PERFORMANCE DRIVERS OF SHIPPING LOANS: AN EMPIRICAL INVESTIGATION

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ABSTRACT

Credit risk is a major issue for lenders and borrowers, threatening the reliability of global logistics operations. Enhanced mechanisms of credit risk analysis are needed to safeguard banks and the flow of goods in supply chains. Little emphasis has been given to the contextual examination of such factors, either in terms of market conditions or the particular characteristics of different industries. This paper investigates the varying importance of a number of factors connected with the performance of corporate bank loans during times of financial turbulence in the shipping industry. Little extant literature exists on default risk drivers for loans made to shipping companies for new build vessels or second-hand ship purchases. A binary logit model is used to examine the criteria for assessing the security of shipping loans issued by banks. Thirty shipping loans made during the period 2005-2009 are examined. Results suggest that financial factors, non-financial factors, shipowners' experience, and employability and market risk indicators are the best criteria for evaluating the performance of shipping loans during turbulent market conditions and periods when financing options are restricted. The paper makes a specific contribution to the literature on risk management with regard to credit risk analysis by highlighting shipping specific factors and their importance for risk measurement. The results are of interest to banks seeking to accurately assess the credibility of shipping loans; shipowners, who can identify credit risk factors on which to focus; and supply chain participants where unfulfilled bank financing can cause disruptions to their logistics operations.

Key Words: Credit risk, Shipping Loans, Performance Drivers, Binary Logit Model

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1. INTRODUCTION

This paper examines the role of certain determinants of shipping bank loan performance, seeking to address the issue of credit risk and the probability of default of bank loans in the shipping industry. The default of shipping bank loans can have wider repercussions for global logistics operations affecting supply chain reliability by, for example, potential disruptions of planned shipments in specific logistic routes. Credit risk is a major issue that banks have to confront and it can be controlled through efficient credit analysis, appropriate structuring of loans and continuous monitoring throughout its duration. At times of crisis financial practices to mitigate the effects of the risk of default acquire greater significance. A wider literature on default risk for corporate credit loans has recognised the importance of a number of factors such as information asymmetry, the financial structure of firm's, market conditions and sectoral idiosyncrasies (Bonfim, 2009). The inter-dependability of industries in global supply chains increases the importance of investigating the risk issues of shipping loan defaults. Although the analysis and evaluation of the performance of bank loans is not an obvious area where operations management techniques are relevant, this has, in part, been addressed in the operations management literature (Chaffai, 1997; De Young, 1997).

Yurdakul and Ic (2004) state that accuracy of banks' credit risk assessment models depend on the stability of economic and financial conditions. They question whether the established mechanisms and characteristics of an industry applied to distinguish between successful and unsuccessful firms in terms of timely payment of credits can be regarded as valid. Therefore, the contextualised aspects of bank loan default risk factors are in need of further investigation. Previous research has largely sought to establish the relationship between explanatory variables and default risk regardless of the market situation and sector-specific characteristics. But to assume that the loan parameters which help evaluate loan default probability during normal financial conditions are the same, or at least have the same weight, as in erratic market situations, could be an oversimplification in itself.

The recent economic crisis in 2008-2009 with an unprecedented large number of corporate insolvencies and bankruptcies has highlighted this issue making risk management associated with the crisis a necessity (Blome and Schoenherrb, 2011).

Tramp[1] shipping markets are classified in the literature to be perfect competitive markets (Koopmans, 1939; Norman, 1979; Stopford, 2009), meaning that transportation costs are determined through the interaction of demand and supply forces (Strandenes, 1984; Stopford 2009). Demand for sea transport is a derived demand that is influenced directly by macroeconomic global activities such as industrial production and seaborne trade, among others (Norman, 1979; Strandenes, 1984; Stopford, 2009). Fleet productivity levels and the availability of shipping finance, mainly drive supply for sea transport. Borrowing from banks is the most common form of finance available for shipowners (Schinas et al., 2014), and its availability is conditional, on the one hand, on shipping macroeconomic factors such as the state of the global economy, demand for seaborne trade, cost and lead-time of new-building, second hand vessel prices, scrapping prices and freight prices (Stopford, 2009) and, on the other hand, on microeconomic factors such as prospective earnings (freight cash flow), vessel particulars, daily running costs and earnings and the availability of shipping finance (Tamvakis, 1995; Alizadeh, 2011).

In the wider financial literature there is a substantial body of work related to financial decision making. Often this is treated in a functional silo separate from areas such as operations management, marketing, manufacturing or administration (Samson and Whybark, 1998; Stuart et al, 2002). Typically lenders will monitor a firm's operations using published accounts which is in contrast to the operational management within a firm which will use a different set of measures, for example physical inventory and where it is positioned in the supply chain or lead times for delivery to customer. However, the challenge faced by many organisations, including shipping companies, is the financing of their operations. Established firms in sectors such as manufacturing and distribution will have fixed assets which lenders will recognise as security. While shipping companies have substantial assets in the form of ships, the markets in which the shipping industry operates are extremely volatile, and post the 2007 financial crisis the obtaining of credit to fund new vessels became substantially more difficult. Additionally the volatility of these

[1] Tramp markets refer to shipping spot markets where vessels operate outside a definite route and without a fixed schedule, and calls at any port where cargo is available.

markets means that positive financial returns are extremely hard to generate and therefore the servicing of debt becomes difficult. The more restrictive nature of credit has meant that operational decisions can be severely constrained, a problem faced by, for example, fast-growing firms in the retail sector (Buzacott and Zhang, 2004). Therefore a broader perspective across financing and the sustainability of operations management is required and operations management provides a bridge between financial considerations and strategy (Schmenner and Swink, 1998; Roth and Menor, 2003; Kleindorfer et al, 2005).

More recently there has been some focus on supply chain management addressing both material, information and financial flows (Cohen and Lee, 1988; Lee and Tang, 1997), although there has been less explicit consideration of financial flows in uncertain environments or issues pertaining to financial constraints (Buzacott and Zhang, 2004). The literature also tends to not explicitly consider the impact of financial constraints on the operational aspects of supply chains (Cohen and Malik, 1998). However, the risk issues associated with the repayment of a shipping loan are directly connected to supply chain reliability. If the ship owner or borrower fails to pay back the shipping loan a ship would become operationally unavailable to the shipping company and thus would no longer be available to operate on its scheduled route. This situation would have serious consequences for the shipping operators' planned operations with the consequence of significant disruptions to global logistics operations within the supply chain that the shipping company is involved in on that route.

The aim of this paper is to investigate the varying importance of a number of factors connected with the performance of corporate bank loans during times of financial turbulence and in the context of an especially risk-laden industry. There are several key issues which impact on this study. With the exception of one recent study (Kavussanos and Tsouknidis, 2011), little, if any, extant literature exists on default risk drivers for loans made to shipping companies for new-build vessels or second-hand ship purchases. Shipping finance is a high-risk area to invest in due to extremely volatile pricing swings in both freight rates and asset values and the wide existence of the 'corporate veil'. Bank loans are, among a number of other financing options, the most important source of finance for shipping firms. Such loans provide for the borrower the required capital in a short period of time, with greater flexibility in terms of the final agreement, and without the need to change the company's ownership structure e.g. become a publicly listed company. The industry in general and shipping finance in particular have been challenged by the financial crisis of 2008 which had serious implications for shipping players and the banking community. Gong et al, (2013) surveyed Hong Kong banks with a shipping division and suggested that more stringent lending requirements have been applied to shipping loan lending after the financial crisis. Lastly, the theoretical and business interest in examining the subject of default risk drivers in the context of bank loans in shipping is also attributed to the idiosyncratic nature of the sector both in respect of its operations and of the bank loan structures.

The paper contributes to the shipping-specific literature, by adding to the examination of default risk parameters. The research reinforces the findings of Kavussanos and Tsouknidis (2011) about the significance of financial factors on shipping bank loans and adds further financial variables, non-financial variables and market risk indicators. The results are also of interest to banks as they can identify the factors to assess the credibility of the shipping loans, minimise their credit risk, assist in the credit granting decision-making process, and thus help them make more reliable investment decisions. Borrowers / Shipowners can also benefit by identifying the factors of credit risk they need to focus to enhance their creditworthiness when competing for scarce financing facilities, especially during risk-laden market conditions. The paper provides useful insights into logistics operations and supply chain reliability.

The remainder of the paper is organised as follows. The next section sets the context of the study by highlighting the main trends in shipping finance. The third section engages in a literature review on performance drivers for shipping loans. The following section provides a description of the variables used in the study including the rationale behind their choice. Then, the methodology used in the conduct of the present research is explained. A discussion of the empirical results and main conclusions follow.

2. TRENDS IN SHIPPING FINANCE

Shipping is a capital intensive industry in need of serious support to finance its projects and relies extensively on bank loans for the provision of this debt financing. Financing requirements for the world fleet range between 60% of the total purchase price for second-hand ships and 80% for new-build vessels (Leggate, 2000). It is also a conservative sector with borrowers favouring traditional finance over other more sophisticated and complex modes of finance (Shipping Finance, 2013). Although the industry is turning to capital markets for equity and debt finance, securing funds through bank loans is the preponderant form of ship financing (Grammenos et al, 2008).

