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Green Bonds in Shipping

An event study of green bonds in shipping and their impact on institutional ownership and equity risk

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Abstract

The allocation of capital to green projects have increased in recent years as focus on climate change and the necessity to transit to a more sustainable and carbon neutral environment have intensified. With decarbonization high on the agenda, and global regulations right around the corner, shipping companies must make important decisions today about which type of technology will be installed on their vessels in the decades to come.

One instrument for allocating capital to green projects is the issuance of green bonds, whose popularity have exploded since the signing of the Paris Agreement. Because of the highly global and cyclical nature of the shipping industry, the changing face of green project financing raises an important question concerning whether green bond issuance influences the decision making of institutional investors in the shipping industry. Do institutional investors reward shipping companies who raises capital to fund green projects?

This study addresses this issue by investigating the fundamental change in shipping companies' ownership structure and risk profile in the years following implementation of green projects. Employing structural equation modeling, this study examines whether and how green bond issuance increase institutional ownership and reduce equity risk. We find evidence that following green bond issuance; total and unsystematic equity risk is reduced, cost of equity is reduced, and relative valuation is increased. Changes in institutional ownership is inconclusive.

The implications of the findings are that equity owners in shipping companies could potentially reap benefits from implementing green projects, by issuing green bonds.

Keywords: Green Bonds - Shipping - Institutional Ownership - Equity Risk - Structural Equation Modeling

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1. Introduction

A green bond is defined by the International Capital Market Association (ICMA) as debt instrument that follow the green bond principles (GBP), (ICMA, 2018) . In short, to be eligible to define your bond as green it has to follow the four core principles; (1) use of proceeds, (2) process for project evaluation and selection, (3) management of proceeds, and (4) reporting, laid out in the GBP. For a shipping company there are several potential projects that could be eligible for a green status, from funding of the entire vessel itself, to new propulsion technology or other pollution mitigation and biodiversity conservation technology.

Green bonds could be attractive for companies as they, in some cases, provide preferential funding at lower rates (Liaw, 2020), also referred to as "greenium". The consensus seems to be that in most cases green bonds are issued at a lower yield in the first-hand market, and trade at a premium in the secondary market (MacAskill, Roca, Liu, Stewart, & Sahin, 2021). Issuances are also often oversubscribed as many institutional investors have mandates to allocate capital to green projects. By investing in green bonds or the company that issue the bond, institutional investors signal that they have a responsible and forward looking long-term approach to capital allocation. This long-term view is usually synonymous with low risk and stable performance. Low risk is subsequently associated with lower cost of capital, which generally is associated with higher valuation.

The greenium effect is primarily found in government issued and investment grade bonds, whereas shipping bonds primarily fall into the high yield category. This study compliments the literature by investigating the impact green shipping bonds have on equity risk. As previous studies concerning the effects of green bond issuance on equity risk does not explore the mediating effect of institutional ownership, this study not only complements the literature by investigating the impact of green bonds in the shipping industry, but also green bonds impact on institutional ownership and equity risk in general. Specifically, this study examines the relationship between all green shipping bond issuances and their impact on institutional ownership and equity risk, by exploring whether different institutional investors in different shipping segment perceive green bond issuance differently by using structural equation modelling (SEM).

Green bond issuance growth accelerated rapidly in 2015, from USD 50 billion following the signing of the Paris Agreement, to USD 290 billion in 2020 (Climate Bonds Initiative, 2021). This growth is expected to continue in the years to come as the transition to renewable and

cleaner alternatives intensifies to combat climate change. Despite the enormous increase in green bond issuance, the shipping industry have not yet seen the same growth, with only four green bonds issued as of December 2020. Therefore, investigating the impact of green bonds issuance on shipping companies could not only provide important insights for shipowners regarding capital structure, but also on the potential benefits from investing in green vessel technology. There is currently no research on green bond issuance in the shipping industry. From this we develop two research questions.

Research Questions: (1) Does green bond issuance reduce equity risk? (2) If so: is the reduction attributed to an increase in institutional ownership?

The remaining of the thesis is organized as follows: Chapter 2 discusses relevant literature of institutional ownership, equity risk, green bonds, and shipping. Chapter 3 first gives a detailed description of the green bonds, the sample companies, and preliminary data description. Chapter 4 first explain the methodology used to answer the research question, before giving a more detailed description for choice of research methodology. Chapter 5 presents the results. Chapter 6 elaborates on robustness and explores the omitted variable bias, before concluding remarks are provided in chapter 7. Appendix and references are located at the end of the thesis.

2. Literature Review

This chapter explores previous literature on green bonds, institutional ownership, equity risk, and institutional ownership and firm performance in shipping.

The impact of green initiatives, such as corporate social responsibility (CSR) and environmental social and governance (ESG) related corporate initiative, on institutional ownership and equity risk have been well studied over the last decades. Early research did not provide consistent results. In a comprehensive study during the beginning of the decade McWilliams and Siegel (2000) found that CSR related initiatives had a neutral effect on firm performance. In recent years, studies have been more consistent, Rehman, Khan, and Rahman (2020) found that CSR related initiatives positively impacts firm reputation and thereby improve firm performance and reduce equity risk. Fu, Lin, and Zhang (2020) found similar results for ESG related initiatives through the impact on institutional ownership, while a recent study by Huang (2021) shows that there is a positive, but modest link between ESG performance and firm financial performance when controlling for a wide range of variables.

Though limited, there are research showing that institutional ownership increases while equity risk is reduced after green bond issuance. The largest study ever performed on green bond issuance was conducted by Tang and Zhang (2020), where they use a comprehensive dataset of all green bond issued over a ten year period to find that a positive cumulative abnormal return (CAR) occurs around the announcement date, while institutional ownership is increased, and stock liquidity improved after issuance. Baulkaran (2019) also found a positive CAR around announcement date and was able to link those findings to a reduction in beta and total risk over the 250-day period following announcement using Morgan Stanley capital international MSCI world index as the reference. A study by Flammer (2021) and Wang, Chen, Li, Yu, and Zhong (2020) breaks down the positive stock market return into different types of institutional investors and find that the positive stock market reaction to green bond announcement can be attributed to especially long-term institutional investors such as norm constrained investors.

What these studies on green bonds fail to address independently they answer collectively; green bond issuance seems to increase institutional ownership (especially norm constrained institutional ownership) and reduce equity risk. To the best of our knowledge, green bond issuance impact on the mediating effect of institutional ownership on equity risk has not been explored, certainly not in the shipping industry.

