were different based on the type of cargo. The greatest growth was experienced in container transport with a growth rate of 116% during the period from 2000-2008, which was much higher than the total goods transport of 56.3%. The data also show the robustness of the liquid bulk traffic since, during the most severe crisis years (2008-2009), its traffic only decreased by 5.6% while the total goods transport decreased by 14.8% during the 2007-2009 period. In the post-crisis period, the sector has witnessed the consolidation of sea container traffic, the maintenance of the growth rates in liquid bulks and the stabilization of solid bulks, as well as the decrease in road traffic during the 2015-2017 period. The economic crisis has had little influence on container traffic through Spanish ports, highlighting the growing importance of the traffic flows that are favoured by the new configuration of international markets and the strategic decisions of large shipping companies, although the latter was more visible for the ports along the Mediterranean coastline (Fig. 3).

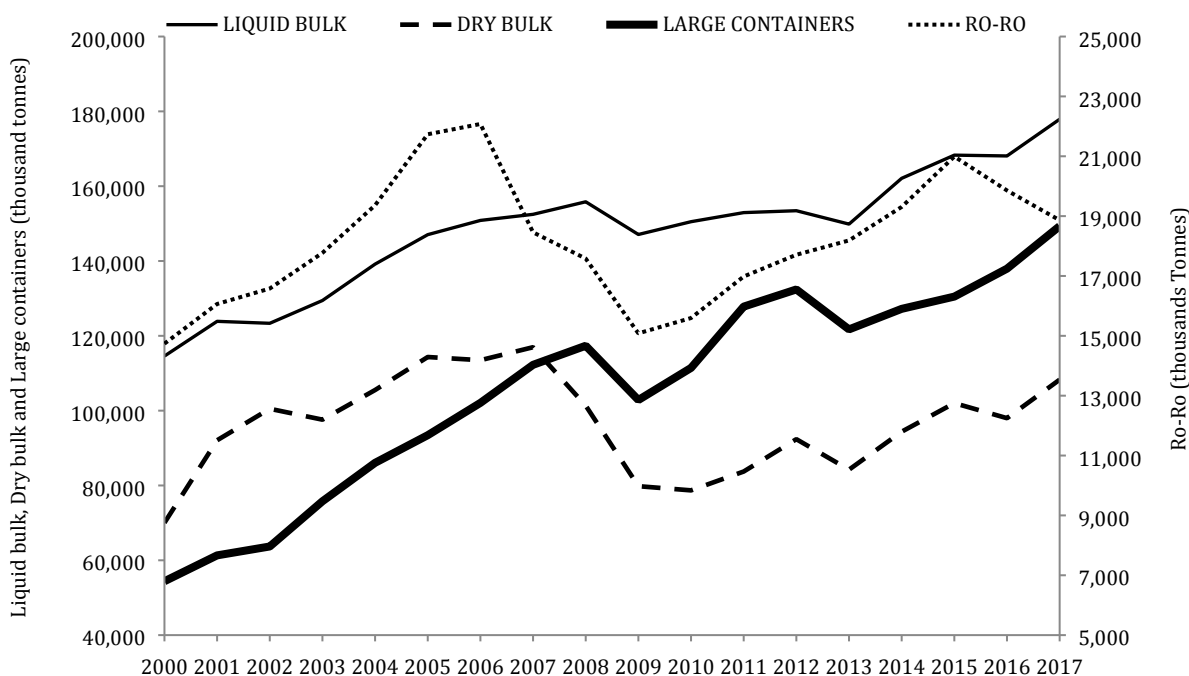


Fig. 3. Gross weight of the goods that were handled in Spanish ports by type of cargo (thousand tonnes), 2000-2017.
Source: Eurostat

According to Spanish Shipowners' Association (ANAVE), Table 1 shows the different modalities of the Spanish flagged merchant fleet.

Table 1. Spanish flagged merchant fleet in 1st April 2020 (by different modalities)

Type	Vessels	Gross tonnage (GT)	Deadweight tonnage (DWT)
Asphalt tanker	1	5,662	7,066
Passage	50	466,633	101,440
Cement tankers	2	12,575	17,359
Reefer containers	3	14,087	14,579
General cargo	14	62,728	90,717
Transport of liquefied gases	16	1,559,019	1,270,538
Roll-on/Roll-off	11	166,787	68,221
Oil tankers	10	44,244	67,271
Chemical vessels	4	41,119	59,892
Total	111	2,372,854	1,697,083

In relative terms, approximately 10% of the maritime freight transport is national, 20% is intra-community and 70% is extra-community. The port with most freight traffic in 2019 was Algeciras (104.8 million tonnes), which was followed by the ports of Valencia (80.8 million), Barcelona (65.9 million), Bilbao (35.4 million), Cartagena (34.4 million), Huelva (33.9 million) and Tarragona (32.7 million), with the first three port authorities accounting for 45% of the total traffic (Fig. 4).

There is significant heterogeneity between ports. In fact, some Spanish ports have specialized terminals where ownership and management are of foreign capital, while other ports are highly specialized in very specific market areas. In this sense, some ports have modified their levels of specialization to respond to new international trade flows and meet the demands of companies in their hinterland. Thus, the greater specialization of maritime flows requires the presence of appropriate facilities that allow adaptation to changes in the international maritime system (González-Laxe and Novo-Corti, 2016).

