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Capital Structure in the Global Shipping Industry

Summary: The current economic crisis emerged from a particular financial crisis that started in the United States and being rapidly propagated all over the world. It did not affect a limited region or a limited economic sector. This crisis induced significant changes in all management areas, including financial management. This study is focused on financing strategies adopted by shipping companies during the crisis, analyzing relevant factors for a specific issue - the capital structure. The research methodology proposed for this analysis on relevant factors that could explain the capital structure of shipping is OLS regression applied on selected variables derived from the financial statements of the major shipping companies. The dependent variables reflecting capital structure are book value to total liabilities ratio and book value to total debt ratio. The explanatory variables are derived from the theory of capital structure. This study empirically illustrates the relevance of the capital structure theory for the studied economic sector and is a useful tool for the shipping companies, providing relevant information about the optimal capital structure adopted by shipping companies and about factors that influence this decision during a crisis period.

Key words: Financial management in shipping companies, Financing decision, Independence and dependence hypothesis, Optimal capital structure.

JEL: D24, G31, G32, L62.

The shipping industry is based on large investments made to organize a fleet of vessels to transport goods all over the world. Financing the industry is a sensitive problem requiring a significant amount of capital. The optimal capital structure (how much debt and how much equity) became a difficult problem in a competitive global market, producing significant savings of capital expenditures and an increasing competitiveness for the shipping companies to properly decide how to finance their fleet.

In a perfect world (without taxation, without agency costs, efficient markets with perfect knowledge, and no bankruptcy distress), the combination between debt and equity is irrelevant for the performance / value of the companies (independence hypothesis; Franco Modigliani and Merton Miller 1958; the basis of the modern theories about the optimal capital structure). However, the global world is not perfect and the current crisis disturbed the existing market conditions. Taxation is the simplest (and initially introduced) factor explaining the importance of the optimal capital structure in such imperfect markets, arguing that this aspect is relevant for the value of companies (dependence theory; Miller 1977). If you want to perform better than your competitors, you should strive to reach an optimal mix of funding sources.

This study is focused on a sensitive economic sector - the shipping industry. This sector is characterized by high capital allocation in fixed assets (ships), which entails important financing sources and specific financing strategies. Similar to the construction or heavy industry sectors, the last financial turmoil significantly changed the importance of relevant factors that could influence the financing decision and the capital structure. This study deals with this important aspect of financial management in such companies and provides an empirical insight based on the financial data of the major shipping companies in the world (based on the value of their assets).

1. Literature Review

The studies on the optimal capital structure started with the Modigliani-Miller independence theorem and the Miller analysis of the tax shield impact on the financing decision. More and more market imperfections are included in different analysis:

(1) Bankruptcy costs. In the sectors with high default probability (high-tech and biotech), the equity investors will prefer more debt and a lower equity to asset ratio. Alan Kraus and Robert Litzenberger (1973) directed the analysis in this direction by studying the balance between the dead-weight costs of bankruptcy and the tax-saving benefits of debt. Viral Acharya, Rangarajan Sundaram, and Kose John (2005) conducted a comparative analysis between the United States and the United Kingdom for the period 1990 to 2002 about the impact of bankruptcy costs on the optimal capital structure using as proxies for liquidation values the asset specificity of the firm and the weight of intangible assets in total assets, and they obtained robust findings. Elie Appelbaum (2007) studied the imminence of bankruptcy and its impact on the financing decision of firms. Armen Hovakimian, Ayla Kayhan, and Sheridan Titman (2011) studied the relevance of the default probabilities to explain the optimal capital structure theory.

(2) Agency costs. A higher leverage (lower equity to asset ratio) is submitted to reduce the agency costs of outside equity and increase the firm value. The investors will be more interested to reduce these agency costs by expanding the total debt of the company. Michael Jensen and William Meckling (1976) developed a theory of the ownership structure of the firm including aspects from the theory of agency. Dimitris Margaritis and Maria Psillaki (2010) studied the influence of agency costs on the financial leverage of French manufacturing companies using nonparametric methods. Mazhar Siddiqi (2009) analyzed the possibility of using simulation and option pricing techniques to obtain an optimal mix of financing sources that could reduce agency costs.

(3) Gains from taxes applied differently to debt and to equity. This is explained by the fact that a company commonly operates in multiple periods and the taxation regimes applied to dividends, capital gain, and repurchases of equities are important for financing decision. Harry DeAngelo and Ronald Masulis (1980) analyzed the case of U.S. companies and found a positive relationship between the market values of the firms and the debt tax shield. Dan Dhaliwal et al. (2005) examined how the corporate and personal taxes affect the association between a firm's capital structure and its cost of equity capital on a sample of 22,874 companies covering a

period between 1982 and 2004. Deen Kemsley and Michael Williams (2002) observed that personal taxes have relevant impact when a company decides to issue new equities but have no impact for internally sold equities.

(4) Asymmetric information. There could be a significant asymmetry between the information available for investors and for creditors regarding the management of the company and its financial stability or significant changes in the efficiency. Sreedhar Bharath, Paolo Pasquariello, and Guojun Wu (2008) found that a asymmetry of information influenced the capital structure on a case of U.S. firms over the sample period 1973 to 2002. Nikolay Halov and Florian Heider (2011) found robust results about the decision to issue securities of a significant unbalanced panel of listed U.S. companies from 1971 to 2001. Muradali Ibrahimo and Carlos Pestana Barros (2010) used a principal-agent model between banks and firms with risk and asymmetric information applied on European companies from 1995 to 2007.

(5) Industry-related factors. There are several studies concentrated on the influence of the activity sector on the capital structure. The sectors with higher growth rate are financed differently from the sectors with lower growth rate. The sectors dependent on fixed assets (construction and shipping) are financed differently from the sectors that are less dependent (intermediation). There are activity sectors with a market that supports different volumes of debt to finance a business development. John Siegfried (1984) was among the first researchers who conducted a comparative analysis of the capital structure of different industries. Jianjun Miao (2004) observed that high growth industries have relatively lower leverage and turnover rates. Magnus Talberg et al. (2008) studied five industrial sectors from the United States and obtained significant differences between them regarding the capital structure.

The shipping industry is considered to be a dynamic, capital-intensive, and cyclical business. The financing alternatives for such sector must ensure the availability of important capital resources for longer maturities. This study consists of the application of the capital structure theory to a specific sector - the shipping industry with many important features: much globalized industry, fuel cost-sensitive industry, high tangibility of assets, and highly leveraged businesses. The access for long-term credit is limited, especially during crisis time when banks and private investors become more risk averse and seek increased fiscal performance and clearance. According to the ABN AMRO Report of 2011, the traditional sources for financing shipping industry are syndicated loans (40.2%); bilateral lending, internal equity finance, shipyard finance, and public finance (36.2%); nonship mortgage loans (8%); bond and public equity (5%); equity funds (2.5%); and others (tax lease investors and KS/KG markets with 8%).