The green bond findings in the literature does not differentiate between industries but uses a broad range of companies to get the average market effect of green bond issuance on institutional ownership and equity risk. How green bonds impacts these variables in the shipping industry is not necessarily comparable to the market in general due to shipping's capital intensive and cyclical nature. The limited literature that exist on the impact of institutional ownership on firm performance in the shipping industry is also not consistent; Drobetz, Ehlert, and Schröder (2021) find that there is a positive relationship between institutional ownership and market value of global shipping firms, while Tsouknidis (2019) find that there is a negative relationship between institutional ownership and firm performance in US-listed shipping firms. Additionally, Drobetz et al. (2021) also finds that the institutional ownership value effect is more pronounced in shipping companies with institutional investors with short-term investment horizons, while other studies conducted by Cleary and Wang (2017) and Erhemjamts and Huang (2019) find that long-term norm constrained institutional investors are associated with better financial performance in general, which is consistent with the view that arbitrageurs places short-term pressure on companies and thereby discouraging long-term investments that create value.

A possible explanation for the inconsistencies concerning institutional ownership and the shipping industry could be a study by Tsionas, Merikas, and Merika (2012) and Drobetz, Janzen, and Requejo (2019) where they identify a positive relationship between ownership concentration and performance of publicly listed shipping companies. The rational being that large investors can be advantageous because the owner has incentive and power to monitor managers, thereby minimizing the free-rider problems in firms with more widely dispersed ownership structure. Another explanation could be that the research period influenced the results, as short-term investors to a larger degree try to time the market, while long-term investors does not (Derrien, Kecskés, & Thesmar, 2013).

Considering the lack of consensus in the literature, this study not only provide valuable insight on how institutional investors impact firm performance in the shipping industry, but also on the interplay between this performance and green project financing, specifically green bonds. To the best of our knowledge this interplay has not been explored in shipping.

3. Sample and Data Description

This chapter first gives a detailed description of the green bonds and sample companies, before providing a short introduction to the data sample.

3.1 Green bond issuing companies and control groups

Out of the approximately 240[1] shipping companies listed on stock exchanges world-wide, four of them had issued green bonds as of December 31, 2020. Our sample covers these four companies and ten similar companies with no green bonds divided into three control groups. The four companies and their issuance will be explored individually throughout this thesis, but to account for heterogeneity among them, and to assign appropriate control groups, we separate one of the four (Altera Infrastructure) from the other three companies (referred to as the "three equities"). The reason being that Altera Infrastructure solely operate in the fossil transportation and exploration industry, and they were acquired right after issuance so only their preferred A shares are available for analysis and proxy for equity risk.

This section first describes the three common equity companies (the three equities) and their control groups, before looking at the use of proceeds described in the bond prospectus. Then, Altera Infrastructure, their control group and use of proceeds are described. As all three control groups represent the majority of publicly traded companies in their respective segments, selection bias is mitigated.

3.1.1 The three equities and their two control groups

As described in Table 1, the three green bond issuing shipping companies: Evergreen Marine Corp., Nippon Yusen Kaisha Line (NYK), and Mitsui O.S.K. Lines (MOL) all announced and issued green bonds during May to September 2018. They have similar geographical origins (East Asia), fleet composition, and market capitalization. Ending 2020 the three shipping companies held a combined 12.1% of the total market share of the container shipping market. Evergreen held 5.5% market share, while Ocean Network Express, which is a joint venture between NYK and MOL established in 2017, held 6.6%. NYK and MOL also have large fleets of bulk, auto-liners, LNG, ferries, and other types of vessels. This type of conglomerate vessel

[1] Clarkson Shipping Intelligence Network

composition is also reflected in the control groups where many of the companies also owns similar types of vessels.

Green bond use of proceeds:

Evergreen use of proceeds primarily focused on installation of scrubber exhaust cleaning systems, which reduce Sulphur oxide (SOx). Their issuance size was $66 million, equivalent to 5% of their market capitalization on issuance date. NYKs use of proceeds also went towards scrubber installation. They further stated investments in liquified natural gas (LNG) as fuel, and also emphasized installation of ballast water management systems (BWMS) to reduce impact on local marine biodiversity. Their issuance size was $92 million, equivalent to 3% of market capitalization on the issuance date. MOLs use of proceeds also included scrubber installation, LNG, and BWMS. But further stated that proceeds will be used to install new more efficient propellers, and research and development of sails technology to be used on large bulk vessels in partnership with Tokyo University. MOLs issuance size was also $92 million, equivalent to 4% of total market capitalization on the first of two issuance dates. In summary, much of the proceeds for the three equities went towards installation of emission and biodiversity reduction technology such as scrubbers and BWMS. Use of proceeds are discussed again in chapter 6.

Control groups for Evergreen, NYK and MOL:

To account for heterogeneity among the control group companies, they are divided into two groups primarily based on their geographical origins (ASIA and EUROPE), but also on market capitalization. Combined they consist of seven shipping companies with similar characteristics as the three equities. The Asian control group consists of five shipping companies; Kawasaki Kisen Kaisha (K-Line), Wan Hai Line, Yang Ming Marine Transport Corp., Orient Overseas, and Hyundai Merchant Marine (HMM). They are all from the same geographical location as the three equities and have similar market capitalization. The European control group consists of two major listed European shipping companies; Hapag Lloyd and AP Moeller - Maersk, both with considerably larger market capitalization than the other companies in the sample.

As of December 31, 2020, the three equities and both control groups combined represent the large majority of the worlds publicly traded container shipping companies, and around 50% of the total market share.