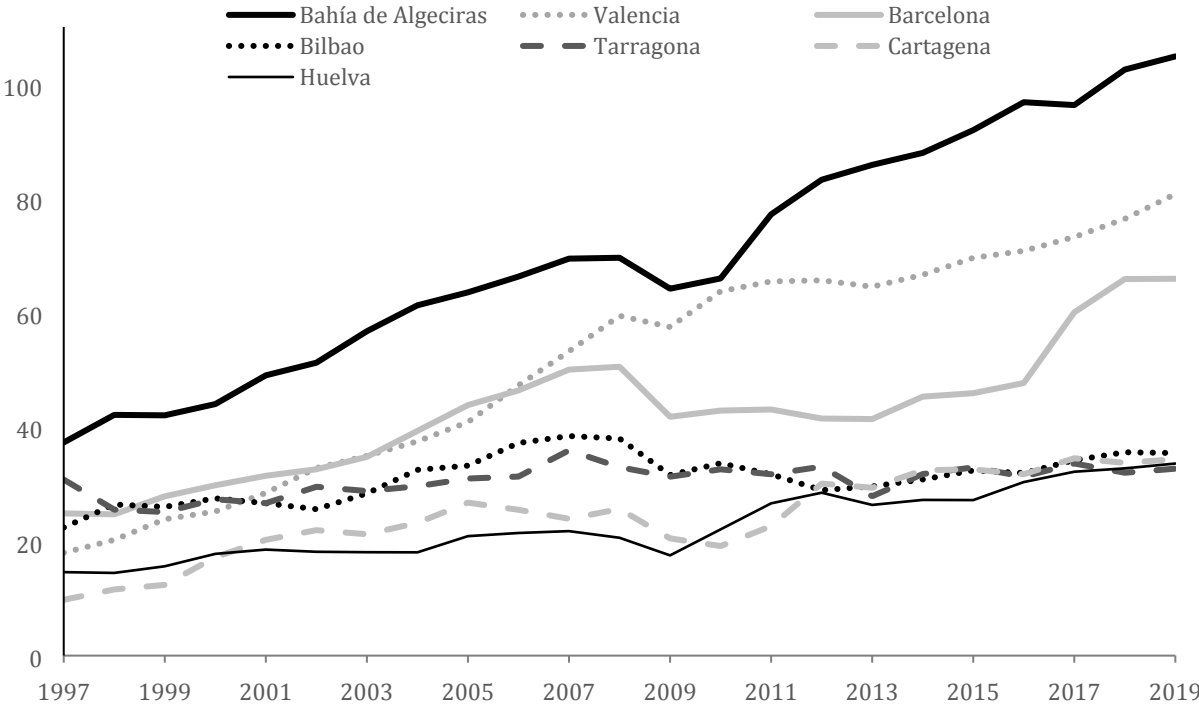


Fig. 4. Freight traffic in the main Spanish ports (millions tonnes), 1997-2019
 Source: Ministerio de Fomento

The main characteristics of the maritime transport in Spain can be summarized by the dominance of containerized transport, the increase of the average maritime transport vessel's size, new transport routes, strengthened shipping alliances for the purpose of covering considerably more ports with a minimum number of vessels, and the increasing pressure on shipping companies by terminal operators to achieve a tariff

reduction given the low profit margins, among others³. Figure 5 shows that the average size of vessels calling in the main Spain ports increased by 174.9%, 169.9%, 112.2% and 54.4% during the period from 2000-2008 in in container ship, specialised carrier, dry bulk carrier and liquid bulk tanker, respectively.

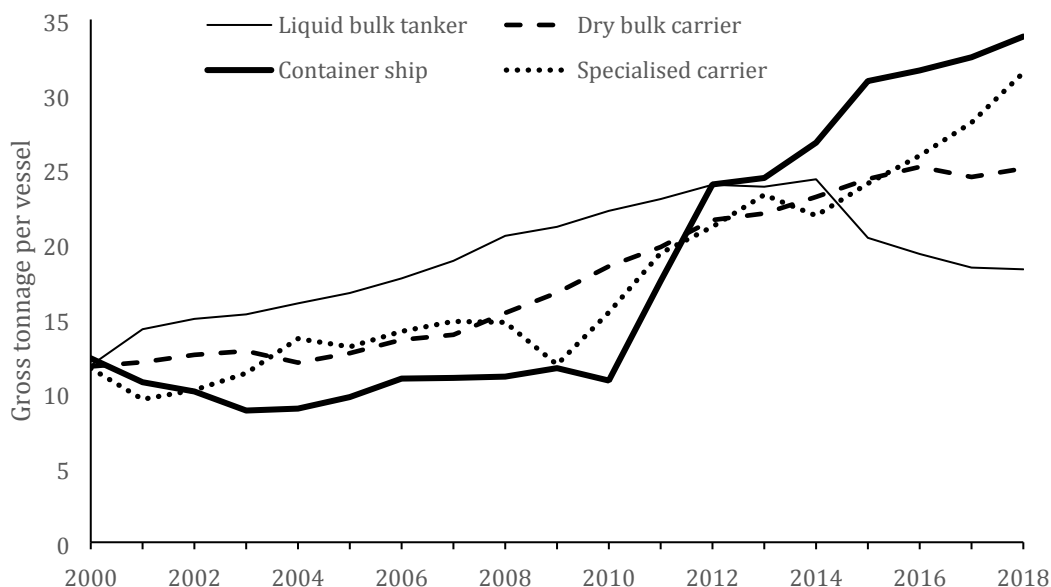


Fig. 5. Average size of vessels (gross tonnage per vessel), 2000-2018
Source: Eurostat

3. Methods and materials

3.1. Data Collection

We have selected all the Spanish maritime goods transport companies from a large sample of firms included in the SABI database and resulting into 142 shipping lines. This database is generated by INFORMA and Bureaus van Dijk and provides internationalization information and company features, as well as very detailed balance sheet information for around 1.25 million Spanish companies and more than 500.000 Portuguese enterprises.

The time (in days) until the exit from the shipping industry takes place is the variable of interest within this research. That is, the period of time between the entry and the exit (complete observations) of a shipping line in the industry or until the end of the study, which is December 2016 (right-censored observation). In the latter case, it means that the shipping line stays operative after the end of the experiment.

³ Alliances have become a dominant feature of container shipping (IFT, 2018).

Therefore, in our case the survival time is the length of time that a shipping company operates actively within the maritime transport sector. In the case of a complete observation the survival time is the period of time between the entry and the exit while in the case of a right-censored observation the survival time finishes at the end of the research.

A short overview of the variables used in the research is included in Table 2. The dummy variable *LEGALSTATUSDUM* equals (1) if the legal condition of the shipping enterprise is not a Public limited company and (0) otherwise. Articles and studies on the subject show diverse results. According to Stiglitz and Weiss (1981), entrepreneurs within limited liability companies are more prone to start projects with fairly higher expected return of investment (ROI) but also with higher failure risks. Nevertheless, after analysing a sample of Portuguese companies, Mata and Portugal (2002) concluded that firms with legal structures other than limited liability had higher probability of existing. In our case, we observed that 35.92% of the shipping enterprises are Public limited company and 64.08% are limited companies.

The analysis includes the variable *TYPECARGODUM* to detect the existence of differences in survival according to the type of main merchandise of the company. In fact, as was previously seen, the types of merchandise that recently experienced the smallest reductions because of the economic and financial crisis were liquid bulks, containers and rolled merchandise, and the transport of solid bulk merchandise experienced the greatest descent. In our case, 17.61% are liquid bulk companies, 3.52% are Ro-Ro firms, 19.01% are containers and 59.86% are dry bulk companies.