In the literature, we can find few academic studies focused on the financing aspects of this specific sector. Stefan Albertijn, Wolfgang Bessler, and Wolfgang Drobetz (2011) offered a managerial perspective on the means of financing the shipping companies and their operations. Theodore Syriopoulos (2007) studied the modern financing techniques that are used by the shipping industry. This paper provides a useful insight in the shipping industry financial management strategies, analyzing the relevant factors for establishing the optimal capital structure according to the most important economic theories: the “trade-off” theory of capital structure that is balanc-

ing the dead-weight costs of bankruptcy of shipping companies and the tax-saving benefits of contracted debt and the "pecking-order" theories that are based on the assumption of prioritizing the sources of financing based on the estimated cost of capital and the strong connection between capital structure and the existing asymmetry of information in this field (when managers from the shipping industry estimate an increasing profitability of their company, they will search for more debt over equity; asymmetry of information on the company financial situation stimulating this behavior; the opposite situation is also available). Crisis time significantly changed the perspective on the liberalization of financial markets (Jamel Boukhatem 2012), corporate governance (including long-term financing), and the role of foreign direct investments for emerging markets, (Rajmund Mirdala 2006). Global stock markets became more and more interrelated, providing fewer benefits from diversification and a significant change in the investors' risk aversion (Cristiana Tudor 2011). During crisis, many banks limit their credit support for the private sector, and investment projects suffer due to these limitations. Moreover, taxes increased in almost all countries and the capital structure is sensitive to this aspect. This study is important to explain the capital structure of highly leveraged companies, such as shipping companies, and the results provided by our empirical research could be used to argue for the debt to equity ratio proposed for investment projects in this particular field of activity. We included in our analysis the most important factors derived from the main theories on capital structure and tested their relevance and influence in accordance with the financial and economic performance reflected in their statements.

2. Development of Hypotheses

The main theories regarding the optimal capital structure could be grouped into two categories: (a) "trade-off hypothesis" that establishes an optimal capital structure for each company based on a trade-off between tax shield and costs with financial distress and (b) "pecking-order hypothesis" that establishes that there is no optimal capital structure for companies, as there is a continuous balance between internal and external financings in accordance with the existence of cash flows necessary for operating the business. This study tests the significance of the selected factors on the capital structure of companies acting in the shipping sector. If the study identifies such relevant factors for capital structure, the pecking-order theory is rejected. The following hypotheses are being tested in this study.

[H1] Size has a positive impact on the financial leverage of shipping companies. According to several studies, the size of the company has a positive influence on the financial leverage of a company (Frank Murray and Vidhan Goyal 2003; Philippe Gaud et al. 2005; Samuel G. H. Huang and Frank M. Song 2006; Ilya Strebulaev and Alexander Kurshev 2006). Anyway, the impact of this factor is considered to be ambiguous due to a number of studies that found a negative impact or no conclusive impact on the financial leverage of the studied companies (Bassan Fattouh, Laurence Harris, and Pasquale Scaramozzino 2005; Drobetz and Roger Fix 2005; Savina Princen 2012). The size of the company could be evaluated in different ways: based on sales volume, number of employees, total assets, etc. For shipping companies, a useful indicator for the size of the companies (market power) is the transporta-

tion capacity expressed in 20-foot equivalent units (TEU) and divided by the total transportation capacity (as proxy a market share measure).

[H2] The profitability of the company has a positive influence on the financial leverage of shipping companies (the negative impact will be reconsidered too due to obtained empirical findings). A higher profitability determines a higher tax shield effect; therefore, the companies will search for higher financial leverage. A higher profitability means higher cash flows available for managers and more debt could force managers to efficiently use the resources generated internally through the activity of the company. A positive effect on the financial leverage was determined by Leora Klapper and Konstantinos Tzioumis 2008; for equity to total assets ratio (TAR) Murray and Goyal 2008; Jin Xu 2011). On the contrary, more profitable shipping companies are generating more free cash flows to be reinvested in the same business. Profitability will have a negative impact on the financial leverage (Raghuram Rajan and Luigi Zingales 1995; Laurence Booth et al. 2001; Patrik Bauer 2004; Drobetz and Fix 2005; Huang and Song 2006; Halov and Heider 2011). The combined effect could be positive on the financial leverage of the companies when the companies remain more interested to distribute profits as dividends rather than to invest them. The fiscal aspects regarding paid dividends and reinvested profits could be relevant for the influence of this factor. The commonly used indicators are return on assets (ROA; net income divided by the total assets), EBIT margin (EBITM; EBIT divided by the total sales), return on equity (ROE; net income divided by the stockholders' equity), and profit margin (PM; net income divided by the total sales).

[H3] The tangible assets of shipping companies have a positive influence on their financial leverage. The value of fixed (tangible) assets is relevant for the credibility of the companies interested to obtain a credit, improving their debt capacity. Theoretically, a higher value for these assets has a positive effect on the financial leverage. The vessels of shipping companies could be used as reliable collateral for banks in case of bankruptcy (this positive effect was illustrated by Drobetz and Fix 2005; Talberg et al. 2008; Halov and Heider 2011). This factor could explain the existing differences in terms of financial leverage between sectors such as construction, transportation, tourism, energy, and raw materials. The commonly used indicator to test this hypothesis is the weight of fixed assets in total assets.

[H4] Higher growth opportunities for business will reduce the financial leverage of shipping companies. When the growth opportunities for a shipping company increase, the company uses more equity financing due to the real interest in transferring such wealth to stockholders. This negative effect was obtained by Rajan and Zingales (1995), Drobetz and Fix (2005) and Ali Mustafa Abdullah Al-Qudah (2011). The indicator recommended by specialists to be used as proxy for testing this hypothesis is the book to market ratio (MBR; net asset value of the company divided by the market capitalization).

[H5] A higher tax rate will increase the financial leverage of shipping companies. The financial situation of shipping companies could be significantly improved if, in case of high taxes, these companies will increase the ratio of debt as much as possible (Bauer 2004; Klapper and Tzioumis 2008; Michael Pfaffermayr, Matthias Stöckl, and Hannes Winner 2008). On the contrary, in a few sectors or countries, the

tax shield effect has a marginal significance compared to other direct or indirect taxes paid by companies (for example, VAT, labor taxes, and taxes on property could be higher than the taxes applied on distributed dividends). The impact of taxation is estimated using the difference between earnings before interest and taxes (EBIT) and earnings after taxes ratio.

[H6] Higher nondebt tax shield will decrease the financial leverage of shipping companies. Beside tax shield, in practice, we can observe another important aspect for the capital structure of a company, which is called nondebt tax shield as tax deductions for depreciation. The negative relationship between nondebt tax shield and financial leverage is present in the studies of Titman and Roberto Wessels (1988), Bauer (2004) and Huang and Song (2006). When this nondebt tax shield is higher (more deductions), the company will be more interested to decrease the debt volume (the specialists observed that nondebt tax shields act as a substitute for tax shield in this case). The recommended indicator for this problem is depreciation divided by the total assets of the company (see Table 1 for summary of these hypothesis).

Table 1 Summary of Hypothesis Regarding the Financial Leverage of Shipping Companies

Hypothesis	Expected influence
[H1] Size	Positive (+)
[H2] Profitability	Positive (+) or negative (-)
[H3] Tangible assets	Positive (+)
[H4] Growth opportunities	Negative (-)
[H5] Tax rate	Positive (+)
[H6] Nondebt tax shield	Negative (-)

Source: The authors.

Similar studies added to the proposed hypothesis the relevance of the activity sector (testing similarities between them using a dummy variable) and the volatility of stocks issued by the companies included in the sample. In our case, not all studied shipping companies are listed on a stock exchange and the analysis is concentrated on a single activity sector, including companies with identical characteristics regarding this subject.

Another sensitive aspect for this kind of analysis refers to the manner in which the financial leverage of a company is estimated. In similar studies, we can find four different indicators used for this dependent variable (Bauer 2004; Drobetz and Fix 2005): (i) BTL (book value to total liabilities ratio; divides the total liabilities by the sum between total liabilities and book value of the company), (ii) BTD (book value to total debt ratio; divides the total debt of the company by the sum between total debt and book value of the company), (iii) market value to total liabilities ratio (divides the total liabilities by the sum between total liabilities and market value of the company, and (iv) market value to total debt ratio (divides the total debt of the company by the sum between total debt and market value of the company). Book value is easier to be calculated and it is available for the companies that are not listed on the stock exchange too. Market value depends on whether the companies are listed or not on the stock exchange. For limited liability companies or partnerships, the market value indicator is also difficult to be obtained.