Credit risk analysis is, for banks, an essential part of shipping loan lending, as they are faced with a number of industry-specific challenges. The first most important challenge comes from the inherent nature of the industry. Capital intensiveness, high volatility in freight rates and prices, cyclicality, seasonality, strong business cycles and exposure to direct fluctuations of regional and global economies create a risk-laden investment environment for banks. Shipping companies are faced with substantial operational business risks which result from large swings in freight rates, voyage and operating costs. These determine a venture's cash flow and have a profound effect on the company's operating profitability and loan repayment capability (Kavussanos and Visvikis, 2006a; Xu et al., 2011). High freight-rate volatility can increase the probability of default on shipping loans, especially when vessels are purchased at high prices and loans are based on high loan-to-value ratios (Alizadeh and Nomikos, 2011). In the 2000s the experience of both the peak and the trough of a shipping cycle exacerbated the impact of recent developments putting more pressure on shipping finance and the parties involved. A number of banks experienced significant losses from shipping loans in default during this period (Fitch Ratings, 2013; Howard, 2013). Abouarghoub (2013) suggests that the abnormal shipping cycle post-2000 is better explained by the structural school of thought and by defining 'up' and 'down' market movements as shipping agent controlled where, practitioners can improve risk management techniques.

The introduction and implementation of a more stringent regulatory framework of banking activities, the New Basel Capital Accord (known as Basel II), requires banks to engage in more rigorous credit risk estimations either by adopting external rating systems or by applying their own internal credit evaluation. Thus the effect on the banker – shipowner relationship, the credit granting decision-making processes and the preference of shipowners for bank loans as an important source of finance should be considered. Traditionally, the bank lending system for shipping relied on relationships and market share (Smith, 1999a), screening borrowers on case-by-case basis rather than applying pre-fabricated borrower evaluation criteria (Simpson, 1995). Bankers report that their shipping loan portfolios are under a high level of scrutiny and that there has been pressure behind the scenes for some banks to increase provisions (Marray, 2013). The exercise of greater institutional prudence by banks has had two direct effects on shipping finance: a shrinking ship finance debt from their portfolios and a change in the nature of the relationship between banker and ship owner with the application of more formal and rigid criteria for credit granting decisions. Greater scrutiny on banks' shipping exposures is also prompted by the industry's prolonged downturn (Fitch Ratings, 2013). Against the background of contraction of traditional lending facilities the shipping industry started looking to the capital markets for both equity and debt finance (Leggate, 2000). Alternative sources of finance, such as the high yield bond market have gained ground due to changes in the corporate profile of the industry and other structural changes, related, for instance, to a tighter regulatory environment (Grammenos and Arkoulis, 2003). At the same time the need for capital and liquidity in the industry has continued to grow, mostly driven by the need for replacement of an ageing world fleet, the high cost of replacing ageing assets and an overall growth of (seaborne) international trade (UNCTAD, 2011).

3. PERFORMANCE DRIVERS OF SHIPPING LOANS

The common underlying effect of these trends is for lending institutions to divert away from unnecessary risk and to exercise more rigorous discretion in respect of borrowers. This has led to the shrinkage of the number of banks involved in ship finance debt, banks becoming more selective in their choices of who to do business with, and the use of rigorous formal rating schemes in the risk evaluation of shipping bank loans (Gray, 2000a; Marray, 2013). Such developments have brought about a two-tier market configuration, placing smaller ship owners at a disadvantage with regard to access to finance (Smith, 1999b) as most institutions with shipping portfolios tend to confine their lending activities only to the top corporate names in the industry (Lennane, 2001). Ship owners must thus adjust their position to meet these challenges. This has led to shipping firms adopting a variety of response strategies to gain and maintain access to capital and improving their financial rating, for example adopting a formal corporate profile, changing their ownership structure (e.g. becoming publicly listed) or becoming receptive to mergers and / or acquisitions. Central to the adaptation of both banks and companies to the changing parameters of institutional ship finance is the successful risk evaluation mechanism for shipping bank loans.

The potential for default by counterparties gives rise to a high level of credit risk for banks (Kavussanos and Visivikis, 2006a; b; Gupton et al, 1997). As Kavussanos and Tsouknidis (2011) highlight, larger banks using internal credit evaluation generally tend to provide cheaper loans compared to smaller banks providing loans assessed against external criteria. The internal rating approach includes more diverse risk weights than external credit assessments and produces greater risk sensitivity. Thus, banks are able to produce greater risk sensitivity calculations for individual loans. However, the credit rating system in itself only provides an ordinal ranking of the default likelihood across risk categories. A quantitative assessment will also have to be made of both the probability of default and the potential loss should a default occur. Grammenos (1979) discussed the five 'C's of credit in ship bank finance, later expanded to six 'C's. The six elements: Character, Company, Capacity, Capital, Collateral and Conditions provide factual evidence of the level of credit risk likely to be faced (Grammenos, 2002). Sommerville and Taffler (1995) showed that bankers tend to be overly pessimistic about credit risk and that objective multivariate credit-scoring systems tend to perform better than subjective approaches. Multivariate credit-scoring systems include the linear probability model; the logit model; the probit model and the discriminant analysis model (Altman and Saunders, 1998). Credit evaluation models have subsequently progressed from statistical methods including multiple regression (Meyer and Pifer, 1970), discriminant analysis (Altman, 1968), and logistic regression (Martin, 1997). Artificial intelligence approaches such as inductive learning (Shaw and Gentry, 1998), artificial neural networks (Zhang et al., 1999) and case-based reasoning (CBR) (Bryant, 1997; Park and Han, 2002) are now used more frequently. However, the credit analysis approach is still adopted by large financial institutions as an effective way of analysing credit risk.

A wider literature on default risk for corporate credit loans has recognised the importance of a number of factors such as information asymmetry and firm's financial structure (Bonfim, 2009). Yurdakul and Ic (2004) examine the importance of both financial and non-financial factors in credit evaluation and stress the importance of non-financial ratios, like a firm's reputation and stay power and commitment in its business, for the calculation of a firm's credibility score, which increases in the case of markets open to global competition and global foreign firms. They also state that ‘financial measures are useful in predicting the repayment ability of a firm especially in stable industries’ (Yurdakul and Ic, 2004). The shipping industry is not only a truly global industry but, also a very volatile one. The importance of the relationship between bank and ship owner as well as the absence of pre-fabricated borrower evaluation criteria have traditionally been the two main features of shipping lending. Dimitras et al (2002) argue that ‘most of the critical parameters in the credit granting decision in shipping industry are not quantitative measures but qualitative characteristics of the loan application under evaluation’. In the light of recent developments and trends, however, a greater emphasis is placed on the need for formality, uniformity and rigorousness. Suggestions which have been put forward include, for example, the introduction of an industry-wide model to cater for the variation in accounting systems, and measures of creditworthiness among shipping interests (Gray, 2000b), or: internal benchmarking schemes being tied more to variables such as cash flows and less on the underlying asset (Measures and Rosa, 2004). The recent shipping crisis has had a serious impact on both shipping and the banking community. In the past, banks ideally looked for modern tonnage with low leverage, a good owner with a strong balance sheet plus a long time-charter to a quality charterer (Wilson, 2009). Yet, today, not only is lending scarce, but the process of lending can now take much longer because bankers have become more risk averse. In the past big family names were used as collateral, but banks are now much more selective and conservative (McGroarty, 2009). Corporate governance, transparency, and proper accounts are high on the wish lists of advisers and financiers.

4. DESCRIPTION OF VARIABLES AND HYPOTHESES

Both financial and non-financial factors have been identified as important drivers for credit risk (Yurdakul and Ic, 2004; Bonfim, 2009). Due to the increased importance of determining regulatory capital adequacy and the focus of banks on risk-return trade-offs it is important that internal credit rating frameworks include a combination of factors to accurately forecast credit default (Grunert et al, 2005). Graham et al. (2008) examine misreporting from debt holder’s perspectives and the effect of financial statements on bank loan contracting by regressing loan spread on financial factors, firm characteristics, loan characteristics, industry effects and macroeconomic factors. Bonfim (2009) stresses the importance of the firms’ financial situation in explaining default probabilities and the importance of macroeconomic conditions in assessing default probabilities over time.

Thus, this study draws on 18 independent variables that represent both financial and non-financial factors and categorise them into five categories of: Loan Nature, Borrower's Finances, Vessel Nature, Borrower's Reliability and Borrower's exposure to Market Risk. The first two represent financial factors and are directly adopted from the bank original data file, the other three represent non-financial factors and are mainly adopted from the literature. Variables that comprise the five categories and reflect performance drivers of shipping loans are used extensively in credit risk empirical frameworks. A selected list of papers identified in academic literature is detailed in Table 1.