Table 2. Description of the variables

Variable	Description
<i>LEGALSTATUSDUM</i>	=1 if the legal condition of the shipping company is not a public limited corporation, and =0 if the legal status of the shipping company is a public limited firm
<i>TYPECARGODUM</i>	=1 if the type of cargo of the firm is dry bulk, and =0 if the type of cargo is liquid bulk, Ro-Ro or containers
<i>SIZEDUM</i>	=1 if the firm is micro or small, and =0 if the firm is medium or large
<i>AIDDUM</i>	=1 if the shipping firm did not receive aid, and =0 otherwise
<i>EXPIMPDUM</i>	=1 if the firm does not have export/import activity, and =0 otherwise
<i>ROADUM</i>	=1 if the economic profitability of the firm is below than the median value of the firms that were analysed, and the 50th percentile = 0.59%. We estimate that using the return on assets (%) =profit (loss) for period/total assets)*100. The variable =0 if the economic profitability of the company is positive, which means that the its economic profitability is greater than the median value.
<i>SOLRDUM1</i>	=1 if the short-term solvency ratio (or current ratio) of the company is less than one. We estimate it with this formula: current assents/ current liabilities. Otherwise, =0
<i>SOLRDUM2</i>	=1 if the short-term solvency ratio (or current ratio) is higher than two; and otherwise, =0

<i>COLLECTIONDUM</i>	= 1 if the average collection period of the firm is greater than three months or 99 days (75 th percentile), and = 0 otherwise
<i>CREDITDUM</i>	= 1 if the average credit period of the firm is less than 58 days (75 th percentile), and = 0 otherwise
<i>COLLECREDITDUM</i>	=1 if the collection period is less than or equal to the credit period, and =0 otherwise

The size of the company (*SIZEDUM*) has been a factor that traditionally influences the company's survival probability in the market (Jovanovic, 1982; Evans, 1987; Dunne et al., 1989; Dunne and Hughes, 1994; Audretsch and Mahmood, 1995). Thus, *SIZEDUM* is measured using the total assets of the firm. The alliances among shipping companies allow firms to effectively share the costs of bigger vessels and to organize services differently. In fact, 67.2% are micro or small firms and 32.8% are medium or large companies. Another dummy variable that is included is *AIDDUM*, through which we incorporate information on whether the company has received any type of subsidy or public aid, whether it is for the acquisition of fixed assets, employee training or the promotion of employment, among others. We anticipate that a company that receives any type of subsidy or public aid will remain in the activity longer.

Therefore, we have also considered the variable *EXPIMPDUM* to study the influence of internationalization on the shipping lines survival. As a matter of fact, companies can increase their incomes by developing internationalization strategies. Calof and Beamish (1995) and Evers (2010) define Internationalization as “*the process of adapting firms' operations (strategy, structure, resources, etc.) to international environments*”. Nevertheless, only 21.13% of the enterprises that are analysed are involved in import and export activities.

Moreover, the variable *ROADUM*, related to the return on assets, has also been considered when conducting this analysis, as it measures the companies' ability of generating revenue. That is, the efficiency of companies to manage their assets in order to generate income. Thus, companies are expected to reach their highest level of profitability and those with lower returns on assets are more likely to cease their shipping activity and search for business opportunities within other sectors (Cordón and García, 2018).

An additional variable used in the model is the solvency or current ratio (*SOLRDUM1* and *SOLRDUM2*), which shows a company's overall financial potential. It is a current ratio that measures a company's ability to pay short-term obligations or those due within one year. Bargaining power with their customers and suppliers (*COLLECTIONDUM*, *CREDITDUM* and *COLLECREDITDUM*) are also considered to study how credit granting policies and collection efforts affects the survival of Spanish firms, which is due to the reduction of cash tensions and the lesser need to finance working capital in the short term.

3.2. Econometric approach

The empirical analysis is carried out using survival analysis, also called event history analysis in other fields like Sociology, duration models in political science or Economics, hazard rate models in Biostatistics or Epidemiology and failure-time models in Engineering. Kiefer (1988), Therneau and Grambsch (2001) and Klein and Moeschberger (2005), among other authors provide complete overviews of the methods used in the survival analysis of economic studies. These methods consider the exit risk evolution and its determinants over time. Thus, survival analysis is suitable for processing censored data to those situations in which the event of interest (the exit of the firm from the activity) has not happened yet, and we the only thing we know is that the firm has survived at least to a certain period t .

The Kaplan–Meier estimator of the survival function $S(t)$ represents the probability of surviving longer than t periods, and is given as follows (Kaplan and Meier, 1958):

$$\hat{S} = \prod_{t_i \leq t} \left(1 - \frac{d_i}{n_i}\right) \tag{1}$$

where n_i is the amount of shipping companies in the risk set at t_i and d_i is the number of companies that have finally exited at t_i , i.e., the number of shipping firms that experienced the event at time t_i . The product is over all observed exit times that are less than or equal to t .

Non-parametric tests comparing two or more censored data distributions are a first step in the estimation, since they allow us to get an initial idea of the individual influence on the duration of each all the relevant covariates. There is a number of non-parametric tests for censored survival data, and the most extended are those of Savage (1956), Mantel-Haenszel (1959), Mantel (1966), Peto (1972), Gehan (1965), Breslow (1970), Prentice (1978) and Tarone and Ware (1977), among others.

Thus, at each distinct exit time t_i , the contribution to the test statistic is obtained as a weighted standardized sum of the difference between the observed and expected number of events in each of the k groups. The expected number of events is obtained under the null hypothesis of no differences between the survival experience of the k groups. Table 3 shows the weights used for each of statistical tests.

Table 3. Non-parametric tests for the equality of the survival functions

Test	Weight at each distinct failure time (t_i)
Log-Rank	1
Wilcoxon-Breslow-Gehan	n_i
Tarone-Ware	$\sqrt{n_i}$
Peto-Peto-Prentice	$\hat{S}(t_i)$
Fleming-Harrington	$\hat{S}(t_{i-1})^p [1 - \hat{S}(t_{i-1})]^q$

where $\hat{S}(t_i)$ is the estimated Kaplan-Meier survivor function value for the combined sample at exit time t_i , $\hat{S}(t_i)$ is a modified estimate of the overall survivor function, and n_i is the number of shipping companies in the risk pool at exit time t_i .

In the Fleming-Harrington test, the two nonnegative arguments p and q allow to give more weights to earlier exits than to later ones ($p > q$) or to give more weights to later

606
607
608 than to earlier times. On the other hand, in the case of p and q are both zero, the weight
609 is 1 at all exit times and the test reduces to the log-rank test.