3. Research Methodology and Model Variables

The research methodology proposed to test the influence of different factors on the financing decision in case of shipping companies is the OLS method, which estimates the coefficients associated with each of one of them. For the homoscedasticity of residuals, the Halbert White (1980) test was applied (applied only on the restricted OLS models' residuals; see Appendix 2 and 3 for outputs), and for the normality test on variables, two separated tests were used: the Kolmogorov-Smirnov test and the Shapiro-Wilk test (when normal distribution was violated, data transformation was applied; see Appendix 1 for outputs before and after data normalization).

The following indicators are associated with each hypothesis.

[H1] Size of the shipping companies: sales volume ratio computed by dividing the sales volume of each shipping company by their total sales (SALES = Company sales / Total sample sales) and TAR computed by dividing the total assets of each company by their total assets (TAR = Company total assets / Total sample assets). The total transportation capacity or the number of employees of the shipping companies could not emphasize correctly the size of the shipping company because there can be unused or not fully used carrying capacity during the year or there can be companies with many employees not directly involved in providing shipping services to the market. The sales volume or the total assets are proxies for the size of the company used in similar studies (Bauer 2004; Drobetz and Fix 2005; Klapper and Tzioumis 2008).

[H2] Profitability of the shipping companies: ROA (ROA = Net profit / Total assets), EBITM (EBITM = EBIT / Total sales), ROE (ROE = Net profit / Shareholders' equity), and PM (PM = Net profit / Total sales).

[H3] Tangible assets of shipping companies: the weight of fixed assets in the total assets of the company (FA = Fixed assets / Total assets of shipping companies).

[H4] Growth opportunities: MBR of the shipping companies (MBR = Market value of the company / Shareholders' equity). The market value of the company is computed by multiplying the total weighted number of shares and market value for these shares (assuming that the company is listed on the stock exchange).

[H5] Taxation: difference between EBIT and EAT divided by EBIT (TAX = Income taxes / EBIT).

[H6] Nondebt tax shield: depreciation divided by the total assets of the company (DEPR = Depreciation and amortization costs / Total assets).

The following two variables were used as dependent variables to estimate the financial leverage of the companies: BTL [BTL = Total liabilities / (Total liabilities + Book value of the company)] and BTD [BTD = Total debt / (Total debt + Book value of the company)] (as suggested in the similar studies developed by Bauer 2004; Drobetz and Fix 2005; Klapper and Tzioumis 2008).

The features of the variables included in our model are as follows: (1) the independent variables are not strongly correlated (see Table 2); (2) the independent variables are precisely measured based on the shipping companies' financial statements with negligible errors; (3) the residuals are presumed to be uncorrelated; (4) the relationship between variables (BTL and BTL as dependent variables and SALES, TAR, ROE, ROA, EBITM, PM, FA, MBR, and TAX as independent vari-

ables) is presumed to be linear in the parameters and they have equal variance and are uncorrelated; and (5) the residuals are presumed to have homogenous variance and to be normal distributes, noise of ε is white (the White test on heteroscedasticity has been applied in this respect; see Appendix 2 and 3). There are no missing data in our sample (OLS is sensitive to this issue). The size of the data sample is not highly consistent, including only 238 firm-year data after we excluded a few inconsistent observations. Therefore, these features explain the option for the OLS regression estimating procedure. This estimating methodology is the simplest type of estimation but is also flexible and easy to be interpreted, with unbiased estimators when the mentioned features are achieved. The estimators provided by the OLS methodology are similar to the maximum likelihood estimation considering that parameters have equal variance and are uncorrelated. If the White test confirms the presence of the heteroscedasticity of errors, the estimators are biased and alternative regressions are recommended.

4. Sample Description

We decided to include in our empirical test only listed shipping companies (to obtain the market value of the company). The list of companies was obtained using the Top 100 Shipping Companies provided by Alphaliner (2013)[1], the listed shipping companies provided by Bloomberg (2013)[2], and the listed shipping companies provided by NASDAQ (2013)[3], the New York Stock Exchange (2013)[4], EURONEXT (2013)[5], and the Tokyo Stock Exchange (2013)[6]. Using these sources, we obtained a list of shipping companies that are publicly listed on these stock exchanges with financial data available for the 2009 to 2011 period (assimilated with the crisis time). We collected the publicly available yearly income statements and balance sheets for all companies included in our list. We decided to remove from the data sample the companies that registered loss in the assessed period (considering that the presence of this negative status is a clear sign of disequilibrium for the companies). The necessary financial data were transferred from the indicated financial statements into an Excel, and we computed each variable according to the aforementioned formula (dependent variables: BTL and BTD and explanatory variables: SALES, TAR, ROE, ROA, EBITM, PM, FA, MBR, TAX, and DEPR). All data denominated in local currencies were converted into USD using the exchange rate available for end of the year (we used http://www.oanda.com to obtain the values for these nominal exchange rates).

[1] **Alphaliner.** 2013. Top 100 Operated Fleets. http://www.alphaliner.com/top100/index.php (accessed May 10, 2013).
[2] **Bloomberg.** 2013. List of Shipping Companies. http://www.bloomberg.com/markets/ companies/transport-marine/ (accessed May 10, 2013).
[3] **National Association of Securities Dealers Automated Quotations (NASDAQ).** 2013. Financial Data for American Shipping Companies. http://www.nasdaq.com/ (accessed May 10, 2013).
[4] **New York Stock Exchange.** 2013. Financial Data for American Shipping Companies. http://www.nyse.com/ (accessed May 10, 2013).
[5] **EURONEXT.** 2013. Financial Data for European Shipping Companies. http://www.euronext.com (accessed May 10, 2013).
[6] **Tokio Stock Exchange.** 2013. Financial Data for Asian Shipping Companies. http://www.tse.or.jp/english/ (accessed May 10, 2013).

For the market value of each company, we used the market price provided by the stock exchange (for this reason, we decided to include in the study only the listed shipping companies). The number of ordinary (or common shares) was provided by the financial statements. The descriptive statistics for selected variables is presented in Table 2. The number of observations initially included in the study is 246 firm-year observations (covering 2009, 2010, and 2011). Following the normalization of the data sets, we kept in the sample only 238 firm-year observations and excluded one dependent variable that failed the normal distribution tests and the common normalization procedures.

Table 2 Descriptive Statistics for the Selected Variables (238 Observations)

Variables	Mean	Median	Maximum	Minimum	SD	Skewness	Kurtosis
BTL	0.515069	0.522237	0.960382	0.005646	0.172336	-0.12225	3.036012
BTD	0.377621	0.376335	0.948082	0.000000	0.198617	0.19633	2.755595
SALES	0.004167	0.000692	0.119450	0.000003	0.012703	5.722504	41.16897
TAR	0.004102	0.001320	0.107990	0.000004	0.009764	6.558827	59.66888
ROA	0.056500	0.041310	0.313896	0.000180	0.053085	1.805058	7.111658
ROE	0.116099	0.087615	0.748390	0.000482	0.105770	2.317281	10.98609
EBITM	0.215868	0.142570	2.973524	0.006587	0.259685	5.662779	55.67045
PM	0.160970	0.088000	2.467116	0.000427	0.232841	5.154403	44.85428
FA	0.650091	0.692945	0.980300	0.045690	0.220905	-0.766300	2.814859
MBR	1.142537	0.983252	4.469969	0.078980	0.784667	1.530889	5.542491
TAX	0.126091	0.062450	0.882300	0.000100	0.142083	1.854559	7.567693
DEPR	0.040712	0.037592	0.157194	0.001334	0.021215	1.761356	9.351127

Source: Own estimations based on 238 observations.