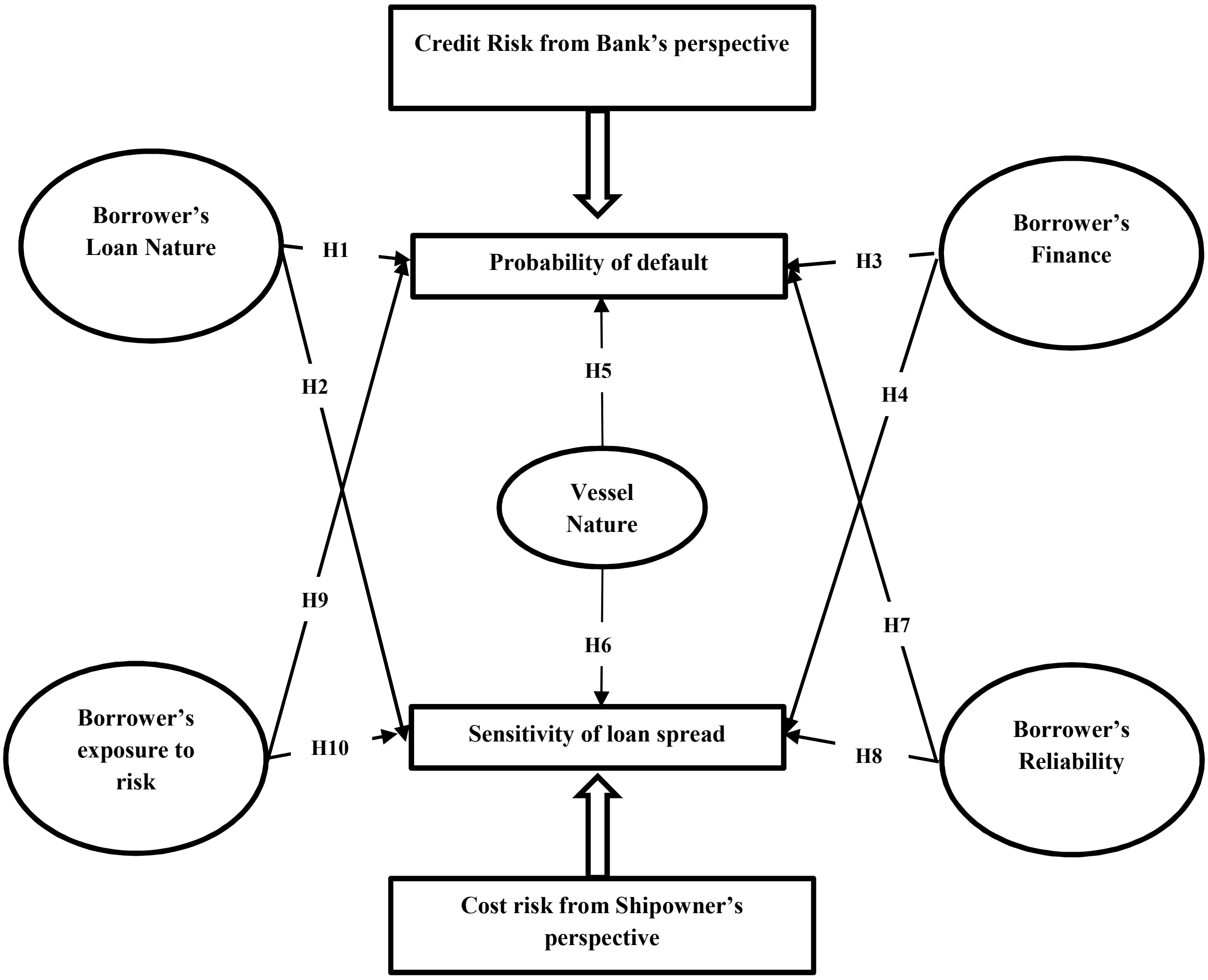
From the literature the main hypothesised relationships between performance drivers of shipping loans and two characteristics of shipping loan risk, namely, probability of default and sensitivity of spread were identified. These two risk characteristics reflect, respectively banks' perception of credit risk and shipowners' perception of cost risk. The relationships are depicted in Figure 1.

Table 1: Key References for Performance Drivers of Shipping Loans

Performance Drivers of Shipping Loans	**Economic Factors**		**Financial Factors**		**Non-Financial Factors**		
	Macroeconomics	Microeconomics	Loan Nature	Borrower's Finance	Vessel Nature	Borrower's Reliability	Borrower's exposure to Market Risk
Campbell and Dietrich (1983)			✓	✓		✓	✓
Tamvakis (1995)	✓	✓			✓		
Beatty et al. (2002)		✓	✓	✓		✓	✓
Grammenos and Arkoulis (2003)		✓	✓	✓	✓	✓	✓
Grunert et al. (2005)			✓	✓		✓	✓
Grammenos et al. (2007)	✓	✓	✓	✓	✓	✓	✓
Graham et al. (2008)	✓	✓	✓	✓		✓	
Kavussanos and Tsouknidis (2011)	✓	✓	✓	✓	✓		
Alizadeh and Talley (2011)		✓			✓		

Source: Authors

Figure 1: The Proposed Research Model



Note: this model depicts this study's main hypothesised relationship between shipping performance factors and two characteristics of shipping loan risks, namely, probability of default of a loan and sensitivity of spread of the loan.

4.1 Loan Nature

The **Spread of the loan** is the "charge" by the banks and is measured by percentage of the loan granted. For a good client the bank would aim for a low spread. It is the price/ interest rate of the loan. This margin will depend on the strength of the borrower and the general levels of spreads in the market. It is clear that the process of assessing the probability of credit risk is also linked with the pricing of the loans because the spreads must generally compensate for potential loan losses. Campbell et al (1983) found that loans with an increased probability of default are those that are priced with higher spreads, but whether this is true with shipping loans requires examination.

The Minimum Value Clause (MVC) is an index and measures the lowest Asset value/ Loan granted where the bank will not ask for additional security (Archer et al, 2002). Under poor market conditions, ship values can plummet and the mortgaged ship will not be adequate security for the banks. When the index Asset value/Loan granted hits a price below the MVC the banks must hedge their position and seek further collateral cover. The **Tenor of the loan** is the period during which the loan is sanctioned. It has an impact on the outflows of the borrower as the longer the tenure of the loans, the lower the outflow of the borrower on each instalment (Blanco et al, 2005). The **Balloon/Loan ratio** is the last repayment instalment and is predominantly the largest. Balloon is measured as a percentage of the total loan granted where a big balloon ratio indicates that the repayment of a big amount of the loan will be protracted while a small balloon ratio amounts to more equal instalments throughout the period of the loan (Archer et al, 2002). As the time horizon of the loan increases, the default risk rises. The tenor of the loan indicates the duration of the loan facility, while the balloon to debt ratio illustrates the percentage of the drawn facility that will be repaid as a final instalment. When the loan is front loaded, the failure of the borrower to repay the loan is minimised as there is greater certainty in the preliminary stage of the loan. In summary, it can be hypothesised[2] that:

H1. Loan nature (spread, MVC, tenor, balloon ratio and amount) has a significant influence on the likelihood of default for a shipping loan. This main Hypothesis (H1) has the following sub-hypotheses:

H1a. The probability of default for a shipping loan increases as the loan amount increases.
H1b. The probability of default for a shipping loan increases as the loan-spread increases.
H1c. The probability of default for a shipping loan increases as tenor decreases.
H1d. The probability of default for a shipping loan increases as the MVC ratio decreases.
H1e. The probability of default for a shipping loan increases as the balloon/loan ratio increases.

H2. Loan nature (probability of default, MVC, tenor, balloon ratio and amount) is sensitive to the spread of the loan This main Hypothesis (H2) has the following sub-hypotheses:

[2] All signs of proposed hypotheses are shown for both models in Table 4.

H2a. The spread of the loan is directly sensitive to the loan amount.
H2b. The spread of the loan is directly sensitive to the probability of default.
H2c. The spread of the loan is inversely sensitive to the tenor of the loan.
H2d. The spread of the loan is inversely sensitive to the MVC ratio.
H2e. The spread of the loan is directly sensitive to the balloon/loan ratio.

4.2. Borrower's Finances

Asset cover ratio is an index that is calculated at regular intervals and it is the Asset value/ Loan granted described in the MVC (Archer et al, 2002). This index is calculated at the start of the loan and throughout its tenure, and is always compared to the MVC. The **Percentage of finance** is measured by Loan granted/ Total price of the vessel and indicates the leverage of the shipping loan. **Fleet leverage** is a percentage of the leverage of the shipowner's whole fleet. The bank has to consider whether the rest of the vessels in the shipowner's fleet are also mortgaged and their average amount of leverage. The whole picture will need to be considered as all the vessels will generate income which is a condition precedent for the smooth repayment of the loan. A low leverage index is an additional security for the bank (Chava et al, 2009). An attempt was made to find out whether the borrower's burden of debt creates any problems in the repayment of his loan. The fundamental aim of this approach is to ascertain whether a percentage of leverage for every ship individually and in total is an important risk reducing factor and is sufficient for the fulfilment of the obligations of the ship to be financed. In summary, it can be hypothesised that:

H3. Borrower's finance (ACR, Finance, Leverage) has a significant influence on the likelihood of default for a shipping loan. This main Hypothesis (H3) has the following sub-hypotheses:

H3a. The probability of default for a shipping loan increases as the ACR increases.
H3b. The probability of default for a shipping loan increases as the percentage of finance decreases.
H3c. The probability of default for a shipping loan increases as the fleet leverage increases.

H4. Borrower's finance (ACR, Finance, Leverage) is sensitive to the spread of the loan. This main Hypothesis (H4) has the following sub-hypotheses:

H4a. The spread of the loan is directly sensitive to the ACR.

H4b. The spread of the loan is inversely sensitive to the percentage of finance.

H4c. The spread of the loan is directly sensitive to the fleet leverage.

4.3. Vessel Nature

Variables representing vessel nature, borrower's reliability and borrower's exposure to market risk to reflect shipping loan performance were selected. **Tonnage deadweight** relates to the size of the vessel in deadweight tonnage (DWT). The bigger the vessel is the more expensive it will be, so a bigger vessel incurs greater risk for both the shipowner and the bank. The sample consists of shipping loans for dry bulk ships of all weight categories. However, it is important to distinguish between different sizes of ships as they are involved in different commodity trades and routes of the world and are therefore clearly distinct in terms of their risk characteristics (Kavussanos, 1997). From an econometric point of view, it is also important in a time series analysis to differentiate to avoid the associated problems of spurious correlation, regressions and inferences. The **Age of the vessel** being financed when the purchase was made and the loan granted is a significant parameter. It is important for banks that the vessel has valuable remaining life through to the settlement of the loan so that it can deal with the effects of a potential downward market. A relatively young vessel has more opportunities to regain its market value during a subsequent market rise and their operating costs are much lower, so their laying up position is higher. Ulusçu et al (2009) also mentioned young vessels are more adaptable and can survive more easily during harsh times. **Fleet size** refers to the number of vessels owned by the borrower at the time of the beginning of the loan agreement. The greater the number of vessels the borrowers owns, the better loan terms they are likely to receive. This also reflects the borrower's ability to provide collateral securities and cross collateralisation. In summary, it can be hypothesised that:

H5. Vessel nature (DWT, Age and Fleet Size) has a significant influence on the likelihood of default for a shipping loan. This main Hypothesis (H5) has the following sub-hypotheses:

H5a. The probability of default for a shipping loan increases as the size of the vessel increases.