610 In order to study how the explanatory variables affect the exit hazard of a company,
611 we use a semiparametric Cox proportional hazards model (Cox, 1972; 1975) in which
612 the hazard function of a company i is the following:⁴
613

$$614 \quad h(t, x_i) = h_0(t)e^{\beta x_i} \quad (2)$$

615
616
617 where $h(t, x_i)$ represents the companies' exit rate at a time t , and $h_0(t)$ is the baseline
618 hazard and represents the hazard when all covariates are equal to zero. This baseline
619 hazard is both an arbitrary and positive function of time, x is a vector of covariates that
620 influences the survival rate of companies, and β is the coefficient's vector that we must
621 estimate⁵.

622 Since this is a semiparametric model, weak assumptions related to the hazard function
623 form are made. However, the proportional hazard assumption needs to be considered
624 because it requires the hazard ratio to keep constant over time or, equivalently, that
625 the hazard for one company is proportional to the hazard for any other company. To
626 check out this proportionality we can use the test by Grambsch and Therneau (1994)
627 In order to interpret the estimates, we need to take into account that risk ratios that are
628 less (higher) than one imply a decrease (increase) of the hazard rate and an increase
629 (decrease) of the corresponding survival probability, ceteris paribus. In the case of a
630 dummy variable covariate, the hazard ratio can be interpreted as the increase in the
631 company's overall hazard rate when the value of this dummy variable equals 1 and the
632 rest of the variables are kept constant.

633 We can evaluate the overall adequacy of this model through Cox-Snell residuals (Cox
634 and Snell, 1968; Collett, 1994) given by the following formula:
635

$$636 \quad r_{C_i} = e^{\beta x_i} \hat{H}_0(t_i) \quad (3)$$

637
638 where the $\hat{H}_0(t_i)$ is the estimated cumulative baseline hazard function.

639 Thus, if the Cox regression model fits the data properly, the cumulative hazard function
640 conditional on the covariate vector has an exponential distribution with a hazard rate
641 of one.
642

643 644 645 646 **4. Results**

647
648 In this section, we have included the most relevant findings of the Cox proportional
649 hazard model. We have analysed in continuous time data from 142 shipping lines, so
650

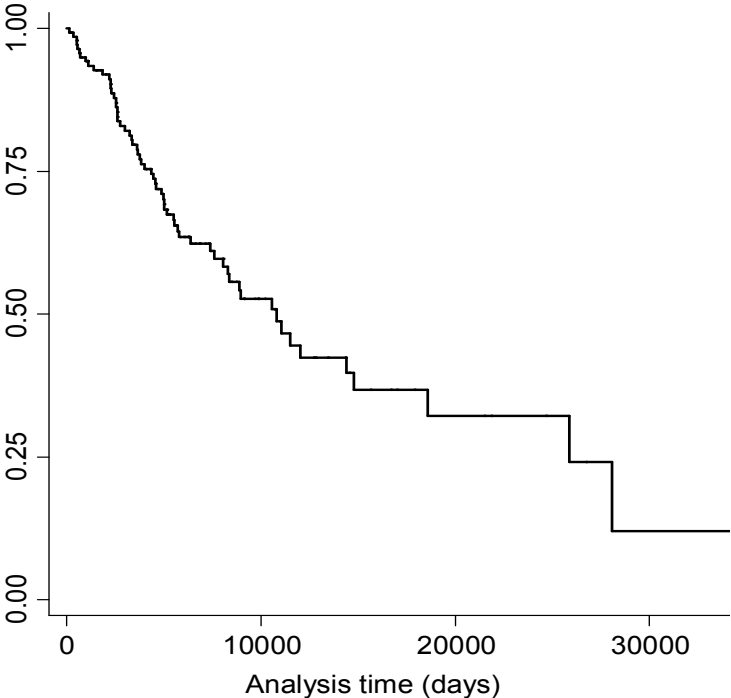
651
652
653 ⁴ Under the partial likelihood framework of Breslow (1974), we have used the Cox proportional model
654 and parameter estimation.

655 ⁵ The Cox model cannot be considered a fully parametric model since it does not specify the form of
656 $h_0(t)$.
657

661 there have been both censored and complete intervals. The dependent variable of
662 interest has been the time elapsed until companies exited the shipping activity.
663 Using the non-parametric and semi-parametric techniques for duration models, we
664 estimate the influence of certain variables on the survival of the shipping firms.
665
666
667

668
669 **4.1. Non-parametric techniques**

670 In Figs. 6 and 7, the survival curves were drawn using Kaplan-Meier estimator method.
671 As noted in Fig. 6, the survival function shows a positive relation between the survival
672 rates and how old the company is due to the greater experience and knowledge they
673 gain on their efficiency and competitiveness (Jovanovic, 1982, Evans, 1987, Hall,
674 1987, Audretsch and Mahmood, 1995, Dunne et al., 1989, Wagner, 1994, Geroski,
675 1995, Clementi and Hopenhayn, 2006). Thus, in the first 1000 days, the survival rate
676 falls more sharply than it does afterwards.
677



678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700 **Fig. 5.** Survival curves that were obtained from the Kaplan-Meier estimator
701 for the Spanish shipping lines
702

703 When we analyse the effects of the type of cargo that is transported by shipping lines
704 on the survival, we notice that the patterns are different. Fig. 7 shows that the function
705 representing the survival rates of companies other than liquid bulk is below the function
706 for this kind of shipping company. This result is a consequence of the strength of the
707 liquid bulk maritime transport sector with respect to the others. In fact, without
708 considering the movement of goods in transit, during the last years, the maritime traffic
709 of liquid bulks in Spain has exhibited the highest growth rates, which has been driven
710 by the activity of the ports of Algeciras, Cartagena, Huelva, Tarragona, Bilbao and,
711

Barcelona, among others, and by a consolidated petrochemical industry. This sustained growth is promoting the creation of new liquid bulk berths that will be operational starting in 2019.

Container and Ro-Ro firms exhibit similar behaviours in terms of their survival and are not too far from the survival patterns of liquid bulk companies, which are driven by the activity of the ports of Valencia, Algeciras and Barcelona, among others. With respect to the lower survival, it is observed that the economic and financial crisis has significantly affected solid bulk companies.