The global shipping industry maintained a relatively high financial leverage during the crisis time, slightly above the average for the overall services industry (the mean for BTL indicator is 52.2% and the mean for BTD indicator is 38.87%; the BTD for the services industry in the United States at the end of 2011 was 44.76%). This sector operates with reduced profitability, slightly above the industry average in the case of ROA and below average in the case of ROE (the mean for ROA is 5.9% and the mean for ROE is 13.6%; the ROA reported for the U.S. services industry at the end of 2011 was 5.34% and the ROE for the same sector was 14.6%). The study excluded companies with negative results during the analyzed period. The EBITM and PM of the global shipping industry continued to be higher than the average for the services industry (the analyzed sample returned a mean EBITM of 22.8% and a mean PM of 16.9%; the U.S. services industry registered only a 5.61% PM in 2011). The taxation ratio is reduced for this sector (4% on average) due to the specific aspect of the activity (international services) and fiscal regime applied to most registered companies (many shipping companies are registered in offshore countries as international companies). This sector is highly dependent on fixed assets (the fixed assets to TAR, on average, is higher than 64%).

The MBR (divides the shareholders' equity by the market value of the company obtained by multiplying the market price of common stocks and total number of

shares) indicates (the mean for MBR is higher than 1) that the book value of the company is higher than the market value (a normal situation for the crisis period when the price of most stocks is significantly decreased due to increased risk aversion and lower capital market activity). All market prices were obtained from the stock exchange and will be converted to the same currency (in this case, the USD). For computing the MBR, we used the stock prices for the last trading day of the year.

Because some explanatory variables failed to be normally distributed, we decided to apply different methods to achieve an approximate normal distribution. Taking into consideration the features of the data sample (firm-year data), we used appropriate methods for normalization: the dependent variables (BTL and BTD) follow an approximately normal distribution (see Appendix 1, Section 1, for tests and histograms); the explanatory variables SALES, EBIT, PM, and MBR have been log normalized (see Section 4 of the Appendix 1, for tests and histograms); and the explanatory variables TAR, ROA, ROE, and TAX have been normalized by adjusting individual values with average and SD (Nornadiah Mohd Razali and Yap Bee Wah 2011). The explanatory variable FA failed normal distribution tests (see Section 3 of the Appendix 1), but the histogram and values for skewness and kurtosis indicate an approximately normal distribution (the same section), so we decided to convert this variable into a normally distributed one. Due to difficulties in achieving normal distribution for the DEPR explanatory variable, we decided to eliminate it from this study.

5. Results

In our model, the dependent variables that describe the capital structure are BTL (divides the total liabilities of shipping companies by the sum between their total liabilities and their book value of equity capital) and BTD (divides the total debt of shipping companies by the sum between their total debt and their book value). According to the trade-off and pecking-order theories, the capital structure of the shipping companies can be explained by different factors such as the size of the company (SALES and TAR), the profitability of the firm (ROA, ROE, EBITM, and PM), the tangibility of the company's assets (FA), the growth opportunities for that business (MBR), and the taxation applied to the level of that business (TAX). DEPR was excluded from the model because this explanatory variable failed to be normally distributed.

The preliminary step was the correlation matrix of the variables included in our empirical study. The correlation analysis is relevant to see if there could be a problem of multicollinearity among explanatory variables (the dependent variables BTL and BTD are explained by different explanatory variables that should be independent in the model; if not, there can be large standard errors in the estimates, the regression can be unstable, and the estimators can be biased). According to the correlation matrix (see Table 3), the only highly correlated variables are the ones associated with the same group of explanatory variables: TAR and SALES (0.940) are associated with [H1] and describe the size of the shipping companies, and ROE and ROA (0.829) are associated with [H2] and describe the profitability of the shipping companies. A strong positive correlation also exists in the case of the dependent variables BTD and BTL (0.822). The existence of these positive strong correlations is

not problematic because these correlated variables are not tested together. The low correlation between variables included in the model suggests that there is no strong collinearity among them.

Table 3 Correlation Matrix for Selected Variables (238 Observations)

Variables	BTL	BTD	SALES	TAR	ROA	ROE	EBITM	PM	FA	MBR	TAX	DEPR
BTL	1.000											
BTD	0.822	1.000										
SALES	0.018	-0.057	1.000									
TAR	0.049	0.023	0.940	1.000								
ROA	-0.412	-0.429	-0.023	-0.044	1.000							
ROE	-0.012	-0.108	-0.003	-0.020	0.829	1.000						
EBITM	-0.181	-0.033	-0.148	-0.090	0.305	0.227	1.000					
PM	-0.293	-0.162	-0.134	-0.091	0.449	0.320	0.920	1.000				
FA	0.218	0.404	-0.179	-0.122	-0.389	-0.255	-0.013	-0.128	1.000			
MBR	-0.096	-0.039	-0.045	-0.025	-0.215	-0.270	-0.034	-0.065	0.217	1.000		
TAX	0.011	-0.187	0.292	0.219	0.014	-0.001	-0.207	-0.151	-0.304	-0.075	1.000	
DEPR	-0.007	0.010	0.332	0.263	-0.058	-0.053	-0.065	-0.101	0.196	0.076	0.095	1.000

Note: A "high" correlation is a correlation higher than 0.8 (in absolute value).

Source: Authors' estimations.

The first step in our analysis was to test "the aggregate impact of all variables at the same time". We ran two sets of eight OLS models for each dependent variable (BTL and BTS). These eight OLS models for each dependent variable are explained by the fact that we included in the data set two different variables for the size of the company factor (SALES and TAR) and four variables for the profitability of the company factor (ROA, ROE, EBITM, and PM), whereas the remaining explanatory variables (FA, MBR, and TAX) are common to all OLS models. The chosen combination of these factors generated the eight OLS equations for each dependent variable for a total of 16 OLS estimating models. The results for the first step of the analysis that included all explanatory variables combined are summarized in Table 4 (for BTL as the dependent variable) and Table 5 (for BTD as the dependent variable).

When we used BTL as the dependent variable (see Table 4), we obtained the following results: companies' profitability (ROA, EBIT, and PM; excluding ROE), business growth opportunities (MBR), and companies' tangibility of their assets (FA) are relevant for explaining the capital structure of the analyzed shipping companies as measured by the BTL indicator. A closer look into the results reveals the following additional aspects: (a) the shipping companies' profitability has a negative impact on their financial leverage (the most relevant factors in this case are ROA, PM, and EBIT; ROE is not relevant in this case), (b) the tangibility of shipping companies' assets (FA) has a positive impact on the financial leverage of the shipping sector, and (c) business growth opportunities (MBR) have a negative impact on the financial leverage of the analyzed sample. These results are robust as observed in all OLS models. Moreover, estimators have a strong significance in all cases (*p*-values are lower than the critical value of 0.01, indicating a significance of 99% for all of them). The combination of ROA, FA, and MBR and the combination of PM, FA, and MBR

have the highest values for F-statistic and adjusted R^2, explaining better the financial leverage (BTL) of the shipping companies. The obtained results indicate that the size of the company (either measured by SALES or measured by TAR) and taxation are not relevant in explaining the capital structure in almost all cases included in the study. Therefore, a restricted OLS model will exclude these two factors: size and fiscal aspects. By doing so, we expect a higher degree of accuracy in our estimating model. All these findings confirm the theoretical hypothesis of our research.