H5b. The probability of default for a shipping loan increases as the age of the vessel increases.
H5c. The probability of default for a shipping loan increases as the fleet size decreases.

H6. Vessel nature (DWT, Age and Fleet Size) is sensitive to the spread of the loan. This main Hypothesis (H6) has the following sub-hypotheses:

H6a. The spread of the loan is directly sensitive to the size of the vessel.
H6b. The spread of the loan is directly sensitive to the age of the vessel.
H6c. The spread of the loan is inversely sensitive to the fleet size.

4.4. Borrower's reliability

Shipowner's experience measures how long the shipowner has been involved in shipping. The name and the experience of the shipowner play a significant role in ship finance and is a qualitative criterion, with a degree of subjectivity, and therefore cannot be easily qualified. However, its significance in the field is important and banks have always followed the practice of name-lending. Gavalas and Syriopoulos (2013) pointed out that reputation in shipping is expected to have a positive impact on loan performance. In order to examine such parameter, a sampling survey was made on whether the shipowner comes from a traditional shipowning family and the number of years that he has been involved in shipping. It was expected that experience would positively affect the outcome of a loan. In summary, it can be hypothesised that:

H7. Borrower's reliability (Experience) is negatively correlated to the likelihood of default for a shipping loan.
H8. Borrower's reliability (Experience) is inversely sensitive to the spread of the loan

4.5. Borrower's exposure to Market Risk

The Baltic Dry Index (**BDI**) is widely regarded as the general market indicator, which reflects freight movements in the dry-bulk market. This is a composite index calculated as the equally weighted average of the Baltic Capesize Index (BCI), Baltic Panamax Index (BPI), Baltic Handysize Index (BHSI) and Baltic Supramax (BSI). **Freight risk** is a measure of employment risk that reflects the extent of earning uncertainty in shipping.

Alizadeh and Nomikos (2010) examine the effect of risk management strategies on shipping investment and operation by defining two strategies that are based on employment type: hedged and unhedged freight operations. Three freight risk levels are defined in this paper, these are zero per cent freight-risk-level reflecting a 100 per cent Time-Charter employment; 50 per cent freight-risk-level reflecting a mixed Time-Charter and Voyage-Charter employment; and 100 per cent freight-risk-level reflecting a 100 per cent Voyage-Charter employment. **Yearly dummies (FrRisk 06, FrRisk 07, FrRisk 08, FrRisk 09)** are binary variables that are included in the regression to capture the impact of the contract year on the probability of default for shipping loans. In summary, it can be hypothesised that:

H9. Borrower's exposure to market risk (BDI, Freight Risk, FrRisk 06, FrRisk 07, FrRisk 08, FrRisk 09) has a significant influence on the likelihood of default for a shipping loan. This main Hypothesis (H9) has the following sub-hypotheses:

H9a. The probability of default for a shipping loan increases as the freight levels decreases.
H9b. The probability of default for a shipping loan increases as freight risk levels increases.
H9c. The likelihood of a shipping loan defaulting is higher post the credit crunch.

H10. Borrower's exposure to market risk (BDI, Freight Risk, FrRisk 06, FrRisk 07, FrRisk 08, FrRisk 09) is sensitive to the spread of the loan. This main Hypothesis (H10) has the following sub-hypotheses:

H10a. The spread of the loan is inversely sensitive to freight levels.
H10b. The spread of the loan is directly sensitive to freight risk levels.
H10c. The spread of the loan is higher post the credit crunch.

5. METHODOLOGY

In this context, this paper evaluates the performance drivers of shipping loans using a binary logit model to examine the criteria for assessing the security of shipping loans issued by banks. Logit models have been found to be useful analytical techniques in previous shipping and finance-related studies (e.g. (Grammenos et al., 2008; Kavussanos and Tsouknidis, 2011). Here, thirty shipping loans to shipping companies operating in the bulk sector, made during the period 2005-2009 are examined. The period under examination includes peak and bust market conditions. It also includes the period of time with the most recent highest ordering activity for newbuild vessels (CESA, 2011), i.e. the period of time with the greatest capital requirements (and therefore finance requirements) for investment activity on behalf of ship owners.

5.1. Sampling Process

The sample used comprises 30 shipping loans secured by Greek ship owning interests from a shipping bank's portfolio located in Greece. The sample covers and represents the totality of loans in this bank's shipping portfolio for the period from 2005 to 2009. It covers the period of time with the highest ordering and investment activity in newbuild vessels over the last four decades (Stopford, 2009). The choice of Greece as the case-study area for the research was made for various reasons. First, Greece has significant ship owning interests, holding 16.17% of the world's tonnage (UNCTAD, 2011). Second, Greek shipowning interests collectively occupy first position among the top five investing nations in ship new-buildings. Greek shipowners invested 57.1 billion US dollars in new vessels in the final part of the boom period (January 2007-September 2008), and 13.2 billion US dollars from the onset of the recession onwards (October 2008-October 2010) (Condon, 2010). The Greek shipping portfolio in terms of bank loans is particularly significant as traditional forms of bank financing remain a strong preference for Greek shipping finance (Petropoulos, 2010).

All the chosen loans refer to the financing of dry bulk carriers. There are advantages to including all or various ship types in a study like this, but the choice of selecting to examine only loans given for dry bulk carriers was justified for the following reasons. Fundamental to the 2008-2009 shipping crisis was the dramatic fall of the dry bulk sector, so it was important to be able to capture this condition in the ship loans examined. While the effects of what happens in one shipping sector eventually ripple through to other sectors in the longer run, in the short run different sectors may, and had for the examined time period, experience differing market swings. As the sample size, i.e. number of shipping loans provided by one bank over the specified period, was relatively small, ther was the need to achieve uniformity in the sample. The type of vessel might play, in the short run in particular, a role in the performance of the bank loan, e.g. in the earnings of the vessel and the income stream of the loan, so the inclusion of different ship types could distort the chosen variables within the realms of a small number of cases. All the loans examined were drawn during the period 2005-2009. This interval is thought to be sufficient because the level of freight rates, the order book, the second hand prices and the scrap volume had high volatility during this time period.

For the present study, defective loans are defined as: a) loans that have presented a failure in the settlement of any scheduled payment, interest or principal, on the exact promised date, and b) loans that have been restructured due to the inability borrowers to fulfil their contractual duties. The definition of a problematic loan does not include any adjustments that emanate from any advance payments against the principal loan, as these do not connote any weakness of the part of the borrower.

5.2. Binary Logit Model

Logit Modelling (or, as very often is referred to, Logistic Regression) has been widely used in various disciplines including transportation, finance and manufacturing. The linear probability model and the logit probit model have been used for credit risk measurement (Altman and Saunders, 1997; Altman et al., 1977). Barniv et al. (2002) stated that logit analysis has been the most commonly used technique in the recent literature of credit risk assessment. However, in the shipping finance literature, Logit Model has been rarely applied (Grammenos et al 2008; Kavussanos and Tsouknidis (2011), which leaves room for further investigation; a research gap towards which the present study attempts to contribute.

18 predictor variables are used in this paper, which are divided into five categories of: Loan Nature, Borrower's Finances, Vessel Nature, Borrower's Reliability and Borrower's exposure to Market Risk. Six logistic regressions are estimated, first, one for each of the five categories, referred to as conditional Logit models. Second, one logistic regression that combines all the categories referred to as the unconditional Logit model.

In the simple discrete choice model the dependent variable only takes on two values when modelling the performance of shipping loans:

$$y_i = \begin{cases} 0 & \text{if shipping loan } i \text{ is fully repaid} \\ 1 & \text{if shipping loan } i \text{ is defaulted at the maturity} \end{cases} \tag{1}$$

Thus, the probability of default of shipping loans is modelled and the definition of the probability of default of shipping loan *i* is:

$$p_i = P\{y_i = 1\} \tag{2}$$

where

$$y_i = X_i'\beta + \varepsilon_i \tag{3}$$

The error term in the above equation is not normally distributed, as it only takes on two values: $\varepsilon_i = 1 - p_i$ or $\varepsilon_i = 0 - p_i$ and so $p_i = X_i'\beta$. Thus, $\hat{y}_i$, is introduced as an underlying continuous variable that is not observed to solve the problem of normality.

$$y_i = \begin{cases} 0 & \text{if } \hat{y}_i < 0 \\ 1 & \text{if } \hat{y}_i \geq 0 \end{cases} \tag{4}$$

so that

$$\hat{y}_i = X_i'\beta - \varepsilon_i \tag{5}$$

where X_i' represents the transpose vector of independent variables and β represents coefficients vector and so:

$$p_i = P\{y_i = 1\} = P\{X_i'\beta - \varepsilon_i \geq 0\} = F_\epsilon(X_i'\beta) \tag{6}$$

let $z = X_i'\beta$ and as the choice of $F_\epsilon$determines the method, the logistic distribution is:

$$F_\epsilon(z) = \left(\frac{e^z}{1+e^z}\right) \tag{7}$$

leading to the following Logit:

$$log\left(\frac{p_i}{1-p_i}\right) = X_i'\beta \tag{8}$$

so if $y_i = 1$ this equates to p_i and if $y_i = 0$ this equates to $1 - p_i$ leading to the following likelihood:

$$L(\beta|X) = \prod_{\{y_i=0\}}(1 - p_i) \prod_{\{y_i=1\}}(p_i) \tag{9}$$

thus, the following likelihood function is estimated:

$$L(\beta|X) = \sum_{i=1}^{N}[(1 - y_i)log(1 - p_i) + y_i \log p_i] \tag{10}$$

Thus, this study hypothesised that the likelihood of probability of default for a shipping loan is higher for; large amount, large spread, short tenor, low MVC, large balloon/loan ratio payment, high ACR, low percentage of finance, high leveraged fleet, large vessel size, less experience, low freight rates, high freight risk and post the credit crunch. This is expressed as:

$$\Pr(DL) = f(Amount^{(+)} + Spread^{(+)} + Tenor^{(-)} + MVC^{(-)} + Balloon^{(+)} + ACR^{(+)} + Finance^{(-)} + Leverage^{(+)} + DWT^{(+)} + Age^{(+)} + Fleet\ Size^{(-)} + Experience^{(-)} + BDI^{(-)} + Freight\ Risk^{(+)} + FrRisk06^{(+/-)} + FrRisk07^{(+/-)} + FrRisk08^{(+/-)} + FrRisk09^{(+/-)}) \quad (11)$$