Table 1 – Company description, all units in millions

Panel A - Green Bond Description

Companies:	*Announcement Date*	*Issuance Date*	*Issuance Size (Local)*	*Issuance Size on issue date (USD)*	*Relative bond size vs Market Capitalization*
Evergreen Marine Corp.	15.05.2018	27.06.2018	2000TWD	66	5%
NYK Line	18.05.2018	24.05.2018	10000JPY	92	3%
Mitsui O.S.K. Lines	24.08.2018	30.08.2018 & 10.09.2018	2*5000JPY	92	3%
Altera Infrastructure	09.10.2019	18.10.2019 & 28.08.2020	125	125	20%

Panel B - Green Bond Issuing Companies Description

Companies:	*Fleet Composition*	*Exchange*	*Average Market Capitalization*	*Min*	*Max*
Evergreen	Container	TPE (Taiwan)	1871	1222	5147
NYK Line	Container, Dry Bulk, Auto-liner, LNG, Offshore	TYO (Japan)	3139	2123	4459
Mitsui O.S.K. Lines	Container, Dry Bulk, Ferry	TYO (Japan)	3055	1997	4358
Altera Infrastructure	Shuttle Tankers, FPSO	NYSE - USA	111	69	140

Panel C - Control Groups

Companies:	*Fleet Composition*	*Exchange*	*Average Market Capitalization*	*Min*	*Max*
"K" Line	Container, Dry Bulk, Auto-liner, LNG, Oil Tankers	TYO (Japan)	1745	812	2559
Wan Hai Lines	Container	TPE (Taiwan)	1331	1085	3390
Yang Ming Marine Transport Corp.	Container, Dry Bulk	TPE (Taiwan)	705	463	1662
Orient Overseas	Container	HKEX (Hong Kong)	3775	2212	6294
Hyundai Merchant Marine	Container	KRX (South Korea)	1215	345	3974
Average Asian Control Group:		East Asia	1754	983.4	3575.8
Hapag Lloyd	Container, Cruise	DAX (Germany)	7426	2135	27112
AP Moller Maersk	Container, Ferry, Oil Tankers, Offshore	CSE (Denmark)	29434	17924	42856
Average European Control Group:		Europe	18430	10029.5	34984
Knutsen NYK Offshore Tankers	Shuttle Tankers	NYSE (USA)	590	342	725
Teekay LNG Partners	LNG	NYSE (USA)	1169	762	1639
Teekay Tankers	Oil Tankers	NYSE (USA)	405	267	762
Average Fossil Control Group:		USA	721	457	1042

3.1.2 Altera Infrastructure and control group

The shuttle tanker company Altera Infrastructure, formally known as Teekay Shuttle Tankers, announced issuance of two green bonds in October 2019 and issued subsequently that month and in October 2020. Even though the use of proceeds went towards funding vessel technology in four newbuilding vessels that would reduce CO_2 emissions by approximately 50%, the bond was undersubscribed and only managed to raise USD 125 million of its initial USD 200 million goal. As reported by Financial Times (2019), consensus in the market seemed to be that a company that transport fossil fuel cannot call their financing green.

As of December 2020, Altera Infrastructure held and operated 29 of the world's 86 shuttle tankers and several floating storage and offloading vessels (FPSOs). Altera Infrastructure's control group consists of three companies: their main competitor Knutsen NYK Offshore Tankers (KNOT), with management of the exact same number of shuttle tankers, and two companies associated with Altera Infrastructures' former owner: Teekay LNG Partners and Teekay Tankers. Altera Infrastructure was acquired on January 23, 2020, by Brookfield Asset Management, three months after green bond issuance. As the common shares are no longer in circulation the six million listed preferred A shares are used as a proxy for development of institutional ownership and equity risk, the implications of this are discussed further throughout the thesis.

3.2 Data Description

Data from the three equities and the seven control group companies represented in two control groups was collected during the five year period from January 2016 to December 2020. The period was chosen because it gives the maximum (and almost equal) number of observations before and after issuance for all three equities. Data from Altera Infrastructure and the three companies making up the fossil control group was collected from September 2018 to December 2020, which provides an equal number of observations before and after issuance. As we are interested in exploring long-term fundamental change in equity risk and institutional ownership after green bond issuance, the equal period before and after issuance is the most appropriate approach.

Daily market capitalization, equity price and turnover have been collected from the Bloomberg Terminal in USD, while monthly institutional ownership and other potential control variables have been collected from Eikon Platform on the last day of each month, or quarterly and

annually. All data have been calculated into monthly variables, resulting in 60 observations for the three equities and their two control groups, and 28 observations for Altera Infrastructure and their control group. Information concerning fleet composition and market share have been collected from the Clarkson Shipping Intelligence Network.

Institutional ownership:

To account for heterogeneity among institutional investors we follow Hong and Kacperczyk (2009) and divide them into norm (NORM) constrained institutional investors and natural arbitrageurs (ARB) institutional investors. Norm constrained investors are defined as pension funds, sovereign wealth funds, insurance companies and endowment funds. While arbitrageurs are defined as hedge funds, private equity firms, investments advisors, venture capital and mutual funds. Mutual funds can be considered as both norm constrained and arbitrageurs, but because they are actively managed and to some degree care about short-term performance, we place them into the arbitrageurs category. Total institutional ownership (IO) is the sum of NORM and ARB.

Table 2 presents the data description of institutional ownership in the sample period. The data shows that the range of institutional ownership is wide throughout the sample, with Evergreen, NYK, MOL, and Altera infrastructure having an average level of total institutional ownership of 13%, 34%, 46%, and 26% respectively. For the Asian and European control groups their average results are similar, 23% and 20% respectively. Altera Infrastructure and the fossil control groups have relative high average institutional ownership presence in the sample. However, they also experience the largest reduction, as discussed later. Table 2 also demonstrates that arbitrageurs are the main institutional investors in the shipping industry. However, norm constrained institutional investors have larger presence in Evergreen, NYK, and MOL, also before green bond issuance, compared to their control groups. This could indicate that there are other fundamental differences between the sample companies which makes norm constrained institutional investors more inclined to invest in the three equities. Some of these differences are discussed further in chapter 6.

Table 2 – Summary statistics of institutional investor for sample period

Variable	Obs	Mean	Median	Min	Max
Evergreen					
IO	60	13 %	13 %	11 %	17 %
NORM	60	6 %	6 %	5 %	8 %
ARB	60	7 %	7 %	5 %	10 %
NYK					
IO	60	34 %	35 %	26 %	45 %
NORM	60	10 %	11 %	7 %	13 %
ARB	60	24 %	24 %	19 %	32 %
MOL					
IO	60	46 %	46 %	38 %	56 %
NORM	60	12 %	13 %	9 %	15 %
ARB	60	34 %	34 %	29 %	42 %
Altera Infrastructure					
IO	28	26 %	24 %	16 %	40 %
NORM	28	0 %	0 %	0 %	0 %
ARB	28	26 %	24 %	16 %	40 %
ASIA					
IO	60	23 %	24 %	20 %	27 %
NORM	60	4 %	4 %	3 %	6 %
ARB	60	19 %	19 %	16 %	21 %
EUROPE					
IO	60	20 %	20 %	18 %	24 %
NORM	60	4 %	4 %	1 %	5 %
ARB	60	17 %	17 %	14 %	19 %
FOSSIL					
IO	28	46 %	43 %	33 %	67 %
NORM	28	6 %	6 %	5 %	7 %
ARB	28	40 %	38 %	27 %	60 %