Table 4 OLS Estimation Results for the Combined Explanatory Factors (BTL)

BTL as the dependent variable (unrestricted OLS): 238 observations								
Indicators	**OLS 1**	**OLS 2**	**OLS 3**	**OLS 4**	**OLS 5**	**OLS 6**	**OLS 7**	**OLS 8**
SALES	0.026* [2.169]	0.020 [1.522]	0.004 [0.328]	0.005 [0.424]				
TAR					2.433 [1.254]	2.297 [1.066]	2.625 [1.272]	2.993 [1.531]
ROA	-2.453* [-7.614]				-2.403* [-7.433]			
ROE		-0.113 [-1.153]				-0.100 [-1.027]		
EBITM			-0.116* [-4.436]				-0.119* [-4.722]	
PM				-0.117* [-6.926]				-0.120* [-7.189]
FA	0.106* [2.128]	0.215* [3.993]	0.256* [5.057]	0.220* [4.620]	0.096 [1.901]	0.206* [3.776]	0.248* [4.871]	0.210* [4.383]
MBR	-0.139* [-4.229]	-0.135* [-3.634]	-0.141* [-3.990]	-0.130* [-3.909]	-0.137* [-4.146]	-0.133* [-3.579]	-0.143* [-4.050]	-0.132* [-3.975]
TAX	0.072 [0.786]	0.132 [1.304]	0.027 [0.101]	0.024 [0.255]	0.095 [1.042]	0.148 [1.470]	0.017 [0.169]	0.015 [0.159]
Intercept	0.410* [8.860]	0.430* [8.331]	0.259* [0.063]	0.255* [4.754]	0.400* [6.687]	0.431* [6.514]	0.311* [4.544]	0.315* [5.064]
Adj. R^2	0.271	0.094	0.160	0.245	0.261	0.089	0.165	0.252
F-statistic	18.587	5.894	10.005	16.346	17.727	5.630	10.372	16.931

Note: *1%; **5%; ***10% significance level. The values in brackets represent the *t*-statistic for coefficients.

Source: Authors' estimations.

The second set of unrestricted OLS models is focused on the second dependent variable describing the financial leverage of shipping companies. The OLS estimations of BTD as the dependent variable revealed the following aspects (see Table 5): the size of the company measured by TAR is relevant in two cases (with a positive influence, confirming though the initial theoretical hypothesis); the profitability of the shipping companies is relevant in explaining the financial leverage measured by BTD only in the case of ROA, PM, and EBIT (only ROE is not relevant in this case); the profitability measured by ROA and PM has a negative influence on the financial leverage; the tangibility of assets measured by FA has a positive influence on the capital structure; and business growth opportunities have a negative impact on the financial leverage based on BTD. The results of the second unrestricted OLS set revealed that the size of the company measured by the volume of sales (SALES) and

fiscal aspects (TAX) has no impact on the capital structure of the shipping companies. These results are also robust as observed in all OLS models. Moreover, estimators once again have a strong significance in all considered cases (the *p*-value is lower than the critical value of 0.01, indicating a significance of 99% for all of them). The combination of ROA, FA, and MBR, the combination of TAR, ROA, FA, and MBR, and the combination of TAR, PM, MBR, and TAX score the highest value for the F-statistic and adjusted R^2, better explaining the financial leverage (BTL) of the shipping companies. The results obtained indicate that the size of the company (only measured by SALES) and taxation are not relevant in explaining the capital structure in almost any of the cases included in the second set of OLS equations. Therefore, a restricted OLS model will exclude again these two factors: size and fiscal aspects. By doing so, we search for more accuracy in our estimating model. We observed that the F-statistic and adjusted R^2 have higher values in the case of BTD that BTL as the dependent variable.

Table 5 OLS Estimation Results for the Combined Explanatory Factors (BTD)

	BTD as the dependent variable (unrestricted OLS)							
Indicators	**OLS 1**	**OLS 2**	**OLS 3**	**OLS 4**	**OLS 5**	**OLS 6**	**OLS 7**	**OLS 8**
SALES	0.019 [1.468]	0.014 [0.994]	0.006 [0.375]	0.002 [0.129]				
TAR					4.556 [2.154]	4.472 [1.922]	4.513 [1.942]	4.903 [2.188]
ROA	-2.571 [-7.23]				-2.541 [-7.209]			
ROE		-0.182 [-1.71]				-0.178 [-1.690]		
EBITM			-0.050 [-1.67]				-0.055 [-1.91]	
PM				-0.086 [-4.42]				-0.089 [-4.659]
FA	0.245 [4.475]	0.351 [5.992]	0.386 [6.747]	0.368 [6.699]	0.228 [4.162]	0.335 [5.693]	0.372 [6.499]	0.352 [6.420]
MBR	-0.129 [-3.57]	-0.130 [-3.21]	-0.123 [-3.08]	-0.120 [-3.11]	-0.130 [-3.616]	-0.131 [-3.260]	-0.127 [-3.19]	-0.123 [-3.239]
TAX	-0.177 [-1.75]	-0.116 [-1.05]	-0.156 [0.114]	-0.192 [-1.77]	-0.172 [-1.733]	-0.117 [-1.081]	-0.174 [-1.53]	-0.213 [-2.000]
Intercept	0.135 [2.64]	0.154 [2.75]	0.083 [0.071]	0.027 [0.437]	0.199 [3.057]	0.230 [3.219]	0.180 [2.334]	0.148 [2.069]
Adj. R^2	0.332	0.191	0.191	0.245	0.339	0.201	0.203	0.260
F-statistic	24.535	12.210	12.181	16.357	25.288	12.890	13.097	17.647

Note: *1%; **5%; ***10% significance level. The values in brackets represent the *t*-statistic for coefficients.

Source: Authors' estimations.

As a preliminary conclusion for the first part of our analysis, by comparing the two dependent variables used to express the financial leverage, we observed the following differences: (i) the test based on BTL revealed that taxation does not explain the financial leverage of the shipping companies, but the BTD-based test confirmed that taxation has a negative impact on the financial leverage (in one case only); (ii)

the test based on BTL revealed that the size of the company does not explain the financial leverage, but the BTD-based test confirmed that the size of the company measured by TAR has a positive impact on the financial leverage of the shipping companies (confirming the initial theoretical hypothesis); (iii) EBIT explains only the financial leverage expressed by BTL (negative impact) and does not explain financial the leverage calculated by BTD; and (iv) the considered explanatory variables explain better the financial leverage measured by BTD than that measured by BTL (according to the adjusted R^2 and F-statistic). Both dependent variables used to express the financial leverage of the shipping companies confirmed that TAX, SALES, and ROE are not relevant explanatory factors.

The next step in our analysis consists of removing the irrelevant explanatory variables and obtaining a restricted number of OLS models from the initial ones. By doing so, we obtained a better correlation between the explanatory factors and the dependent variable (higher adjusted R^2), a better statistical significance for the estimating models (higher F-statistic), and a higher significance for each coefficient determined for each explanatory variable (higher *p*-value). Moreover, by restricting the OLS models, we confirmed the robustness of the results previously returned by the unrestricted OLS models. The results corresponding to the restricted OLS sets for each dependent variable (BTL and BTD) are summarized in Tables 6 and 7.