5.3 Local data generation process (LDGP)

To complement the previous estimation of the determinants of the probability of default for shipping loans supplementary analysis was also undertaken where the sensitivity of the spread of the loan was modelled. As the estimation of the joint density of all the variables in a given economy is a complex task and is referred to as the economic data generation process (DGP). Therefore, the general approach is to adopt local DGP models, which is the underpinning concept of the theory of reduction. (Hendry, 1979; Hendry and Richard, 1982; Hendry, 1987). Thus, similar to Grammenos and Arkoulis (2003) the general-to-specific modelling approach of Hendry (1977) is adopted to avoid the possible omitted variables bias highlighted by Spanos (1986), and estimate the following cross-sectional ordinary least square (OLS) model:

$$s_i = \alpha_0 + \alpha_1 p_i(z) + \sum_{i=2}^{n} \alpha_i x_i + \varepsilon_i \quad (12)$$

where s_i is the spread of the loan i, α_0 is the constant of the regression, $\alpha_1$is the coefficient of p_i(z) that represents the probability of default for shipping loan i that was estimated in equation (6), n refers to total number of loans in the sample, α_i represents the coefficient for the independent variable x_i and ε_i is the error term for loan i. Each of the regression coefficients describes the size of the contribution of the independent variable.

This study hypothesised that the spread of a shipping loan is directly sensitive to; large amount, likelihood of probability of default, short tenor, low MVC, large balloon/loan ratio payment, high ACR, low percentage of finance, high leveraged fleet, large vessel size, less experience, low freight rates, high freight risk and post the credit crunch. This is expressed as:

$$\text{Spread} = f(Amount^{(+)} + \Pr(DL)^{(+)} + Tenor^{(-)} + MVC^{(-)} + Balloon^{(+)} + ACR^{(+)} + Finance^{(-)} + Leverage^{(+)} + DWT^{(+)} + Age^{(+)} + Fleet\ Size^{(-)} + Experience^{(-)} + BDI^{(-)} + Freight\ Risk^{(+)} + FrRisk06^{(+/-)} + FrRisk07^{(+/-)} + FrRisk08^{(+/-)} + FrRisk09^{(+/-)}) \quad (13)$$

6. DATA DESCRIPTION, RESULTS AND DISCUSSION

6.1. Data and Empirical Results

The dataset comprises 30 shipping loans which was the total number of shipping loans in a bank's shipping portfolio over the period 2005-2009. Of these, 18 shipping loans were fully paid and 12 had problems in their repayment. The dependent variable reflects the repayment status of the shipping loan, 0 denotes the shipping loan with full repayment, and 1 denotes the shipping loans with repayment problems. For the latter, repayment of the loan was defective at the maturity date. 18 independent variables are used in light of the literature and industry examination. The 18 variables are further divided into five categories of: Loan Nature, Borrower's Finances, Vessel Nature, Borrower's Reliability and Borrower's exposure to Market Risk.

Summary descriptive statistics of the 18 variables are shown in Table 2 and are reported in three panels. Panel (a) reports statistics of the full-sample, panel (b) reports statistics of fully-paid shipping loans and panel (c) reports statistics of default shipping loans. Positive coefficients of kurtosis indicate the leptokurtic property of all-time series. Positive coefficients of skewness indicate right skewed distributions for Amount, Spread, Tenor, MVC, ACR, Balloon, DWT and Fleet size, while negative coefficients of skewness indicate left skewed distributions for Finance, Age, Experience and Leverage. J-B is the Jarque-Bera statistic for testing whether the series is normally distributed. In general these statistics are consistent between the full-sample and in-samples. More interestly, a comparison between fully-paid and default samples of shipping loans indicate that averages and dispersions of Spread, Tenor and MVC for shipping loans are higher for the former relevant to the latter. Whereas averages and dispersions of Amount, ACR, DWT, Fleet Size and Leverage for shipping loans are higher for default loans relevant to fully paid loans. Thus, based on the shipping loans sample, defaulted shipping loans are characterised by large amounts, small spreads, short tenors and lower MVC, and that borrowers of these loans have less experience and are higher leveraged. In Figure 2, the difference in financial performance drivers between fully paid and defaulted shipping loans are examined through an illustration of a plot of an ascending borrowed amount against finance, balloon and finance loan performance drivers, for both in-samples. Figure 2 shows that level of finance provided and leverage levels for borrowers are better matched and that balloon percentages are consistently proportionate to borrowed amount, for fully paid loans in comparison to defaulted loans. This might be an indication that initial setup and continuous monitoring are important parts of successful shipping loan agreements.

Furthermore, as argued in the literature section, borrowers' exposure to freight risk is captured by three levels, namely; zero per cent, 50 per cent and 100 per cent. Therefore, in Table 3 risk characteristics of shipping loans for full-sample and in-samples are reported. These are employment risk represented by type of freight contract and performance indicators relevant to contract dates. Reported statistics indicate that employment risk and probability of default for shipping loans are positively correlated. In other words, borrowers that employ their vessels in the time-charter market are better placed to meet their financial liabilities than borrowers that employ their vessels in the spot market. Moreover, performance of shipping loans within the full-sample and in-sample are further analysed relevant to contract date. This indicates that 73% of contracts signed in 2007 were fully paid in contrast to 64% of contracts signed in 2008 that were defaulted. This might be due to banks tightening loan arrangements in 2007 just after the start of the subprime crisis or the freight market going from peak to collapse. This reasoning aligns with the previous discussion where it was shown that the level of finance by borrowers and their leverage exposure are better matched for fully paid loans when compared to defaulted loans.

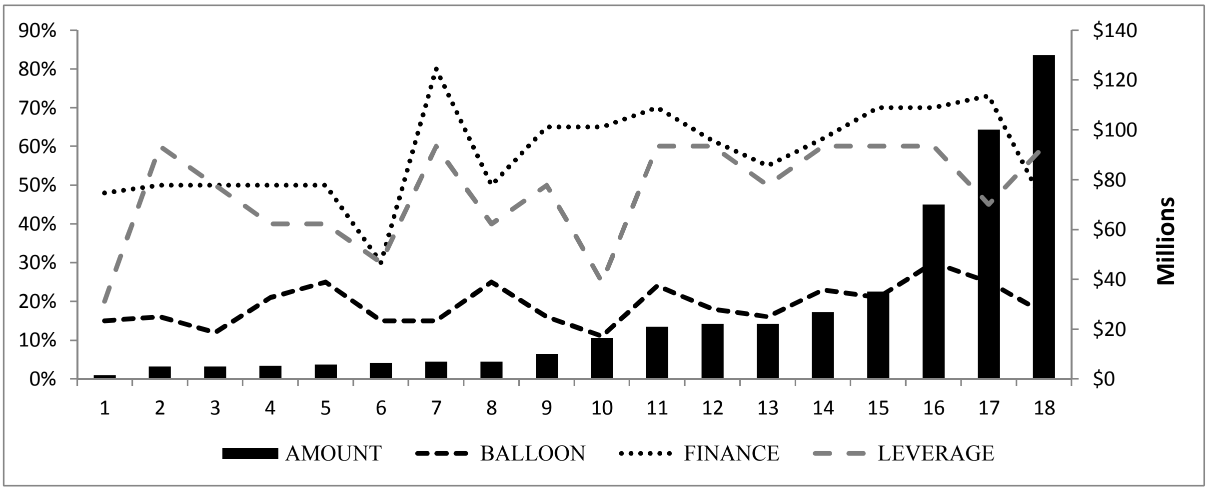
Table 2: Descriptive statistics of performance variables of shipping loans