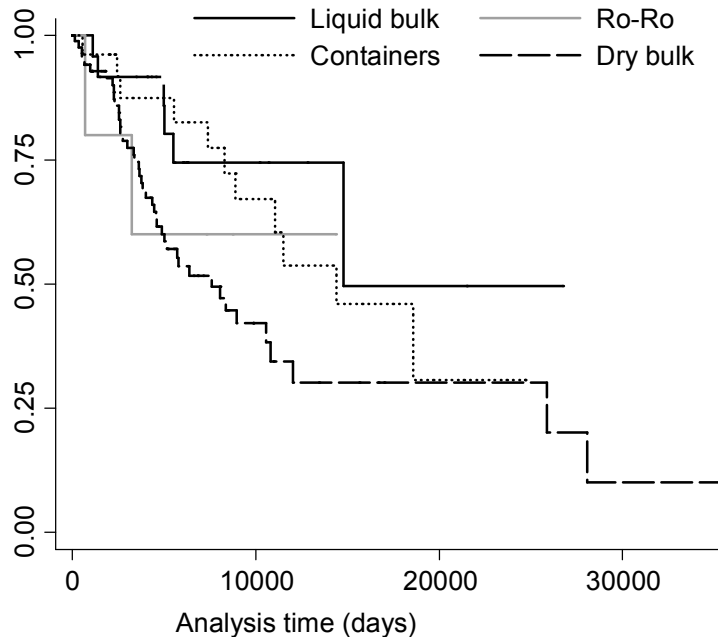


Fig. 7. Survival curves that were obtained from the Kaplan-Meier estimator according to the main type of cargo that was transported by the shipping lines

The results reported in Table 4, clearly show significant differences in the survival between groups for each of the variables. Therefore, these results allow the rejection of the hypothesis that the survivor functions are identical.

Table 4. Non-parametric tests for the equality of the survival functions (by explanatory variables)

Variable	Log-Rank	Wilcoxon-Breslow-Gehan	Tarone-Ware	Peto-Peto-Prentice	Fleming-Harrington (p=3, q=0)
<i>LEGALSTATUSDUM</i>	9.41 (0.002)	9.87 (0.002)	4.76 (0.002)	10.02 (0.001)	10.03 (0.001)
<i>TYPECARGODUM</i>	6.70 (0.009)	7.03 (0.008)	7.46 (0.006)	7.27 (0.007)	6.10 (0.013)
<i>SIZEDUM</i>	14.07 (0.000)	12.82 (0.000)	13.86 (0.000)	13.85 (0.000)	12.03 (0.000)
<i>AIDDUM</i>	16.87 (0.000)	14.11 (0.000)	15.83 (0.000)	15.98 (0.000)	12.55 (0.000)
<i>EXPIMPDPUM</i>	6.65 (0.010)	7.81 (0.005)	7.63 (0.006)	7.45 (0.006)	7.69 (0.006)

771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825

<i>ROADUM</i>	8.39 (0.004)	6.95 (0.008)	8.21 (0.004)	7.94 (0.005)	6.38 (0.023)
<i>SOLRDUM</i>	6.77 (0.034)	2.73 (0.256)	4.07 (0.131)	4.42 (0.110)	2.37 (0.306)
<i>COLLECTIONDUM</i>	10.80 (0.001)	8.07 (0.004)	9.57 (0.002)	9.60 (0.002)	6.58 (0.010)
<i>COLLECREDITDUM</i>	13.96 (0.000)	7.46 (0.006)	10.08 (0.001)	10.03 (0.001)	4.97 (0.026)

Table 5 shows the average, 25th percentile, median, and 75th percentile survival times. For some variables, some percentiles are not shown because there is right-censored data. Furthermore, the average survival times are very different for some of the variables analysed, such as the legal condition of the shipping firm, the company size, the effect of international activity, the receipt of any type of subsidy or public aid, a firm's overall financial strength, and the bargaining power of the shipping lines with their customers and suppliers.

Table 5. Descriptive statistics of the sample (shipping firms): Average survival times, 25th percentile, 50th percentile and 75th percentile

Variables	Average Time	25th Percentile	50th Percentile	75th Percentile
<i>LEGALSTATUSDUM</i>				
0-Public limited company	19,739	7,375	14,791	28,059
1-Otherwise	8,056	3,227	7,582	10,805
<i>TYPECARGODUM</i>				
0-Liquid bulk, Ro-Ro and containers	15,876	7,375	14,791	
1- Otherwise	13,739	3,381	7,582	25,866
<i>SIZEDUM</i>				
0-Medium or large	22,987	11,034	18,576	28,059
1-Micro or small	11,206	3,381	7,582	25,866
<i>AIDDUM</i>				
0-Received	21,865			
1-Did not receive	13,157	3,614	8,050	18,576
<i>EXPIMPDUM</i>				
0-Yes	24,952	10,563	18,576	45,868
1-No	12,575	3,614	8,280	25,866
<i>ROADUM</i>				
0-Greater	15,393	8,347	14,385	
1-Lower	12,537	3,381	5,781	18,576
<i>SOLRDUM1</i>				
<i>SOLRDUM2</i>				
Less than 1	10,906	3,331	7,582	14,791
Between 1 and 2	29,771	4,601	45,868	45,868
Greater than 2	10,690	5,506		
<i>COLLECTIONDUM</i>				
0-Less than 3 months	17,025	7,582	14,791	
1-Greater than 3 months	11,420	3,381	5,781	14,385

<i>COLLECREDITDUM</i>	20,218	5,781	14,385	28,059
0-Collection period is greater than the credit period				
1- Collection period less or equal to the credit period	7,849	3,633	5,506	10,563

4.2. Semi-parametric techniques

The Kaplan-Meier estimator survival analysis enabled us to perform an initial assessment of Spanish shipping firms, and the Cox model or semi-parametric regression model of the proportional hazards allowed us to simultaneously analyse the influence of the independent variables on the companies' duration.

We are working in continuous time, so there are both censored and complete intervals. The dependent variable of interest is the time that elapses until an event takes place. This event for us is the moment when shipping companies cease their activity.

Table 6 presents the results of the Cox regression model, in which the coefficient estimates show the impact of a certain independent covariate on the hazard rate. Therefore, positive values imply higher hazards and correspondingly shorter durations. In fact, a hazard rate higher than 1 means that the covariate increases the company's exit hazard and a hazard rate under 1, the opposite. Hazard rates provides the ratio of the initial hazard rate to the new hazard rate when the latter is computed allowing a one unit increase of the independent variable.