Table 6 OLS Estimation Results for the Restricted Models (BTL Case)

BTL as the dependent variable (restricted OLS): 238 observations								
Indicators	**OLS 1**	**OLS 2**	**OLS 3**	**OLS 4**	**OLS 5**	**OLS 6**	**OLS 7**	**OLS 8**
SALES	0.027 [2.338]							
TAR								
ROA	-2.477 [-7.728]				-2.614 [-8.521]			
ROE								
EBITM			-0.120 [-4.956]				-0.120 [-4.956]	
PM				-0.119 [-7.317]				-0.122 [-7.374]
FA	0.092 [1.980]	0.198 [4.012]	0.251 [5.218]	0.214 [4.807]		0.198 [4.012]	0.251 [5.218]	0.217 [4.772]
MBR	-0.138 [-4.205]	-0.122 [-3.323]	-0.140 [-3.992]	-0.129 [-3.898]	-0.125 [-3.802]	-0.122 [-3.323]	-0.140 [-3.992]	-0.041 [-3.202]
TAX								
Intercept	0.417 [9.159]	0.382 [11.240]	0.242 [5.641]	0.238 [6.508]	0.384 [21.538]	0.382 [11.240]	0.242 [5.641]	0.285 [7.727]
Adj. R^2	0.272	0.083	0.166	0.250	0.251	0.083	0.166	0.235
F-statistic	23.118	11.656	16.738	27.353	40.726	11.656	16.738	25.265

Note: *1%; **5%; ***10% significance level. The values in brackets represent the *t*-statistic for coefficients. For the homoscedasticity of the data sample, the White test was applied (see Appendix 2).

Source: Authors' estimations.

The restricted OLS models applied to the BTL case (Table 6) confirmed the results obtained by the unrestricted OLS models: the size of the company estimated by the TAR is inconclusive to explain the financial leverage of the shipping companies and the size of the company estimated by total sales (SALES) has a positive impact on the capital structure of the shipping companies (only in one case); the profitability of the shipping companies measured by ROA has a negative impact on the capital structure, the profitability of the shipping companies measured by ROE is not relevant to explain the financial leverage, the profitability expressed by EBIT has a negative impact on the capital structure, and the profitability of the shipping companies measured by PM has a negative impact on their capital structure; the tangible assets ratio (FA) has a positive impact on the capital structure of the shipping companies; the MBR that expresses the growth opportunities of the shipping companies has a negative impact on their capital structure; and the taxation level (TAX) has no relevant impact on the financial leverage of the shipping sector.

Similarly, the restricted OLS model was applied on the second dependent variable that describes the financial leverage of the shipping companies (BTD) by removing irrelevant explanatory variables.

Table 7 OLS Estimation Results for the Restricted Models (BTD Case)

BTD as the dependent variable (unrestricted OLS): 238 observations								
Indicators	**OLS 1**	**OLS 2**	**OLS 3**	**OLS 4**	**OLS 5**	**OLS 6**	**OLS 7**	**OLS 8**
SALES								
TAR					4.216 [1.993]			4.903 [2.188]
ROA	-2.485 [-7.000]				-2.490 [-7.059]			
ROE								
EBITM								
PM				-0.085 [-5.373]				-0.089 [-4.66]
FA	0.273 [5.309]	0.390 [7.301]	0.554 [32.070]	0.424 [14.542]	0.263 [5.110]	0.390 [7.301]	0.390 [7.301]	0.352 [6.420]
MBR	-0.129 [-3.567]	-0.118 [-2.961]	-0.143 [-3.606]	-0.127 [-3.354]	-0.133 [-3.680]	-0.118 [-2.96]	-0.118 [-2.96]	-0.123 [-3.24]
TAX								-0.213 [-2.00]
Intercept	0.075 [2.196]	0.120 [3.243]			0.185 [2.856]	0.120 [3.243]	0.120 [3.243]	0.148 [2.069]
Adj. R^2	0.325	0.187	0.154	0.243	0.333	0.187	0.187	0.260
F-statistic	38.975	28.200	N/A	N/A	30.597	28.200	28.200	17.647

Note: *1%; **5%; ***10% significance level. The values in brackets represent the *t*-statistic for coefficients. For the homoscedasticity of the data sample, the White test was applied (Appendix 3).

Source: Authors' estimations.

The restricted OLS models BTD case (Table 7) confirmed again the results obtained by applying the unrestricted OLS models: the size of the company expressed by SALES is inconclusive for explaining the financial leverage returned by BTD and the size of the company expressed by TAR has a positive impact on the financial leverage of the shipping companies; the profitability of the shipping companies explains the financial leverage measured by BTD only for ROA and PM (not EBIT and ROE), and the impact is negative in both cases; the tangibility of assets has a positive impact on the financial leverage measured by BTD (in all considered cases); and the business growth opportunities (MBR) have a negative impact on the financial leverage.

The estimators provided by the OLS estimating procedure are highly sensitive to the existence of the heteroscedasticity of errors. Therefore, we applied a White test on the restricted OLS only to identify the violation of homoscedasticity of errors (in this case, the results are assumed to be biased). According to the results (see Appendix 2 for restricted OLS based on BTL as the explanatory variable and Appendix 3 for restricted OLS based on BTD). In almost all cases (with only one exception), the OLS estimating models failed the White test, thus indicating that errors are homoscedastic and the estimators are unbiased.

6. Final Conclusions

This research on the shipping sector analyzed, using the OLS estimating framework, the impact of various factors derived from the trade-off and pecking-order theories on the capital structure. The study proposes two indicators as proxies for capital structure (BTL and BTD) and includes relevant indicators for the size of the company, such as profitability, tangibility of assets, business development, and taxation. The depreciation of fixed assets was excluded from the analysis due to the lack of statistical relevance. This study confirmed the existence of a relationship between capital structure and the selected explanatory variables of companies acting in the shipping industry (excluding the depreciation of fixed assets). The empirical results rejected the pecking-order theory (no determinants for the optimal capital structure) and confirmed the validity of the trade-off theory (there are relevant factors for the optimal capital structure related to the company size, profitability, taxation, etc.) for the international shipping industry.

Our research revealed that taxation is not relevant to explain the capital structure of the shipping sector, a possible explanation being that most shipping companies are multinationally located in various tax heavens. Profitability, assets' tangibility, and business development are the most important factors in explaining the capital structure for the selected sector. The profitability described by ROA and PM is more relevant than EBIT or ROE. On the contrary, the results provided by the empirical test indicated that the size of the company measured by volume of sales is relevant only for BTD and the size of the company estimated by total assets value is relevant only for BTL. The study revealed that total debt is better explained by the selected variables than total liabilities. The study confirmed the major research hypothesis and expected relationships between variables included in the models: a positive relationship between the size of the company and the capital structure, a negative relation-

ship between the profitability of the company and the capital structure, a positive relationship between the tangibility of fixed assets and capital structure, and a negative relationship between business growth perspectives and capital structure.

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Appendix 1
Normality Tests for Distribution of Panel Firm-Data

Section 1
Dependent Variable: Book Value to Total Liabilities Ratio (BTL)

Descriptive Statistics for Distribution

		Statistic	Std. error
BTL	Skewness	**-,123**	,158
	Kurtosis	**,062**	,314

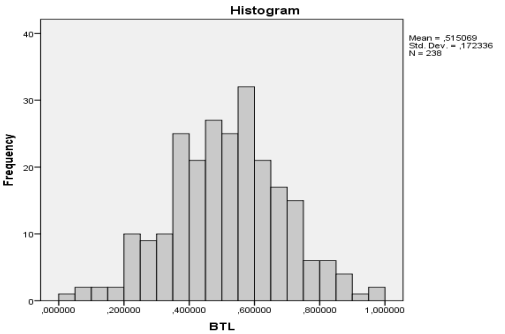
Source: Authors' estimations.

Normality Tests

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	**Sig.**	Statistic	df	**Statistic**
BTL	,031	238	**,200**	,997	238	**,031**

Source: Authors' estimations.

Histogram for BTL (Dependent Variable)



Source: Authors' estimations.