	Minimum	Average	Maximum	SD	Skewness	Kurtosis	J-B
	Panel A: Full Sample of Shipping Loans						
Amount	1,500,000	38,575,000	255,000,000	52,614,000	2.5 (5.9)‡	11.1 (8.5)‡	95.7
BDI	1,574	6,726	11,458	3,336	0.2 (0.4)	5.6 (1.6)*	2.6
Spread	1.5%	2.4%	4.3%	0.7%	1.3 (3.1)‡	4.2 (1.5)	10.8‡
Tenor	2	6.1	20	3.9	1.7 (3.9)‡	6.5 (4.2)‡	28.9‡
MVC	130%	140%	175%	10%	1.6 (3.7)‡	6.5 (4.3)‡	28.0‡
ACR	148%	221%	671%	107%	2.7 (6.5)‡	11.2 (9.9)‡	122.6‡
Balloon	10%	20%	30%	6%	0.1 (0.3)	1.8 (1.4)	1.8
Finance	30%	59%	80%	13%	-0.6 (1.4)	2.8 (0.2)	1.7
DWT	8,000	51,110	214,000	37,522	2.6 (6.2)‡	12.1 (10.9)‡	138.6 ‡
Age	1.0	18.9	31.0	8.0	-0.6 (1.5)	2.4 (0.7)	2.3
Experience	20	34	47	8.6	-0.3 (0.6)	1.8 (1.4)	2.1
Fleet Size	1	4.2	15	3.2	1.9 (4.6)‡	6.8 (4.6)‡	37.9‡
Leverage	20%	52%	70%	14%	-0.5 (1.1)	2.5 (0.6)	1.5
	Panel B: Fully Paid Shipping Loans						
Amount	1,500,000	27,566,667	130,000,000	35,040,000	1.9 (3.5)‡	5.3 (2.2)†	14.2‡
BDI	1,574	5,854	11,458	3,180	0.6 (1.1)	2.2 (0.8)	1.6
Spread	1.5%	**2.5%**	**4.3%**	**0.8%**	0.8 (1.5)	2.7 (0.3)	1.9
Tenor	**3**	**6.8**	**20**	4.2	1.7 (3.2)‡	6.0 (2.9)‡	15.7‡
MVC	130%	**142%**	**175%**	**11%**	1.3 (2.4)†	5.0 (1.9)*	8.2†
ACR	148%	208%	420%	68%	1.9 (3.6)‡	6.1 (3.0)‡	18.4‡
Balloon	11%	19%	30%	5%	0.3 (0.6)	2.1 (0.8)	0.9
Finance	30%	58%	80%	12%	-0.2 (0.5)	2.6 (0.4)	0.3
DWT	16,000	41,522	93,667	22,280	1.0 (1.9)†	2.8 (0.2)	3.3
Age	1.0	18.2	31.0	9.0	-0.4 (0.8)	2.1 (0.8)	1.12
Experience	20	33	47	8.9	-0.1 (0.1)	1.7 (1.2)	1.2
Fleet Size	1	3.5	13	2.8	2.2 (4.1)‡	8.1 (4.9)‡	33.9‡
Leverage	20%	48%	60%	13%	-0.8 (1.5)	2.4 (0.5)	2.1
	Panel C: Default Shipping Loans						
Amount	**1,800,000**	**55,087,500**	**255,000,000**	**68,003,000**	2.0 (3.2)‡	3.4 (2.7)‡	13.9‡
BDI	3,025	8,034	11,458	3,132	-0.4 (0.6)	1.7 (1.1)	1.2
Spread	1.8%	2.1%	2.5%	0.3%	0.3 (0.5)	1.7 (1.1)	1.1
Tenor	2	4.9	12	3	0.9 (1.5)	3.1 (0.1)	1.9
MVC	130%	137%	150%	6%	0.5 (0.8)	2.8 (0.2)	0.6
ACR	**149%**	**240%**	**671%**	**145%**	2.2 (3.9)‡	6.7 (2.9)‡	16.1‡
Balloon	10%	22%	30%	6%	-0.4 (0.6)	2.8 (0.9)	0.9
Finance	30%	60%	78%	14%	-0.9 (1.5)	3.1 (0.1)	1.9
DWT	8,000	**65,492**	**214,000**	**49,299**	2.1 (3.3)‡	7.0 (3.3)‡	16.9‡
Age	9.0	19.9	26.2	6.1	-0.8 (1.3)	2.1 (0.8)	1.8
Experience	20	34	45	8	-0.7 (1.1)	2.1 (0.7)	1.3
Fleet Size	**2**	**5.25**	**15**	**3.4**	1.8 (2.8)‡	5.7 (2.2)†	10.2‡
Leverage	**35%**	**58%**	**70%**	13%	-0.3 (0.5)	1.5 (1.2)	1.3

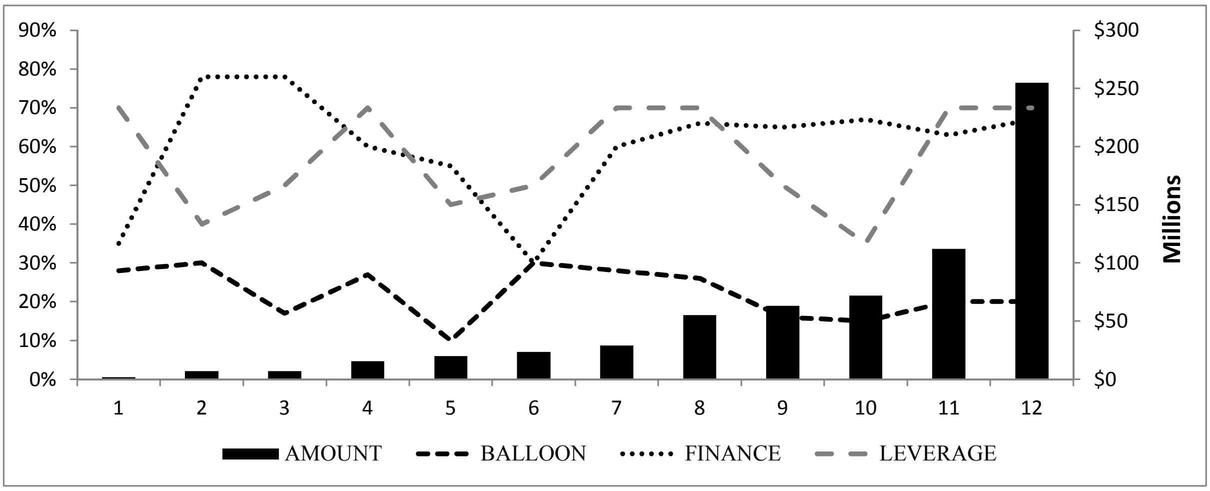
Note Table 2: reports descriptive statistics of the data sample for shipping loans in three sections. These three panels represent statistics for the full-sample, honoured-shipping-loans-sample and default-shipping-loans-sample. Reported statistics are minimum, average, maximum, standard deviation (SD), skewness, and excess kurtosis and normality. Values in ( ) are t-values. Characters ‡, † and * denote significance at 1%, 5% and 10% respectively. Values in bold are highlighted for comparison.

Figure 2: A comparison of financial performance drivers of shipping loans between non-defaulted and defaulted loans.

Panel A: Fully paid Loans



Panel B: Default Loans



Note Figure 2: A comparison of financial performance drivers of shipping loans between non-defaulted and defaulted shipping loans, illustrated in two panels. Left axis represents percentages of Balloon, level of Finance and level of Leverage. Right axis represents loan amount in Millions of US dollars.

Table 3: Risk characteristics of shipping loans

Risk Characteristics of Shipping Loans			
	Full Sample SL	**Fully Paid SL**	**Default SL**
Employment Risk			
Freight Risk	33.3%	27.8%	**41.7%**
FR 0%	66.7%	**72.2%**	58.3%
FR 50%	25.0%	11.1%	**16.5%**
FR 100%	8.3%	16.7%	**25.0%**
No of Shipping Loans by Contract Data			
2005	1	0	1
2006	3	2	1
2007	11	**8 (2.39)†**	3
2008	11	4	**7 (3.96)‡**
2009	4	4	0

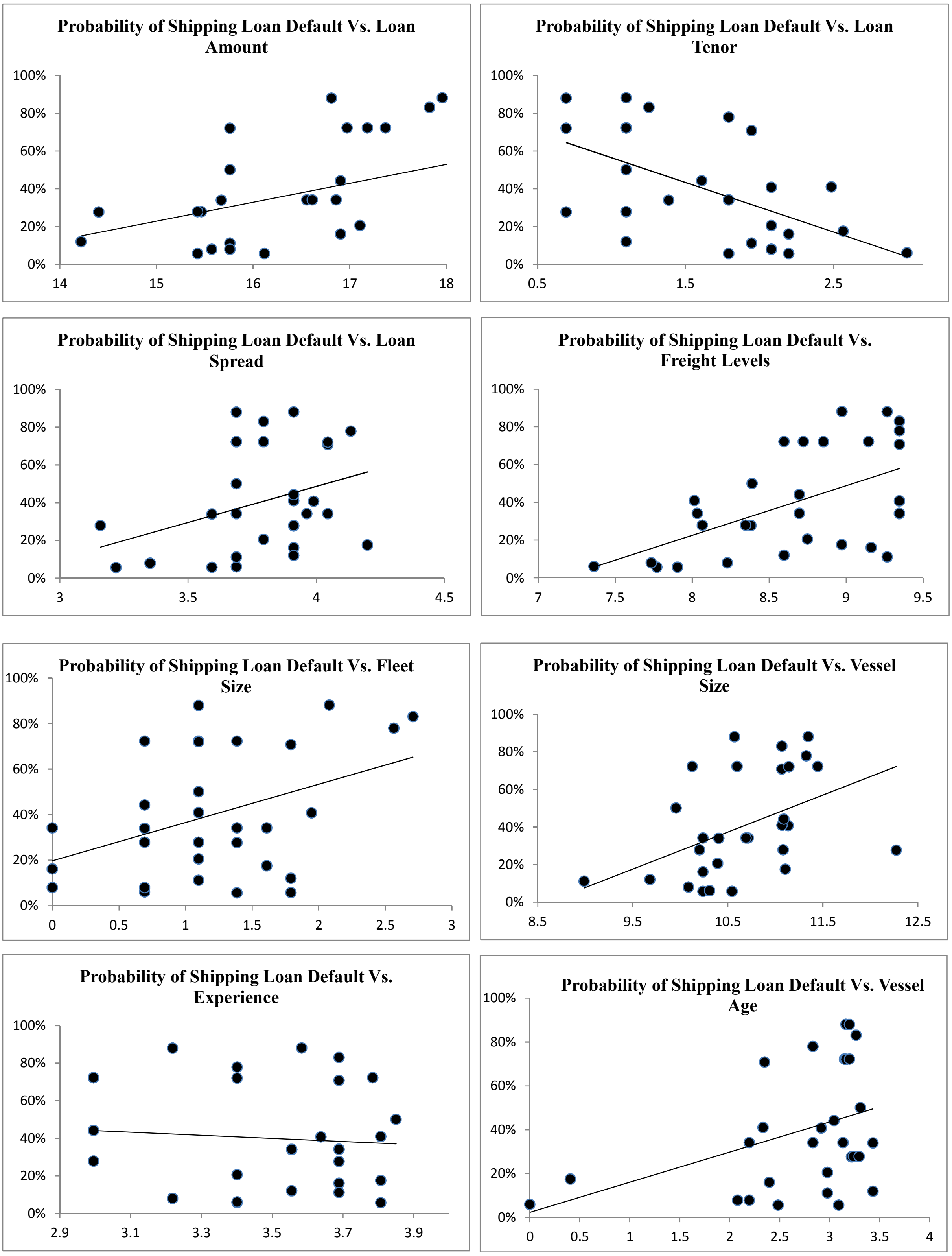
Note Table 3: reports risk characteristics of shipping loans for the full-sample and the in-sample. The latter consist of honoured and defaulted sample of shipping loans. The table is of two parts. The first part reports employment risk statistics; these are overall exposure to freight risk for all samples. Furthermore, overall freight risk is decomposed to three levels of freight risks; zero percentage risk referring to 100% TC employment, 50% risk referring to 50:50 TC and Spot employment and 100% risk referring to Spot employment. The second part reports number of shipping loans by contract year. Values in ( ) are t-values. Characters ‡ and † denote significance at 1% and 5%. Values in bold are highlighted to further discuss in the text.