Table 6.
Proportional hazards model estimation

Variable	Coefficient	Std Error	Hazard Rate	Std Error	P-Values
<i>LEGALSTATUSDUM</i>	1.106***	0.329	3.022	0.994	0.001
<i>TYPECARGODUM</i>	0.543**	0.288	1.721	0.495	0.059
<i>ROADUM</i>	0.608*	0.315	1.837	0.579	0.054
<i>SOLRDUM1</i>	0.739**	0.372	2.094	0.779	0.047
<i>SOLRDUM2</i>	0.022	0.443	1,022	0.452	0.961
<i>COLLECTIONDUM</i>	0.641**	0.283	1.899	0.537	0.023
<i>COLLECREDITDUM</i>	0.628**	0.280	1.873	0.524	0.025

Note. (*), (**), and (***): significant at the 10%, 5% and 1% level, respectively.

Log-likelihood -234.729

We have obtained statistically significant positive results for those variables related to the legal structure (*LEGALSTATUSDUM*), the type of cargo (*TYPECARGODUM*), the return on assets (*ROADUM*), the solvency ratios (*SOLRDUM1* and *SOLRDUM2*), and the bargaining power of the companies with their customers and suppliers (*COLLECTIONDUM* and *COLLECREDITDUM*). There are no significant interactions between the independent covariates.

To include a variable in the model we have followed a criterion of stepwise selection. Regarding the legal structure of companies, we found that having other factors under control, limited companies less exit probabilities than others with different legal structures. Thus, we observe that those firms whose legal form (*LEGALSTATUSDUM*) is not a limited company experienced an exit hazard that was 3 times higher than those whose legal form is a limited company. This result is compatible with the weaknesses

of other generally less well capitalized company forms and with greater barriers to attract financial resources.

Additionally, the main type of cargo had a significant influence on the survival times of shipping firms. The analysis reveals that dry bulk firms experienced an exit hazard 1.7 times higher than liquid bulk, Ro-Ro and container firms.

The results for the variable economic profitability of the firm (*ROADUM*) indicate that the exit hazard is around 1.8 times higher for companies whose economic profitability is below the median value of the analysed firms, i.e., lower than 0.59%

With regard to short-term solvency ratio (*SOLRDUM1* and *SOLRDUM2*), the exit hazard is approximately 2.1 times greater for companies with a solvency ratio lower than 1 than for those with a solvency ratio between 1 and 2.

Moreover, the difficulty in the access to credit in recent years influences the relevance of the efficient management of collections to clients and payments to suppliers by firms (*COLLECTION* and *COLLECREDITDUM*). We anticipated this result and, consequently companies whose average payment period exceeds 3 months experience an exit risk that is almost 1.9 times higher than those with an average collection period of less than 3 months. It is evident that those companies whose average period of payment is higher than the average credit period with suppliers will have greater pressure on their cash reserves, given their 1.9 times higher risk. Therefore, the estimated model shows the strength in terms of the survival of the companies that manage to negotiate better collection and payment conditions with customers and suppliers.

In order to evaluate the significance of all coefficients we have used both the Wald and the partial likelihood ratio tests. We have used log-log plots to visually assess the proportional hazard assumption for each variable. In addition, Schoenfeld residuals have been used to analytically test the assumption. These residuals are based on a non-zero slope test for a generalized linear regression of them as a time function. This assessment is the same as testing the proportional hazards assumption, that is that the log hazard ratio function remains constant over time. Hence, since we are rejecting the null hypothesis of a zero slope, there is a deviation from the proportional hazards assumption (Grambsch and Therneau, 1994). Table 7 shows these results and no evidence of a violation of the proportional hazards assumption.

Table 7.
Results of the proportional hazards tests

Variable	Estimated P	χ^2 Statistic	G.L.	P-Value
<i>LEGALSTATUSDUM</i>	-0.048	0.16	1	0.687
<i>TYPECARGODUM</i>	-0.129	1.09	1	0.297
<i>ROADUM</i>	0.069	0.34	1	0.561
<i>SOLRDUM1</i>	0.143	1.34	1	0.247
<i>SOLRDUM2</i>	0.111	0.85	1	0.358
<i>COLLECTION</i>	0.076	0.40	1	0.530
<i>COLLECREDITDUM</i>	0.115	0.89	1	0.346
Test Global		6.13	7	0.525

To evaluate the overall fit of the model the Cox-Snell residual plot for the Cox proportional has proven to be very effective. The plot of the accumulated hazard versus Cox-Snell residuals should have an exponential distribution if the model fits the data correctly, that is it should a straight line with a 1 slope. Figure 8 shows that the Cox model fits the data reasonably.

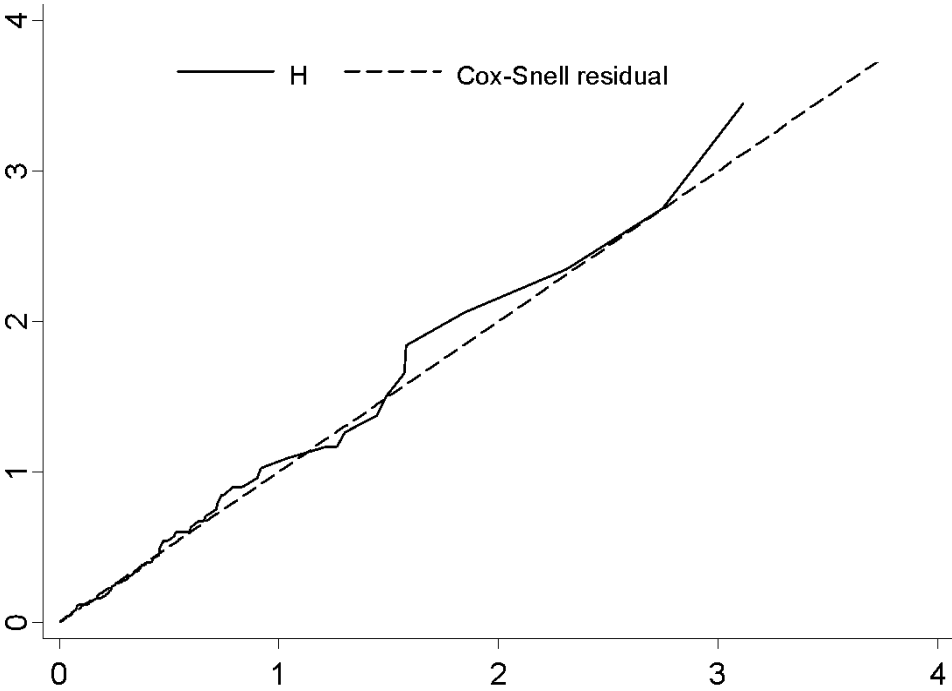


Fig. 8. Cox-Snell residual plot for the Cox model

5. Conclusions

Although the dominant position of the world maritime transport compared to other forms of transport is evident (Jessen and Jürgen, 2016), some challenges lie ahead for shipping and international maritime trade.