Section 2
Dependent Variable: Book Value to Total Debt Ratio (BTD)

Descriptive Statistics for Distribution

		Statistic	Std. error
BTD	Skewness	**,198**	,158
	Kurtosis	**-,224**	,314

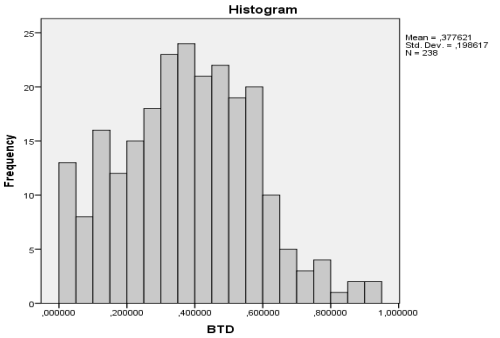
Source: Authors' estimations.

Normality Tests

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	**Sig.**	Statistic	df	**Sig.**
BTD	,036	238	**,200**	,987	238	**,028**

Source: Authors' estimations.

Histogram for BTD (Dependent Variable)



Source: Authors' estimations.

Section 3

Explanatory Variables (Descriptive and Kolmogorov-Smirnov and Shapiro-Wilk Tests) BEFORE Data Transformation

Descriptive Statistics before Data Transformation

Explanatory variables		Statistic	Std. error	Decision about data transformation
SALES	Skewness	5,893	,154	Log transformation applied
	Kurtosis	40,894	,307	
TAR	Skewness	6,741	,154	Z score transformation applied
	Kurtosis	60,475	,307	
ROA	Skewness	2,582	,154	Z score transformation applied
	Kurtosis	10,666	,307	
ROE	Skewness	6,254	,154	Z score transformation applied
	Kurtosis	49,935	,307	
EBITM	Skewness	5,141	,154	Log transformation applied
	Kurtosis	45,828	,307	
PM	Skewness	4,745	,154	Log transformation applied
	Kurtosis	36,862	,307	
FA	**Skewness**	**-,757**	**,154**	**No transformation applied (skewness and kurtosis closed to 0)**
	Kurtosis	**-,275**	**,307**	
MBR	Skewness	1,535	,154	Log transformation applied
	Kurtosis	2,568	,307	
TAX	Skewness	1,910	,154	Z score transformation applied
	Kurtosis	4,879	,307	
DEPR	Skewness	1,710	,154	Several methods of data transformation were applied without conclu-
	Kurtosis	6,261	,307	sive results. Therefore, this variable was excluded from the analysis.

Source: Authors' estimations.

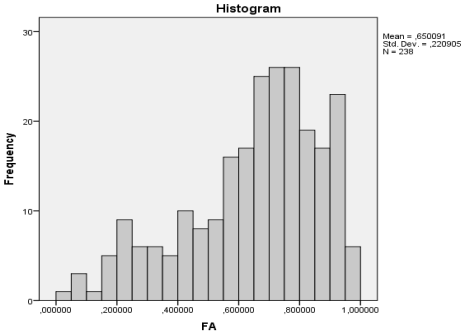
Normality Test of Data Distribution

Explanatory variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	**Sig.**	Statistic	df	**Sig.**
SALES	,373	238	**,000**	,323	238	**,000**
TAR	,337	238	**,000**	,373	238	**,000**
ROA	,166	238	**,000**	,773	238	**,000**
ROE	,253	238	**,000**	,467	238	**,000**
EBITM	,205	238	**,000**	,628	238	**,000**
PM	,241	238	**,000**	,607	238	**,000**
FA	,106	238	**,000**	,931	238	**,000**

MBR	,142	238	**,000**	,866	238	**,000**
TAX	,195	238	**,000**	,786	238	**,000**
DEPR	,117	238	**,000**	,889	238	**,000**

Source: Authors' estimations.

Histogram for Explanatory Variable FA



Note: Skewness and Kurtosis are closed to 0, we can assume that FA is approximatively normal distributed, no need for data transformation.

Source: Authors' estimations.

Section 4

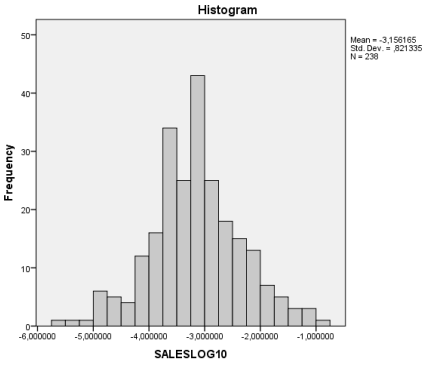
Explanatory Variables (Descriptive and Kolmogorov-Smirnov and Shapiro-Wilk Tests) AFTER Data Transformation

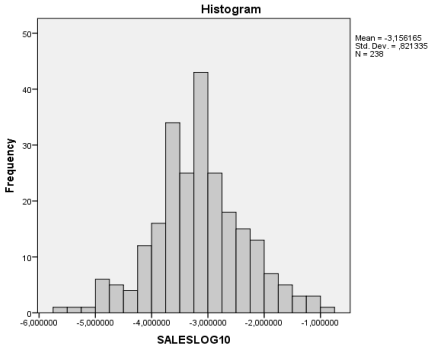
Normality Test for LOG10 Transformed Explanatory Variables

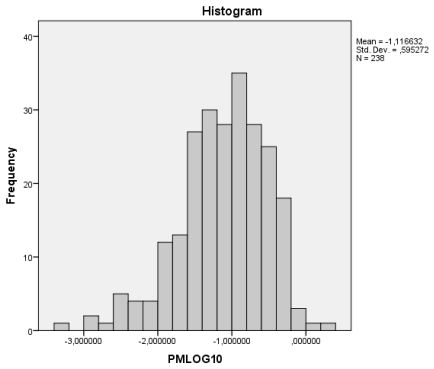
Explanatory variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	Df	**Sig.**	Statistic	df	**Sig.**
SALESLOG10	,049	238	**,200**	,992	238	**,214**
EBITMLOG10	,039	238	**,200**	,993	238	**,283**
PMLOG10	,047	238	**,200**	,976	238	**,000**
MBRLOG10	,056	238	**,071**	,992	238	**,205**

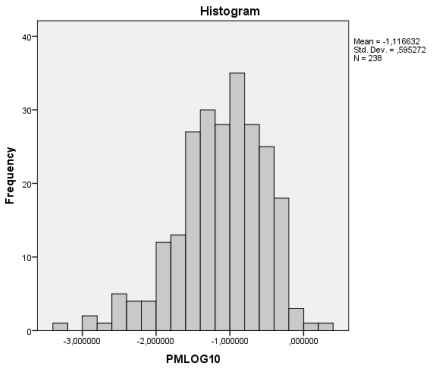
Source: Authors' estimations.

Histograms of Log10 Transformed Explanatory Variables









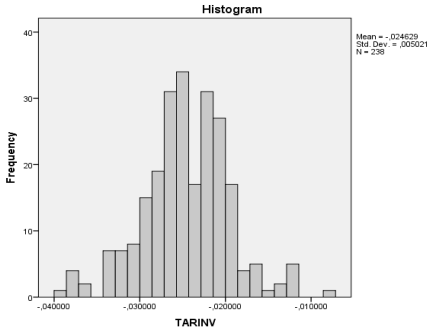
Source: Authors' estimations.