Evergreen – Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA - Asian control group, EUROPE - European control group, FOSSIL - Fossil control group

Equity risk:

We follow Li, Nguyen, Pham, and Wei (2011) and use the change in daily equity price, standard deviation, to proxy for how total equity risk changes, calculated as monthly variables. Table 3 presents the data description of total risk in the sample period. The data shows that the range of daily standard deviation is wide throughout the sample with Evergreen having the lowest total risk of 1.44% and the fossil control group having the highest with 1.87%. This is interesting as the level of institutional ownership is considerably higher in the fossil control group, however these institutional investors are mainly arbitrageurs, which is in line with the literature suggesting these types of investors can have destabilizing effect on equity risk.

Table 3 – Summary statistics of daily standard deviation for sample period

Variable	Obs	Mean	Median	Min	Max
Evergreen					
SD	60	0.0144	0.0130	0.0075	0.0264
NYK					
SD	60	0.0146	0.0133	0.0087	0.0247
MOL					
SD	60	0.0168	0.0148	0.0099	0.0298
Altera Infrastructure					
SD	28	0.0162	0.0128	0.0065	0.0412
ASIA					
SD	60	0.0153	0.0150	0.0068	0.0308
EUROPE					
SD	60	0.0177	0.0170	0.0105	0.0327
FOSSIL					
SD	28	0.0187	0.0179	0.0091	0.0405

Evergreen – Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA - Asian control group, EUROPE - European control group, FOSSIL - Fossil control group

To ensure that outliers concerning abnormal equity prices does not bias calculations in the sample, following common practice laid out in a 2012 paper by Ghosh and Vogt (2012), values lower and greater than the 5th and 95th percentile are set to the 5th and 95th percentile. This ensures that, for example, large fluctuations during Covid-19 outbreak are reduced. This is illustrated in Figure 1:

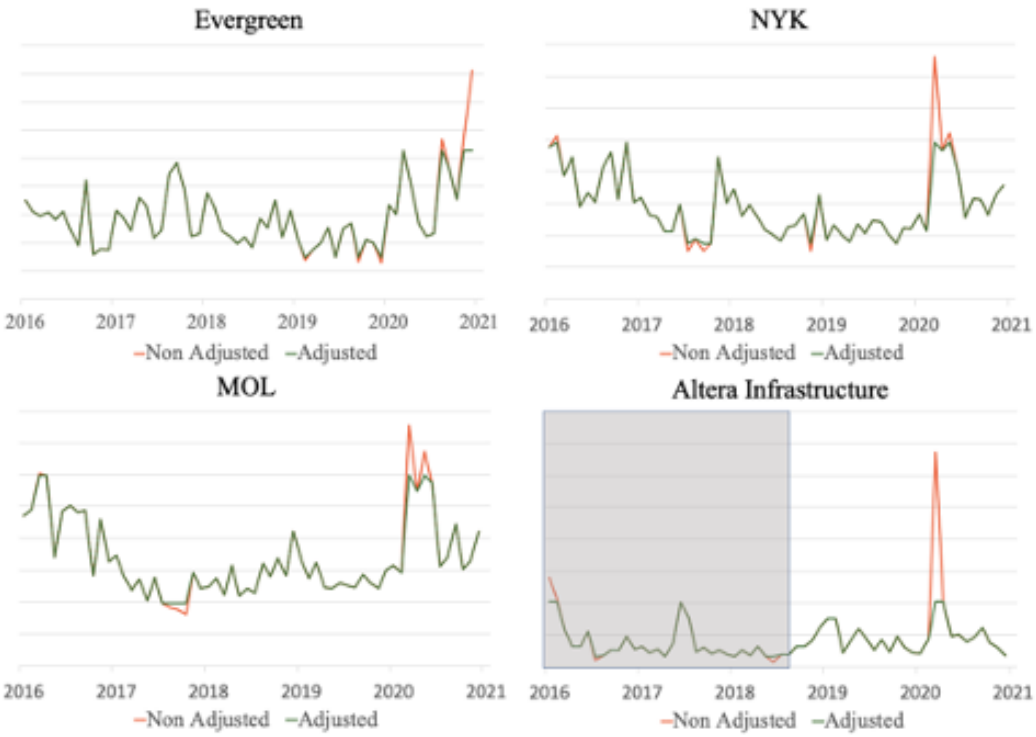

Figure 1 – Evergreen, NYK, MOL and Altera Infrastructure standard deviation
Grey area excluded from calculations

4. Research Question and Methodology

This chapter first explores the methodology used to answer the two research questions: *(1) Does green bond issuance reduce equity risk? (2) If so: is the reduction attributed to an increase in institutional ownership?* Then, financial methodology used for checking that results are consistent with what is happening in the market is explored. Finally, the structural equation model is explained.

4.1 The impact of green bond issuance on institutional ownership and price volatility

To answer if equity risk is reduced following green bond issuance, we calculate standard deviation for each specific company and weight the result by the average monthly market capitalization of that specific company in the control groups. Also, to supplement the main result for total risk we follow Y. Kim, M. Kim, and O'Neill (2013) and perform an additional test to calculate the unsystematic risk, which is the residuals from a regression of individual daily returns on the market return (MSCI) to proxy for idiosyncratic risk (IR). These daily residuals are also calculated into monthly standard deviation and explains how much equity risk changes compared to the market in the period following green bond issuance.

To answer if institutional ownership increases in the period following green bond issuance, we calculated institutional ownership in the control groups as the monthly change for each specific company weighted by average monthly market capitalization. This is to capture the actual change in institutional ownership for the control groups and not the change in companies' weights as a result of market capitalization fluctuations.