The growing uncertainties in the international geopolitical panorama are generating deep tensions in supply and demand. As a result, a dangerous competitive race is being generated in the markets, jeopardizing the profitability of companies in the sector.

Sustainable maritime transport needs a sound financial system to support its requirements for the efficient long-term allocation of resources to advance the three pillars of sustainable growth: economy, society and environment. If any one pillar is

991
992
993 weak then the system as a whole is unsustainable. Conciliating economic growth,
994 social well-being and environmental sustainability has become increasingly
995 problematic. In the fact, the gap between these three poles is increasing.

996 This paper empirically analyses some challenges related to economic aspects of
997 Spanish maritime goods transport firms. Specifically, this research is focused on the
998 economic aspects and evaluates the factors influencing the survival of Spanish
999 shipping firms.

1000
1001 In order to conduct the empirical analysis, we have used non-parametric and semi-
1002 parametric survival analysis techniques. The results and conclusions of this research
1003 contribute to better understand the factors affecting companies' survival and have
1004 relevant political implications. However, since shipping is business, the economic
1005 viability of companies should be at the core of any focus on sustainability,
1006 environmental consideration and integrated system.

1007 Interest in the use of sea waters has begun to grow recently with the emergence of the
1008 'blue growth' concept. Until then there is hardly any research on the subject, in spite of
1009 its socio-economic relevance.

1010 For the studied case firms, this research shows the positive relation between the
1011 survival rates and the age of the firms, which is due to the broad experience and
1012 knowledge they gain on their efficiency and market competitiveness. It is the large
1013 shipping companies, with high experience in the sector, who are the protagonists of
1014 the generation of alliances that dominate the market and influence the configuration of
1015 the ports analysed. Furthermore, alliances have become a dominant feature of
1016 container shipping.

1017 To sum up, this study also suggests that the firms whose main type of transport is the
1018 liquid bulk, roll-on/roll-off good or container transport have better survival prospects. In
1019 the fact, the ports that have a nearby refinery are those that demand high volumes of
1020 liquid bulk traffic. Moreover, ports and shipping companies highlight the importance of
1021 investing in rail infrastructure, such as that of the Atlantic and Mediterranean Corridors,
1022 which is essential to connecting the Iberian Peninsula with the rest of Europe.

1023 In fact, there are certain aspects of the economic environment and the international
1024 situation that act as conditioning factors for the survival of the companies analysed.

1025 Furthermore, our results also indicate that the legal conditions of the shipping lines
1026 confer greater advantages to public limited companies in comparison with other
1027 corporate forms. Moreover, it confirms the results from the previous literature that
1028 concluded that firms with legal structures other than limited liability had higher
1029 probability of existing (Mata and Portugal, 2002). This result might be because this
1030 type of firm projects a good image to the outside. Additionally, the European Union's
1031 subsidy policy has for years on end supported big businesses and limited companies
1032 to the detriment of small and medium-sized companies, so that the latter have been
1033 driven out of the market.

1034 Despite the importance of internationalization since it can bring companies new
1035 sources of revenue, only 21.13% of the analysed firms are involved in import and
1036 export activities. However, internationalization has proven not to be a relevant factor
1037 for the survival of shipping lines, since it did not significantly contribute to the model.

1038 This study also reveals that the financial strength of the shipping lines and their
1039 negotiation power with their suppliers have significant influences on their survival. In
1040

1046
1047
1048 fact, the difficulty in the access to credit in recent years influences the relevance of the
1049 efficient management of collections from clients and payments to suppliers by the
1050 firms.

1051 Furthermore, there are certain aspects of the economic environment and the
1052 international situation that act as conditioning factors for the survival of the companies
1053 analysed.

1054 Finally, it is important to note that survival analysis is very useful to understand the
1055 decisions made by shipping lines to stay in the market. This study and the conclusions
1056 derived from it have helped us to have a deeper knowledge of the maritime transport
1057 sector.
1058
1059
1060

1061 REFERENCES

- 1062
1063
1064 Allison, P. D. (1995): Survival Analysis using the SAS system: A practical guide, USA:
1065 SAS Institute.
- 1066 Audretsch, D.B. (1995): Innovation, Growth and Survival, *International Journal of*
1067 *Industrial Organization*, 13 (4), 441-457.
- 1068 Audretsch, D.B.; Mahmood, T. (1995): New firm survival: new results using a hazard
1069 function. *Review of Economics and Statistics*, 77, 97-103.
- 1070 Breslow, N. E. (1970): Generalized Kruskal-Wallis Test for comparing k samples
1071 subject to unequal patterns of censorship, *Biometrika*, 57, 579-594.
- 1072 Breslow, N.E. (1974): Covariance analysis of censored survival data. *Biometrics*, 30,
1073 89-99.
- 1074 Calof, J.L.; Beamish, P.W. (1995): Adapting to foreign markets: explaining
1075 internationalization. *International Business Review*, 4 (2), 115–131.
- 1076 Clementi, G.L.; Hopenhayn, H. (2006): A Theory of Financing Constraints and Firm
1077 Dynamics. *Quarterly Journal of Economics*, 121(1), 229-265.
- 1078 Collett, D. (1994): *Modelling Survival Data in Medical Research*. Chapman & Hall,
1079 London.
- 1080 Cordon, E.; García Ordaz, F.; García del Hoyo, J.J. (2018): Innovation, environmental
1081 commitment, internationalization and sustainability: A survival analysis of
1082 Spanish marine aquaculture firms. *Ocean & Coastal Management* 151, 61-68.
- 1083 Cox, D.R. (1972): Regression Model and Life-Tables. *Journal of Royal Statistical*
1084 *Society, Series B* 34, 187-220.
- 1085 Cox, D.R. (1975): Partial likelihood. *Biometrika*, 62, 269-276.
- 1086 Cox, D.R.; Snell, E.J. (1968): A general definition of residuals. *Journal of Royal*
1087 *Statistical Society*, 30, 248-275.
- 1088 Dunne, T.; Roberts, M.J.; Samuelson, L. (1989): The Growth and Failure of U.S.
1089 Manufacturing Plants. *Quarterly Journal of Economics*, 104, 671-698.
- 1090 Dragomir, L. (2011): *Vertical and horizontal integration in the maritime industry*.
1091 Erasmus University of Rotterdam (these doctoral).
- 1092 EC (2012). *Communication from the Commission to the European Parliament, the*
1093 *Council, the European Economic and Social Committee and the Committee of*
1094
1095
1096
1097
1098
1099
1100