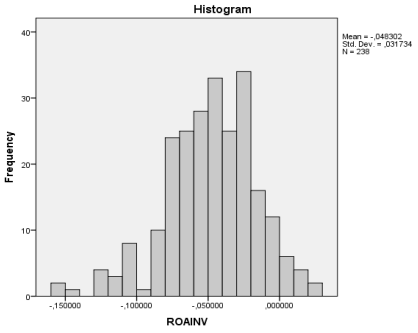
Normality Test for NORMINV Transformed Explanatory Variables

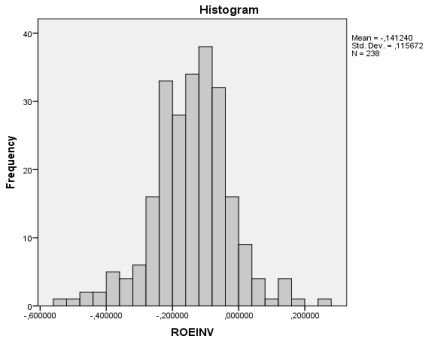
Explanatory variables	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	**Sig.**	Statistic	df	**Sig.**
TARINV	,053	238	**,200**	,985	238	**,012**
ROAINV	,048	238	**,200**	,981	238	**,003**
ROEINV	,062	238	**,029**	,979	238	**,001**
TAXINV	,065	238	**,018**	,989	238	**,056**

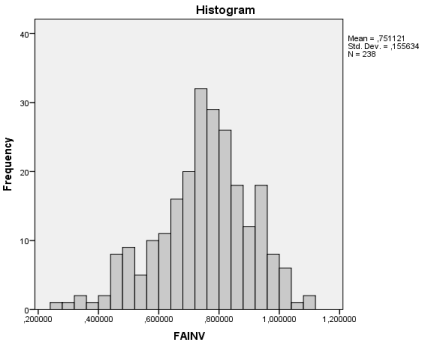
Source: Authors' estimations.

Histograms of NORMINV Transformed Explanatory Variables









Source: Authors' estimations.

Appendix 2

White Heteroscedasticity Test on Restricted OLS Residuals with BTL as Dependent Variable (1 to 8)

Model (BTL as dependent variable)	Heteroskedasticity test: White			
OLS 1: BTL = C(1)*SALESLG10 + + C(2)*ROAINV + C(3)*FA + + C(4)*MBRLG10 + C(5)	F-statistic	0.572567	Prob. F(14,223)	0.8848
	Obs*R-squared	8.258271	Prob. Chi-Square(14)	0.8754
	Scaled explained SS	7.887243	Prob. Chi-Square(14)	0.8951
OLS 2: BTL = C(1)*FA + C(2)*MBRLG10 + + C(3)	F-statistic	0.530845	Prob. F(5,232)	0.7528
	Obs*R-squared	2.692068	Prob. Chi-Square(5)	0.7473
	Scaled explained SS	2.41392	Prob. Chi-Square(5)	0.7894
OLS 3: BTL = C(1)*EBITLG10 + C(2)*FA + + C(3)*MBRLG10 + C(4)	F-statistic	0.220574	Prob. F(9,228)	0.9914
	Obs*R-squared	2.054351	Prob. Chi-Square(9)	0.9906
	Scaled explained SS	1.984357	Prob. Chi-Square(9)	0.9917
OLS 4: BTL = C(1)*PMLG10 + C(2)*FA + + C(3)*MBRLG10 + C(4)	F-statistic	0.527633	Prob. F(9,228)	0.8537
	Obs*R-squared	4.85584	Prob. Chi-Square(9)	0.8467
	Scaled explained SS	4.908319	Prob. Chi-Square(9)	0.8422
OLS 5: BTL = C(1)*ROAINV + + C(2)*MBRLG10 + C(3)	F-statistic	0.885997	Prob. F(5,232)	0.4911
	Obs*R-squared	4.459402	Prob. Chi-Square(5)	0.4853
	Scaled explained SS	4.490526	Prob. Chi-Square(5)	0.4812
OLS 6: BTL = C(1)*FA + C(2)*MBRLG10 + + C(3)	F-statistic	0.530845	Prob. F(5,232)	0.7528
	Obs*R-squared	2.692068	Prob. Chi-Square(5)	0.7473
	Scaled explained SS	2.41392	Prob. Chi-Square(5)	0.7894
OLS 7: BTL = C(1)*EBITLG10 + C(2)*FA + + C(3)*MBRLG10 + C(4)	F-statistic	0.220574	Prob. F(9,228)	0.9914
	Obs*R-squared	2.054351	Prob. Chi-Square(9)	0.9906
	Scaled explained SS	1.984357	Prob. Chi-Square(9)	0.9917
OLS 8: BTL = C(1)*PMLG10 + C(2)*FA + + C(3)*MBR + C(4)	F-statistic	0.646097	Prob. F(9,228)	0.7568
	Obs*R-squared	5.918956	Prob. Chi-Square(9)	0.748
	Scaled explained SS	6.108642	Prob. Chi-Square(9)	0.729

Note: A lower value of F-statistic than critical values indicates the rejection of the presence of heteroscedasticity in the models considered (White 1980), the variance of the disturbance term is homoscedastic (significance level 5%).

Source: Authors' estimations.

Appendix 3

White Heteroscedasticity Test on Restricted OLS Residuals with BTD as Dependent Variable (1 to 8)

Model (BTD as dependent variable)	Heteroskedasticity test: White			
OLS 1: BTD = C(1)*ROAINV + + C(2)*FA + C(3)*MBRLG10 + C(4)	F-statistic	1.874707	Prob. F(9,228)	0.0567
	Obs*R-squared	16.39884	Prob. Chi-Square(9)	0.059
	Scaled explained SS	15.79374	Prob. Chi-Square(9)	0.0713
OLS 2: BTD = C(1)*FA + + C(2)*MBRLG10 + C(3)	F-statistic	0.484666	Prob. F(5,232)	0.7876
	Obs*R-squared	2.460302	Prob. Chi-Square(5)	0.7825
	Scaled explained SS	2.302526	Prob. Chi-Square(5)	0.8059
OLS 3: BTD = C(1)*FA + + C(2)*MBRLG10	F-statistic	0.420592	Prob. F(3,234)	0.7384
	Obs*R-squared	1.276462	Prob. Chi-Square(3)	0.7347
	Scaled explained SS	1.311836	Prob. Chi-Square(3)	0.7263
OLS 4: BTD = C(1)*PMLG10 + + C(2)*FA + C(3)*MBRLG10	F-statistic	0.952505	Prob. F(6,231)	0.4583
	Obs*R-squared	5.746052	Prob. Chi-Square(6)	0.4522
	Scaled explained SS	5.503124	Prob. Chi-Square(6)	0.4811
OLS 5: BTD = C(1)*TARINV + + C(2)*ROAINV + C(3)*FA + + C(4)*MBRLG10 + C(5)	F-statistic	1.368341	Prob. F(14,223)	0.1701
	Obs*R-squared	18.82794	Prob. Chi-Square(14)	0.1716
	Scaled explained SS	18.70205	Prob. Chi-Square(14)	0.1766
OLS 6: BTD = C(1)*FA + + C(2)*MBRLG10 + C(3)	F-statistic	0.484666	Prob. F(5,232)	0.7876
	Obs*R-squared	2.460302	Prob. Chi-Square(5)	0.7825
	Scaled explained SS	2.302526	Prob. Chi-Square(5)	0.8059
OLS 7: BTD = C(1)*FA + + C(2)*MBRLG10 + C(3)	F-statistic	0.484666	Prob. F(5,232)	0.7876
	Obs*R-squared	2.460302	Prob. Chi-Square(5)	0.7825
	Scaled explained SS	2.302526	Prob. Chi-Square(5)	0.8059
OLS 8: BTD = C(1)*TARINV + + C(2)*PMLG10 + C(3)*FA + + C(4)*MBRLG10 + C(5)*TAXINV + C(6)	F-statistic	2.330697*	Prob. F(20,217)	0.0015
	Obs*R-squared	42.08472	Prob. Chi-Square(20)	0.0027
	Scaled explained SS	45.28796	Prob. Chi-Square(20)	0.001

Note: A lower value of F-statistic than critical values indicates the rejection of the presence of heteroscedasticity in the models considered (White 1980), the variance of the disturbance term is homoscedastic (* - significance level 5%).

Source: Authors' estimations.