From this we derive the following equations:

$$Institutional\ Ownership_{i,t} = a_1 + B_1 T_{i,t} + \vartheta_1 X_{i,t} + v_{i,t} \quad (1)$$

$$Equity\ Price\ Volatility_{i,t} = a_2 + B_2 Institutional\ Ownership_{i,t} + B_3 T_{i,t} + B_4 X_{i,t} + u_{i,t} \quad (2)$$

In equation (1), B_1 is the coefficient of green bond issuance on institutional ownership. T is a time trend "dummy" variable equal to 0 before issuance and increasing to 0.5 in the month of issuance, and equal to 1 every month thereafter. The intermediary 0.5 is added because data on institutional ownership are collected at the end of each month. ϑ_1 is the coefficient of firm

specific control variables X on institutional ownership, and v_t is the error term. In equation (2), equity price volatility is the change in daily standard deviation after green bond issuance. B_2 is the coefficient of institutional ownership on equity price volatility as a product of green bond issuance, while the direct effect of green bond issuance on equity price volatility is B_3. B_1 is the coefficient of firm specific control variables X, while $u_{i,t}$ is the error term.

4.2 The impact of green bond issuance on cost of equity and enterprice valuation

To check that any change in equity risk is consistent with market developments, we first employ the capital asset pricing model (CAPM) by Fama and MacBeth (1973) to calculate relative difference in cost of equity between equity "I" and control group "cg" after green bond issuance.

$$R_i = R_f + \beta_i * R_m + \varepsilon_i \quad (3)$$

$$\beta_i = Corr(R_i, R_m) * \frac{\sigma_i}{\sigma_m} \quad (4)$$

Where in equation (3) to (7):

R_i: return of equity i.

R_{cg}: return of control group.

R_m: market return based on MSCI.

R_f: risk free rate of return.

β_i: beta, systematic risk of equity i.

$Corr(R_i, R_m)$: correlation between equity return and market return.

$Corr(R_{cg}, R_m)$: correlation between control group return and market return.

σ_i: standard deviation of return of equity.

σ_{cg}: standard deviation of return of control group.

σ_m: standard deviation of market return based on MSCI.

$\Delta R_{i,cg}$: relative difference in cost of equity between equity i and control group.

$\Delta\sigma_{i,cg}$: relative difference in total risk between equity i and control group cg.

ϵ_i: residual of equity i.

Based on equation (3) and (4), the following equation can be derived:

$$R_i = R_f + \frac{Corr(R_i,R_m)}{\sigma_m} * R_m * \sigma_i + \varepsilon_i \quad (5)$$

We follow Fu et al. (2020) approach for quantifying effects of ESG related initiatives on cost of equity where they argue that a change in σ_i can lead to a change in R_i by $\frac{Corr(R_i,R_m)}{\sigma_m} * R_m$, even though σ_i is endogenous as a product of R_i.

Different from Fu et al. (2020), we are primarily interested in the total difference in cost of equity ($\Delta R_{i,cg,t}$) between equity "i" and control group "cg" after green bond issuance, compared to the period prior to issuance, resulting in the following two equations:

$$\Delta R_{i,cg,t} = \frac{Corr(R_i,R_m)}{\sigma_m} * R_m * \Delta\sigma_i - \frac{Corr(R_{cg},R_m)}{\sigma_m} * R_m * \Delta\sigma_{cg} \quad (6)$$

$$\Delta\sigma_{i,cg,t} = \Delta\sigma_i - \Delta\sigma_{cg} \quad (7)$$

Where $\Delta\sigma_{i,cg}$ is the change in equity price volatility after green bond issuance between equity "i" ($\Delta\sigma_i$) and control group "cg" ($\Delta\sigma_{cg}$), compared to the period prior to issuance, derived from Equation (1) and (2).

Then, to investigate if a difference in cost of equity is synonymous with a relative difference in valuation, we employ multiple valuation methodology. We use market capitalization to revenue (P/S) and enterprise value to revenue (EV/S) multiples for relative valuation comparison to investigate if a difference in cost of equity is also associated with a difference in multiple expansion or contraction. The EV/S multiple are especially useful for comparison in industries with highly volatile profit margins (Koller, Goedhart, & Wessels, 2015), like shipping, where over the long term companies should have roughly similar profit margin. The change in multiple expansion or contraction between equity i and control group cg ($\Delta Multiple_{i-cg,t}$) in the period following green bond issuance is calculated as a product of change in equity price volatility by re-calculating equation (1) and (2) while simultaneously adding a third equation:

$$\Delta Multiple_{i,cg,t} = a_3 + B_5\Delta\sigma_{i,cg,t} + z_{i,cg,t} \quad (8)$$

Here, B_5 is the coefficient on how much one unit relative change in equity price volatility impacts relative valuation between equity "I" and the control groups "cg". The rational for this

exercise is that any difference in cost of equity should be synonymous with a relative multiple expansion, all else equal. Likewise, any increase in relative cost of equity should be synonymous with a relative contraction in valuation multiples, all else equal. Also, when applying the well-known discounted cash flow model (DCFM) in valuation, there are two main ways a company can increase its valuation: cash flow either has to increase, or the discount rate calculated as a function of risk has to decrease. If the later occurs, all else equal, we get a relative multiple expansion. The "all else equal" assumption fails to address debt in its entirety. The implications of this, and why the assumption holds, is addressed in section 5.4.

4.3 The structual equation model

Structural equation modeling (SEM) has been used in several studies in the shipping sector when exploring CSR and ESG related effects, similar to green bond effects. Using SEM, Yang (2018) finds a positive relationship between the effects of institutional pressures on green performance through the mediating effect of internal green practices in Taiwanese container shipping companies. Also using SEM, Yuen, Thai, Wong, and Wang (2018) find that service quality on financial performance on shipping firms with operations in Singapore is fully-mediated by customer and job satisfaction.

Our research question is a particular good fit for SEM as it enables us to explore different complex causal relationships among multiple variables by looking at the structure of interrelationships expressed in a series of equations simultaneously. This is done by constructing a model based on theory, prior experience, and research objectives (Hair, Anderson, Black, & Babin, 2018). SEM statistical theory is based on the distribution of the sample covariances in large samples. We follow methodology laid out in a 2019 paper by Maydeu-Olivares, Shi, and Rosseel (2019) and use maximum likelihood and assume that our data is normally distributed. By doing so the coefficients reflects the change in mean in the dependent variables as a function of the independent variables in the period after green bond issuance.