- 1101 the Regions - Blue Growth opportunities for marine and maritime sustainable
1102 growth.
- 1103 Ecorys, 2012. Blue Growth. Scenarios and drivers for Sustainable. Growth from the
1104 Oceans, Seas and Coasts. Third Interim Report..
- 1105 Eurostat. Eurostat database. Available at:<
1106 <https://ec.europa.eu/eurostat/data/database/>>[Accessed 20 May 2020].
- 1107 Evans, D.S. (1987): The Relationship between Firm Growth, Size and Age: Estimates
1108 from 100 Manufacturing Industries. *Journal of Industrial Economics*, 35 (4), 567-
1109 581.
- 1110 Frémont, A. (2009): Empirical Evidence for Integration and Disintegration of Maritime
1111 Shipping, Port and Logistics Activities. OECD/ITF Discussion Paper2009-1.
- 1112 Gehan, E. (1965): A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-
1113 Censored Samples. *Biometrika*, 52, 203-223.
- 1114 González-Laxe, F.; Novo-Corti, I. (2016): Concentración, Especialización y Liderazgo
1115 de los Puertos Españoles. *Análisis de los Efectos de la Crisis Económica.*
1116 *Investigaciones Regionales-Journal of Regional Research*. Vol. 35.
- 1117 Grambsch, P.M.; Therneau, T.M. (1994): Proportional hazards tests and diagnostics
1118 based on weighted residuals. *Biometrika*, 81, 515-526.
- 1119 Grant, D. B.; Elliott, M. (2018): A proposed interdisciplinary framework for the
1120 environmental management of water and air-borne emissions in maritime
1121 logistics, *Ocean and Coastal Management* 163, 162-172.
- 1122 Hall, B. H. (1987): The relationship between Firm Size and Firm Growth in the US
1123 Manufacturing Sector. *Journal of Industrial Economics*, 35, 583-605.
- 1124 Hosmer, D. W.; Lemeshow, S. (2003): *Applied Survival Analysis: Regression Modeling*
1125 *of Time to Event Data*. Wiley, New York.
- 1126 IFT (2018): *The Impact of Alliances in Container Shipping*. International Transport
1127 Forum Policy Papers 62, OECD Publishing,
1128 Paris, <https://doi.org/10.1787/61e65d38-en>.
- 1129 Jessen, H. and Jürgen, M. (2016). *EU Maritime Transport Law*. Nomos/Hart.
- 1130 Jovanovic, B. (1982): Selection and the Evolution of Industry. *Econometrica*, 50, 649-
1131 670.
- 1132 Kaplan, E. L.; Meier, P. (1958): Nonparametric estimation from incomplete
1133 observations, *Journal of American Statistical Association*, 53, pp. 457-481.
- 1134 Kiefer, N. M. (1988): Economic Duration Data and Hazard Functions, *Journal of*
1135 *Economic Literature*, 6, 646–670.
- 1136 Kildow, J.T., McIlgorm, A. (2010): The importance of estimating the contribution of the
1137 oceans to national economies. *Marine Policy* 34, 367–374.
- 1138 Klein, J.P.; Moeschberger, M.L. (2005): *Survival Analysis: Techniques for Censored*
1139 *and Truncated Data*. Springer Verlag, New York.
- 1140 Kleinbaum, D.G.; Klein, M. (2005): *Survival Analysis: A Self-Learning Text*. Springer,
1141 New York.
- 1142 Kronfeld-Goharani, U. (2018): Maritime economy: Insights on corporate visions and
1143 strategies towards sustainability, *Ocean and Coastal Management* 165, 126-
1144 140.

- 1156
1157
1158 Mantel, N.; Haenszel, W. (1959): Statistical aspects of the analysis of data from
1159 retrospective studies of disease, *Journal of the National Cancer Institute*, 22 (4),
1160 719-748.
1161 Mata, J.; Portugal, P.; Guimaraes, P., (1995): The Survival of New Plants: Start-up
1162 Conditions and Post-entry Evolution, *International Journal of Industrial*
1163 *Organization*, 13 (4), 459-482.
1164
1165 Niavis, S.; Theodora, P.; Theofilos K.; Harry C. (2017): Revealing the Potential of
1166 Maritime Transport for 'Blue Economy' in the Adriatic-Ionian Region, *Case*
1167 *Studies on Transport Policy* 5 (2), 380–88.
1168 Panigrahi, J.K.; Pradhan, A. (2012): Competitive maritime policies and strategic
1169 dimensions for commercial seaports in India, *Ocean and Coastal Management*
1170 62, 54-67.
1171 Peto, R.; Peto, J. (1972): Asymptotically efficient rank invariant test procedures,
1172 *Journal of the Royal Statistical Society (Series A)*, 135, 185-206.
1173 Prentice, R.L. (1978): Linear rank test with right-censored data, *Biometrika*, 65, 167-
1174 179.
1175 Sislian, L.; Jaegler, A.; Cariou, P. (2016): A literature review on port sustainability and
1176 ocean's carrier network problem, *Research in Transportation Business &*
1177 *Management*, 19, 19-26.
1178 Shulla, K.; Leal Filho, W.; Lardjane, S.; Sommer, J. H.; Salvia, A. L.; Borgemeister, C.
1179 (2019). The contribution of Regional Centers of Expertise for the implementation
1180 of the 2030 Agenda for Sustainable Development. *Journal of Cleaner*
1181 *Production*, 237, 117809. Tarone, R.E.; Ware, J. H. (1977): On distribution-free
1182 tests for equality of survival distributions. *Biometrika*, 64, 156-160.
1183 Therneau, T.M.; Grambsch, P.M. (2001): *Modeling Survival Data: Extending the Cox*
1184 *Model*. Springer Verlag, New York.
1185 Van de Voorde, E., Vanellander, T. (2009): *Market Power and Vertical and Horizontal*
1186 *Integration in the Maritime Shipping and Port Industry*. OECD/ITF Discussion
1187 Paper 2009-2.
1188 Wagner, J. (1994): The Post-Entry Performance of New Small Firms in German
1189 manufacturing Industries. *Journal of Industrial Economics*, 62, 141-154.
1190
1191
1192
1193
1194
1195
1196
1197
1198
1199
1200
1201
1202
1203
1204
1205
1206
1207
1208
1209
1210

Author statement

Encarnación Cordón-Lagares, Félix García Ordaz: Conceived and designed the experiments; Performed the experiments; Analysed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.