In Figure 3 the probability of default against performance drivers of shipping loans is plotted. These are Loan Amount, Loan Tenor, Loan Spread, Freight Levels, Fleet Size, Vessel Size, Experience and Vessel Age. For all illustrations in Figure 3, the vertical axis represents shipping loan probability of default and the horizontal axis represents the log of performance derivers. The purpose of such illustrations is to get a feel of the relationship between the proposed performance drivers in this paper and the probability of default for shipping loans. In general the probability of default for shipping loans is positively correlated with the loan amount, freight levels, loan spread, fleet size, vessel size and age, and is negatively correlated with the loan tenor.

In Table 4 the coefficient-value, the t-value and the p-value associated to each explanatory variable in the regressions for the five categories under investigations, and in two panels is reported. The first column in both panel's report the expected signs of the explanatory variables based on the discussion of the theory of shipping financial operations. In panel (a) the results of the applied Binary Logit model are reported for modelling the probabilities of shipping loans defaults, in two parts. First, columns 2-6 report results for modelling the probabilities of defaults conditional on the five categories of shipping performance factors under investigation, one at the time; this is referred to in the methodology section as the conditional Logit model. Second, column 7 reports results for modelling the probabilities of shipping defaults relevant to all explanatory variables; this is referred to in the methodology section as the unconditional Logit model. Thus, in panel (a) the dependent variable is the probabilities of default for shipping loans and the independent variables are grouped in five shipping performance categories; Loan Nature, Borrower's Finance, Vessel Nature, Borrower's Reliability and Market Risk. Panel (b) report results of the ordinary least squares (OLS) model to estimate the sensitivity of the spread of the shipping loan. The dependent variable is the spread of the loan and the independent variables are all the shipping performance factors under investigation, in addition to the probability of default for shipping loans.

The estimates of the Binary Logit Model based on the Loan Nature are shown in the second column of Panel (a) in Table 4. Amount of the loan (Amount), Spread of the loan (Spread), Tenor of the loan (Tenor), Minimum value clause (MVC) and Balloon/Loan ratio (Balloon) represent the loan nature. It can be seen that all variables are statistically significant. The spread and tenor of the loan are negatively related to the shipping loan probability of default, while the amount of the loan and the balloon/loan ratio has a positive impact on the shipping loan probability of default. The results show that loans with higher spreads and longer tenor periods are more likely to be fully repaid, and more equal installments throughout the period of the loan can enhance the performance of the loan. For a good client the bank would aim for a low spread, and intuitively loans with an increased probability of default are those that are priced with higher spreads. However, the results show the opposite and this is discussed in Section 7.

Figure 3: Probability of default vs. performance drivers of shipping loans



Note Figure 3: show the relationship between the probability of default for shipping loans and the following performance drivers; loan amount, loan tenor, loan spread, freight levels, fleet size, vessel size, vessel age and experience. The vertical axis represents the probability of default for shipping loans and the horizontal axis represents the log of the performance drivers.

The estimates of the Binary Logit Model based on Borrower's Finances are shown in the third column of Panel (a) in Table 4. Asset cover ratio (ACR), Percentage of finance (Finance) and Fleet leverage (Leverage) was used to represent the borrowers' finances. Only one variable Leverage contributes to the performance of shipping loans, and it is positively related to the probability of default. This shows that a low leverage of the shipowner's whole fleet index can increase the security for the bank. This finding is in line with the "capital" character in the six 'C's of credit in ship bank Capital (Grammenos, 1977; 1979): a high level of capital for the company indicates both confidence in their own business, and the company's financial strength.

Tonnage deadweight (DWT), Age of the vessel (Age) and Fleet Size (Fleet Size) represent the Vessel Nature of the shipping loan. As shown in the fourth column of Panel (a) in Table 4 none of them are statistically significant, this implies the vessel nature is not a critical driver of the performance of shipping loans.

Borrower's Reliability using the shipowner's experience (Experience) was measured. Reported in the fifth column of Panel (a) in Table 4 it is statistically significant, indicating that experience contributes to the performance of shipping loans and has a negative impact on the shipping loan probability of default. The results indicate that the shipowner's experience can enhance the performance of the loan. Grammenos (1977; 1979) also included shipowner's experience as one of the most important factors in analysing credit risk, for example, the expertise and credibility of the shipowner regarding investment, finance, chartering, risk management and creditors. In the past well-known family names were used as collateral (McGroarty, 2009). The results reconfirm the importance of the qualitative characteristics in analysing credit risk.

The Baltic Dry Index (BDI), the level of employability (Freight Risk) and yearly dummy variables are included to capture Borrower's Exposure to Market Risk. Freight Risk and yearly dummy variables are statistically significant. Results suggest that type of employability and market sentiments influence the performance of shipping loans. Furthermore, in the final column of Table 4 Panel (a) the results of the unconditional Logit model are reported. Amount, Spread, Tenor, Balloon, Finance, Leverage, Experience, Freight Risk and yearly dummy variables are statistically significant. Finally, in Panel (b) the estimates of the (OLS) model are reported.

The results suggest that loan amount; loan spread; loan tenor; balloon/loan ratio; the level of fleet finance, leverage and employability and the shipowner's experience are good estimates for evaluating the performance of shipping loans. Small amounts of loans with higher spread, longer tenor debt and lower leverage are more likely to see the full repayment of the loans, and shipowner's experience also ensures a greater likelihood of repayment. As discussed earlier the process of lending can now take much longer because bankers have become more risk averse and (Anon, 2009) the results provide empirical evidence of the importance of qualitative characteristics of the loan application under evaluation, as most of the critical parameters in the credit granting decision in shipping industry are not quantitative measures (Dimitras et al, 2002).

McFadden R-square is a pseudo R-square used to measure the goodness of fit. This value tends to be smaller than R-square and values of 20% to 40% are considered highly satisfactory. The McFadden R-squares are high in the overall model presented in Table 4. This study considered shipping loans that were drawn over the period 2005 – 2009. This interval is thought to be sufficient because the level of freight rate, the order-book, the second hand prices and the scrap volume have noted high volatility due to the complexities of economic turbulence before and during the financial crisis.

Table 4: Binary Logit Model for Predicting the Performance of Shipping Loans vs. Sensitivity of Spread of the Loan

		Panel A							Panel B	
		Expected Sign of Explanatory Variables	Binary Logit Model for Predicting the Performance of Shipping Loans (Dependent Variable is probability of default)						Expected Sign of Explanatory Variables	Sensitivity of Spread of the Loan
			Loan Nature	Borrower's Finance	Vessel Nature	Borrower's Reliability	Market Risk	All Categories		
			Coeff t-value Prob	Coeff t-value Prob	Coeff t-value Prob	Coeff t-value Prob	Coeff t-value Prob	Coeff t-value Prob		Coeff t-value Prob
Loan Nature	Constant		-2.08 (-11.7)‡	0.46 (2.79)‡	-1.7 (-2.3)†	0.68 (1.06)	0.15 (1.9)†	-8.96 (-9.8)‡		-4.83 (-2.1)*
	Amount	Positive (+)	0.19 (17.9)‡					0.36 (8.4)‡	Positive (+)	0.22 (1.9)*
	Spread/Pr(DL)	Positive (+)	-0.05 (2.0)†					-0.04 (-1.3)*	Positive (+)	-0.38 (-2.8)†
	Tenor	Negative (-)	-0.47 (-20.1)‡					-0.51 (-9.1)‡	Negative (-)	-0.49 (-2.5)†
	MVC	Negative (-)	- 0.06 (-1.8)†					-0.12 (-1.2)	Negative (-)	-.0.30 (-0.3)
	Balloon	Positive (+)	0.03 (1.8)†					0.05 (1.4)*	Positive (+)	0.01 (0.1)
Borr Fin	ACR	Positive (+)		0.21 (1.2)				0.11 (1.3)	Positive (+)	
	Finance	Negative (-)		-0.06 (-1.3)				-0.07 (-1.5)*	Negative (-)	-0.37 (-1.5)
	Leverage	Positive (+)		0.04 (1.6)*				0.35 (1.6)*	Positive (+)	0.13 (0.8)
V/L Nat	DWT	Positive (+)			0.16 (1.21)			0.07 (1.3)	Positive (+)	-0.11 (0.9)
	Age	Positive (+)			0.12 (1.26)			0.06 (1.3)	Positive (+)	0.15 (1.8)*
	Fleet Size	Negative (-)			0.09 (1.33)			-0.02 (-0.7)	Negative (-)	-0.16 (-2.3)†
BR	Experience	Negative (-)				-0.08 (-1.45)*		-0.05 (-1.8)†	Negative (-)	0.13 (0.7)
Market Risk	BDI	Negative (-)					-0.26 (-1.1)	-0.05 (-1.1)	Negative (-)	-0.16 (-1.7)*
	Freight Risk	Positive (+)					0.14 (2.8)‡	0.18 (3.2)‡	Positive (+)	0.32 (-1.9)*
	FrRisk 06	(+/-)					-0.20 (-1.3)	-0.22 (-1.5)	(+/-)	-0.59 (-1.4)
	FrRisk 07	(+/-)					-0.27 (-1.8)†	-0.32 (-2.5)†	(+/-)	-0.58 (-1.5)
	FrRisk 08	(+/-)					-0.18 (-1.9)†	-0.29 (-2.2)†	(+/-)	-0.44 (-1.1)
	FrRisk 09	(+/-)					-0.28 (-2.7)‡	-0.33 (-3.4)‡	(+/-)	0.18 (0.6)
	F-Test		114.6‡	126.4‡	1.163	198.7‡	78.3‡	406‡		136‡
	R-Squared		49%	17%	12%	21%	37%	79%		56%
	Nor-Test							0.0355 [0.9824]		3.2822 [0.1938]
	Rest-Test							2.6006 [0.1095]		1.0167 [0.3998]