To avoid misspecification of the model, selection among control variables has been done using theory, but also by looking at correlation matrixes found in Appendix 1-7. Variables that load inconsistently across different samples will not reflect the true population, and further reporting will not explain the phenomenon based on the correlation being far from the real

relation (Antonakis, Bendahan, Jacquart, & Lalive, 2014). To avoid biased results, we only control for turnover as it is the only variable to be supported by theory and that loads consistently and significantly on equity risk in the correlation matrixes. Turnover is calculated as the daily traded volume divided by the total number of shares outstanding, where high turnover generally means higher equity price volatility (Ferreira & Matos, 2008). Other potentially relevant variables for institutional ownership and equity risk excluded from the model are ownership concentration, age of company, debt-to-equity, ESG-score, size (market capitalization), and company "green focus" as a result of a textual analysis. Model selection is discussed further in the chapter 6.

To answer both research question, we simultaneously regress equation (1) and (2) using SEM. In the first regression, we regress institutional ownership on the green bond issuing time trend dummy variable (GBI). In the second regression we regress equity price volatility, daily standard deviation (SD), on the results from the first equation, the time trend dummy variable, and turnover (TURN). By doing so we find the effect of green bond issuance on institutional ownership and equity risk, and potential mediating effects. The indirect effect of green bond issuance on equity price volatility through the mediating effect of institutional ownership is B_1 multiplied by B_2. The direct effect of green bond issuance on equity price volatility is B_3. The total mediating effect is $B_1 * B_2 + B_3$, illustrated:

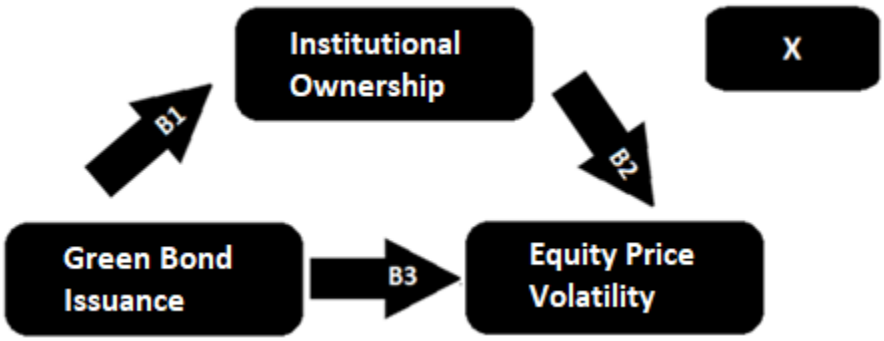

Figure 2 – SEM illustration

To address omitted variable bias, the endogeneity problem, and to avoid problems with nonnormal distribution we use lagged values of the independent variables and bootstrapping analysis to check the robustness of our main result. As we suspect equity price volatility to be correlated with omitted variables, we include control variables for the independent variables to increase the explanatory power of the model (Wilkins, 2018). By using lagged independent variables in our equations, we are able to account for historical factors that cause current

differences in the equity price volatility that are difficult to account for in other ways (Wooldridge, 2019). The main reason for putting lagged independent variables in the equation is that we expect companies with historically high institutional ownership and low turnover to have lower equity risk. Thus, unobserved factors that affect institutional ownership and turnover are likely to be correlated with equity risk. To check the stability of our coefficients we follow (Preacher & Hayes, 2004) and re-estimate Equation (1) and (2) using lagged values (1. month) and bootstrapping techniques (300 re-estimations).

Figure 3 illustrates the relationship between green bond issuance and multiple expansion or contraction by running equation (1), (2), and (8) simultaneously. From this we are able to observe if the relative valuation between the green bond issuing companies and their control groups expand or contract in the period following issuance as a product of change in equity price volatility.

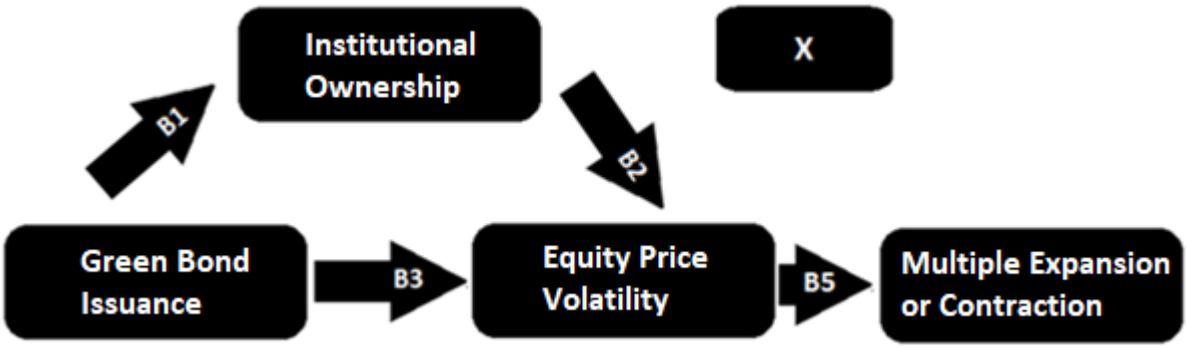

Figure 3 – SEM illustration with multiple expansion or contraction

5. Results and Analysis

This chapter first presents the main results from the four green bond issuing companies, comparing fundamental developments in the period following issuance to the similar period prior to issuance. Second, we compare the development against the three control groups. Third, unsystematic risk is explored to further demonstrate that any reduction in volatility is directly attributed to effects related firm specific risk. Finally, potential implications on cost of equity and enterprise valuation are addressed.

5.1 Main results for green bond issuers – Total Risk

Table 4 reports the main findings from the presented SEM model that jointly estimates equation (1) and (2) for the four companies, for equivalent estimations for the control groups see Appendix 8.

Institutional Ownership:

The main results in Table 4 show that total institutional ownership increased in the period following green bond issuance for Evergreen, NYK and MOL, significant at the 1%,10% and 10% respectively. For Evergreen there is a significant increase in arbitrageurs in the period following issuance, for NYK there is a significant increase in norm constrained investors following issuance, while for MOL there is a reduction in norm constrained investors and increase in arbitrageurs significant at the 5% and 1% level. For Altera Infrastructure institutional ownership, which only consists of arbitrageurs, decreased in the period following issuance, significant at the 1% level.

Equity price volatility:

Even though the results show that there in general is a significant increase in institutional ownership in the period following green bond issuance, the main results in Table 4 show that there is no indirect effect of institutional ownership on equity risk. NYK is the only company with a significant negative indirect effect on a reduction in equity risk through the increase of norm constrained investors. The total effect of green bond issuance on equity risk is also not consistent. Altera Infrastructure is the only company with a significant total effect result; however, it is positive, meaning that for Altera Infrastructure equity risk increased in the period following green bond issuance, confirming the notion that a fossil transportation company issuance of green bond is really not green.

Table 4 – Green bond companies results

	Evergreen			NYK			MOL			AI
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB	IO, ARB
Institutional investor (Dep. Var)										
GBI	0.0103***	0.0025	0.0077***	0.0219*	0.0339***	-0.0120	0.0188*	-0.0104**	0.0292***	-0.0574***
	(2.62)	(1.18)	(2.73)	(1.88)	(11.38)	(-1.18)	(1.81)	(-2.34)	(4.11)	(-3.17)
Constant	0.1248***	0.0592***	0.0657***	0.3325***	0.0832***	0.2492***	0.4553***	0.1275***	0.3279***	0.2710***
	(44.85)	(38.71)	(32.67)	(42.33)	(41.50)	(36.22)	(65.01)	(42.68)	(68.47)	(29.90)
Equity price volatility (Dep. Var)										
Institutional investor	0.0128	-0.0802	0.0610	-0.0333***	-0.1372***	-0.0323**	0.0176	0.0730**	0.0112	0.0212
	(0.29)	(-1.10)	(1.15)	(-3.02)	(-3.14)	(-2.51)	(1.33)	(2.30)	(0.59)	(1.31)
GBI	-0.0014	-0.0012	-0.0016	0.0009	0.0047***	-0.0002	0.0013	0.0023**	0.0013	0.0061**
	(-1.26)	(-1.18)	(-1.51)	(0.87)	(2.64)	(-0.14)	(1.24)	(2.26)	(1.14)	(2.46)
TURN	0.3110***	0.3585***	0.2923***	1.0473***	0.9133***	1.0756***	1.1934***	1.1017***	1.2380***	2.2370***
	(4.74)	(6.00)	(5.14)	(5.14)	(4.43)	(5.15)	(7.67)	(6.92)	(8.09)	(5.85)
Constant	0.0115**	0.0176***	0.0092***	0.0138***	0.0157***	0.0104***	-0.0044	-0.0047	-0.0006	0.0003
	(2.14)	(4.15)	(2.66)	(3.14)	(3.28)	(2.64)	(-0.76)	(-1.27)	(-0.09)	(0.06)
Indirect effect	0.0001	-0.0002	0.0005	-0.0007	-0.0046***	0.0004	0.0003	-0.0008	0.0003	-0.0012
Total effect	-0.0012	-0.0014	-0.0012	0.0002	0.0000	0.0002	0.0016	0.0016	0.0017	0.0049**
R2 Institutional investor	0.1026	0.0227	0.1105	0.0554	0.6835	0.0226	0.0519	0.0837	0.2198	0.1433
R2 Equity price volatility	0.3854	0.4665	0.3719	0.3834	0.3498	0.3667	0.5263	0.5194	0.6329	0.3908
R2 total	0.4478	0.4707	0.4324	0.3467	0.7737	0.3446	0.5422	0.5424	0.6329	0.4759
Observations	60	60	60	60	60	60	60	60	60	28

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, AI - Altera infrastructure

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

5.2 Difference-in-difference – Total Risk

Table 5, 6 and 7 reports the difference in difference results that compares the results found in Table 4 to the equivalent results from the control groups by taking the difference between the variables used and re-estimating equation (1) and (2). Table 5 present the difference in difference between Evergreen, NYK and MOL with the Asian control group. Table 6 presents the difference in difference between Evergreen, NYK and MOL with the European control group. Table 7 presents the difference in difference between Altera Infrastructure and the Fossil control group.

Institutional Ownership:

The results in Table 5 show that compared to Asian control group, total institutional ownership increased in the period following green bond issuance in the three equities Evergreen, NYK and MOL significant at the 1%, 5%, and 5% level, respectively. For Evergreen there is a significant increase in arbitrageurs in Table 4. Compared to the Asian control group, a relative increase in norm constrained investors is the actual driver of the change in institutional ownership, significant at the 1% level. For NYK there is a significant increase in norm constrained investors in Table 4, this significance has now increased further when compared to the Asian control group. For MOL there is a reduction in norm constrained investors and increase in arbitrageurs significant at the 5% and 1% respectively in Table 4, when compared to the Asian control group the previous significant reduction in norm constrained investors is now not significant, and the increase in arbitrageurs has higher significance.

From this we can conclude that there is a diverging pattern of institutional holdings among the three equities and the Asian control group. The observed increase in institutional ownership might be driven by these institutions increased willingness to hold these equities because they believe that issuance of green bonds will fund green vessel technology. Which in turn will make the companies better equipped to handle potential changes in regulator environment or get preferential treatment when chartered. As discussed further in the chapter 6, the increase might be driven by other factors than the green bond issuance.

Equity price volatility:

Even though the results in Table 5 support the notion that institutional ownership increase in the period following green bond issuance, the results also show that there is no clear indirect effect of institutional ownership on equity risk. However, the total effect of green bond

issuance on equity risk is negative and highly significant all three equities, meaning that equity risk is reduced in all three companies in the period following green bond issuance compared to the Asian control group.