Note Table 4: reports results for multiple Binary Logit outputs and OLS model in two panels. The first column of the table outlines the shipping performance factors under investigation. The first column in both panel's report expected regression sign. Panel (a) report results for conditional and unconditional Binary Logit models, were the dependent variable is the probability of default for shipping loans regressed against performance factors of shipping loans; namely, loan nature factors, borrower's finance factors; vessel nature factors; borrower's reliability and market risk. Panel (b) report results for the (OLS) model. Values in ( ) and [ ] are t-values and P-Values, respectively. Characters ‡, † and * denote significance at 1%, 5% and 10% respectively. Joint significance, goodness of fit, normality and model correct specification tests are reported in the bottom of the table.

6.2. Discussion of Hypotheses

In summary, our hypotheses tests suggest that the probability of default for shipping loans is directly correlated with employability risk. The probability of default is influenced by criteria such as borrower's reliability (H7), loan nature (H1), borrower's finance (H3), and market risk (H9). Thus, these can be seen to be of value in evaluating the performance of shipping loans during turbulent markets, while vessel nature (H5) is irrelevant. On the other hand, the spread of the loan is relevant to loan nature (H2), vessel nature (H6) and market risk (H10), while borrower's finance (H4) and borrower's reliability (H8) are irrelevant.

Specifically, ten main hypotheses, each with sub-hypotheses, were proposed in sections 4.1., 4.2., 4.3., 4.4. and 4.5. Of these, the hypothesis that was fully supported was H7. The hypotheses that were partially supported were H1 (with three sub-hypotheses supported)[3], H2 (with two sub-hypotheses supported)[4], H3 (with two sub-hypotheses supported)[5], H6 (with two sub-hypotheses supported)[6], H9 (with four sub-hypotheses supported)[7] and H10 (with two sub-hypotheses supported)[8]. The hypotheses that were rejected were H4, H5 and H8.

Furthermore, using the two-perspective framework depicted in Figure 1, banks' assessment of credit risk can be improved by full consideration of financial factors, client experience, type of shipping charter and market indicators. The cost of loans for shipowners is more sensitive to the amount and tenor of the loan, probability of default, vessel age and availability of collateral assets. This means that a less experienced and leveraged shipowner that employs his vessels in the spot market and owns more than one vessel that can be used as collateral is unlikely to be granted a loan, particularly during turbulent markets. If granted, the cost of the loan would depend on the amount borrowed, tenor, credit history and prospective earnings.

Defaulted shipping loans in the sample are associated with shipowners that have less experience and are highly leveraged, these loans are characterised to be of a large amount, small spreads, short tenors and lower asset value. In addition, the analysis provides some

[3] The sub-hypotheses are H1a, H1d and H1e
[4] The sub-hypotheses are H2a, H2d
[5] The sub-hypotheses are H3b, H3c
[6] The sub-hypotheses are H6b, H6c
[7] The sub-hypotheses are H9b, H9d, H9e, H9f
[8] The sub-hypotheses are H10a, H10b

evidence that these defaults are associated with inadequate initial setups and poor continuous monitoring from the bank side. However, it is evident that better arrangements were put in place in 2007, just after the start of the subprime crisis.

7. CONCLUSIONS

Credit risk analysis in the evaluation of bank loans is unquestionably a vital issue, especially for lenders but inevitably also for borrowers and related industries, as in the case of global supply chains involved in affected logistic routes. In financially distressed times the credit granting decision-making and process becomes stricter, tighter and with even lower margins of judgment error. This is particularly true for inherently risk-laden sectors. Previous research in default risk criteria has failed to include a contextualised examination of the subject matter leaving the field under-theorised. This study fills this gap by recognising the importance of context in any investigation of the factors that have an impact on the probability of default for bank loans. Further, it was hypothesised that the cost of shipping loans is directly associated with the probability of default. However, the results show an indirect relationship. A possible explanation is that loans with higher spread induce more efficient monitoring by banks, thus they are more likely to act prudently and perform well financially; while inflation, wrong decisions and other changes in the shipping market can alter or wipe out the lower-spread loans with the best-planned cash flows. Finally, this paper is in agreement with the literature that both financial and non-financial factors are important drivers of credit risk, in particular during turbulent markets. Results suggest employability contract and market sentiment are important drivers of shipping loan performance.

This study provides lending institutions with insight into performance drivers of shipping loans which can be fed in their more rigorous credit risk estimations and their internal credit evaluation application tools. The findings show that qualitative factors are still prevalent in the banker – shipowner relationship, even during turbulent times and even in an environment displaying increased emphasis on formality, uniformity and measurable rigorousness. Evidently qualitative factors have a positive contribution to both the 'before' and 'after' phase of debt finance: they not only increase the willingness of banks to take more risks in relation to loan borrowing (Jimenez and Saurina, 2004) but that they can also be related to more accurate assessment of loan performance, according to the findings. Pal et al's (2013) research point to similar conclusions highlighting the indirect influence of the 'soft' aspects like attentive leadership on firms' economic resilience against bankruptcy during economic crises.

This study has also shown that this is a period of greater institutional prudence by banks financing shipping. The exercise of such cautiousness may have two direct effects for shipping finance: a shrinking ship finance debt from the banks' portfolios and a change in the nature of the relationship between banker and ship owner with the application of more formal and rigid criteria for credit granting decisions. Borrowers may have learned that true protection against loan default lies in themselves and their ability to make optimal deployment of their assets in a constantly changing business environment. Shipping companies are likely to adjust their structure and position in the market in order to enable them to have continued access to capital and finance, for example, through mergers or acquisitions, changing the ownership structure (becoming publicly listed) and developing the areas which allude more to a more positive financial rating. The results of the study can help to identify the factors of credit risk they need to focus on to enhance their creditworthiness when competing for scarce financing facilities, especially during risk-laden market conditions.

Through the emphasis on the context of an examination of default risk analysis, this paper has also demonstrated the idiosyncrasies – finance-wise – of the shipping sector. In participating in this sector, many financial institutions have found the shipping industry to be a lucrative business. Increased profits during boom years strengthen banks involved in shipping and attract new players. New players in shipping finance, however, are expected to start playing a greater role also in today's fairly troubled times, such as Asian countries which have both the cash and the appetite to support the shipping industry (Xiradakis, 2010). Yet, there is a requirement that banks should know the industry, have competent staff and not panic during cyclical downturns. Shipping has the advantage of combining high returns with relative security, when it involves sound owners, young vessels and low finance (Petropoulos, 2009).

As it is, however, this paper adds to extant literature examining new variables which could be considered important when banks are assessing potential loans. It specifically adds to the conceptualisation of credit risk by contextualising it in the specific setting of the shipping industry. Further, a specific contribution to the shipping literature on risk management is made with regard to credit risk analysis by highlighting shipping specific factors and their importance for risk measurement. The paper also makes a significant contribution to industry practice; the results are of interest to banks and ship owners as they can identify the factors to assess the credibility of the shipping loans, minimise their credit risk, assist in the credit granting decision-making process, and thus help them make more reliable investment decisions. However, it is not only directly connected industries, like the banking sector, which are affected. In the context of global supply chains where the operations of interrelated industries and organisations depend on the smooth and uninterrupted flow of goods and information, a disruption in the maritime leg of the logistics route can cause serious operational and financial problems for producers, manufacturers, suppliers and other logistics service providers. The findings are also of interest to other capital intensive industries, such as the automobile and chemical industries. The economic cycle in such industries has also an impact on their supply chain reliability, i.e. unfulfilled bank financing can cause disruptions of global logistics operations.

The study benefited from access to particularly sensitive data of an especially secretive industry and at considerably turbulent times. Its limited data set allows us to gain some useful insights into debt financing in the context of risk-laden market conditions – whether stemming from a sector's features or its economic situation – but further research on the subject matter would be able to shed more light. Future studies could make use of a different set of performance drivers; they could examine a longer period of time than the one used in this research; they could focus on different shipping sectors – e.g. tanker fleet or specialised vessels, or; they could use an expanded bank base.

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