Table 5 – Difference in difference three equities vs ASIA control group

	Evergreen vs ASIA			NYK vs ASIA			MOL vg ASIA		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
Institutional investor (Dep. Var)									
GBI	0.0193***	0.0108***	0.0085*	0.0302**	0.0419***	-0.0118	0.0271**	-0.0023	0.0295***
	(3.28)	(4.44)	(1.83)	(2.29)	(11.98)	(-1.04)	(2.27)	(-0.49)	(3.54)
Constant	-0.1077***	0.0135***	-0.1213***	0.1007***	0.0381***	0.0626***	0.2235***	0.0824***	0.1412***
	(-25.80)	(7.81)	(-36.97)	(11.35)	(16.16)	(8.24)	(27.70)	(25.68)	(25.14)
Equity price volatility (Dep. Var)									
Institutional investor	0.0773**	0.0353	0.0946***	-0.0111	-0.0763**	-0.0078	0.0073	0.0265	0.0062
	(2.47)	(0.43)	(2.65)	(-1.09)	(-2.03)	(-0.65)	(0.58)	(0.87)	(0.33)
GBI	-0.0053***	-0.0047***	-0.0048***	-0.0043***	-0.0014	-0.0047***	-0.0031***	-0.0028**	-0.0031**
	(-4.09)	(-3.29)	(-3.86)	(-4.01)	(-0.77)	(-4.52)	(-2.60)	(-2.49)	(-2.41)
TURN	0.1293	0.2268**	0.1694**	0.4947***	0.4710***	0.5054***	0.6019***	0.5865***	0.5984***
	(1.45)	(2.33)	(2.12)	(4.06)	(3.93)	(4.14)	(4.36)	(4.38)	(4.22)
Constant	0.0092***	0.0006	0.0124***	-0.0005	0.0014	-0.0012	-0.0020	-0.0025	-0.0012
	(2.70)	(0.37)	(2.84)	(-0.35)	(0.75)	(-0.93)	(-0.64)	(-0.91)	(-0.41)
Indirect effect	0.0015**	0.0004	0.0008	-0.0003	-0.0032**	0.0001	0.0002	-0.0001	0.0002
Total effect	-0.0038***	-0.0043***	-0.0040***	-0.0046***	-0.0046***	-0.0046***	-0.0029**	-0.0029**	-0.0029**
R2 Institutional investor	0.1521	0.2474	0.0531	0.0804	0.7051	0.0178	0.0789	0.0040	0.1726
R2 Equity price volatility	0.2381	0.2009	0.2550	0.3962	0.4150	0.3929	0.2978	0.2941	0.2932
R2 total	0.3291	0.3937	0.2500	0.4116	0.7693	0.4037	0.3531	0.2884	0.4126
Observations	60	60	60	60	60	60	60	60	60

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA - Asian control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Institutional Ownership:

The main results in Table 6 show that compared to the European control group, total institutional ownership decreased in the period following green bond issuance for Evergreen, NYK and MOL, significant at the 1% level for Evergreen and not significant for NYK and MOL. For Evergreen there is a significant increase in arbitrageurs in Table 4. When compared to the European control group, both norm constrained and arbitrageurs declines, significant at the 1% and 10% level. For NYK there is a significant increase in norm constrained investors in Table 4, this significance has now increased further when compared to the European control group. For MOL there is a reduction in norm constrained investors and an increase in arbitrageurs significant at the 5% and 1% level in Table 4, when compared to the European control group the direction remains the same, but significance is changed to the 1% and 10% level.

Equity price volatility:

As there is no clear increase in institutional ownership compared to the European control group, there is no clear indirect effect of institutional ownership on equity risk. However, the total effect of green bond issuance on equity risk is also negative and highly significant for all three, meaning that equity risk is reduces in all three equities in the period following green bond issuance compared to the European control group. It is not possible to say with that this reduction alone is a product of the increase in institutional ownership based on the model.

Table 6 – Difference in difference three equities vs EUROPE control group

	Evergreen vs EUROPE			NYK vs EUROPE			MOL vg EUROPE		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
Institutional investor (Dep. Var)									
GBI	-0.0149***	-0.0080***	-0.0070*	0.0004	0.0251***	-0.0247**	-0.0026	-0.0192***	0.0165*
	(-3.02)	(-2.65)	(-1.69)	(0.03)	(7.67)	(-2.37)	(-0.22)	(-4.04)	(1.93)
Constant	-0.0672***	0.0277***	-0.0950***	0.1374***	0.0505***	0.0869***	0.2603***	0.0947***	0.1655***
	(-19.16)	(12.97)	(-32.46)	(17.54)	(22.93)	(12.36)	(32.14)	(29.63)	(28.75)
Equity price volatility (Dep. Var)									
Institutional investor	0.0024	0.0707	-0.0350	-0.0180	-0.1269***	-0.0098	-0.0004	0.0065	-0.0024
	(0.05)	(1.10)	(-0.74)	(-1.40)	(-2.94)	(-0.68)	(-0.03)	(0.18)	(-0.13)
GBI	-0.0054***	-0.0048***	-0.0058***	-0.0041***	-0.0009	-0.0043***	-0.0023*	-0.0022	-0.0023*
	(-3.26)	(-3.12)	(-3.98)	(-3.42)	(-0.60)	(-3.48)	(-1.96)	(-1.63)	(-1.86)
TURN	0.3418***	0.3091***	0.3687***	0.5361**	0.5138**	0.5238**	0.5260***	0.5070**	0.5298***
	(3.95)	(4.18)	(4.97)	(2.19)	(2.22)	(2.11)	(2.75)	(2.50)	(2.88)
Constant	-0.0021	-0.0041**	-0.0057	-0.0042	0.0000	-0.0057*	-0.0046	-0.0051	-0.0043
	(-0.61)	(-2.10)	(-1.21)	(-1.34)	(0.00)	(-1.94)	(-1.33)	(-1.62)	(-1.34)
Indirect effect	-0.0000	-0.0006	0.0002	-0.0000	-0.0032***	0.0002	0.0000	-0.0001	-0.0000
Total effect	-0.0055***	-0.0053***	-0.0056***	-0.0041***	-0.0041***	-0.0041***	-0.0023**	-0.0023**	-0.0023**
R2 Institutional investor	0.1323	0.1046	0.0456	-0.0000	0.4953	0.0854	0.0008	0.2139	0.0587
R2 Equity price volatility	0.3670	0.3488	0.4003	0.2861	0.3525	0.2663	0.1831	0.1766	0.1847
R2 total	0.4430	0.3869	0.4275	0.2685	0.5411	0.3265	0.1837	0.3400	0.2280
Observations	60	60	60	60	60	60	60	60	60

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, EUROPE - European control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Institutional Ownership:

The main results in Table 7 show that compared to fossil control group, total institutional ownership increased in the period following green bond issuance for Altera Infrastructure, significant at the 5% level. This is because the declining trend in institutional ownership stops after issuance while the level of institutional ownership in the fossil control group continues to decline. Total institutional ownership in the fossil control group is still over twice as high in the period following issuance. The decline in institutional ownership in both Altera Infrastructure and its control group is mostly (or only) driven by a selloff from arbitrageurs, as norm constrained investors are not present in the sector to any significant degree. This is consistent with literature and the notion that norm constrained investors have longer investment horizons and thereby are more interested in sustainable investments which is likely to become a part of the solution to climate change. Investments in fossil transportation shipping companies might be considered by long-term investors as highly risky because the changing regulatory environment could lead to a situation with stranded assets, such as oil tankers, with little to no value.

Equity price volatility:

Even though there is a relative increase in institutional ownership, there is no significant indirect effect or total effect on equity risk. Drawing causal inference with Altera Infrastructure is, and would have been, difficult regardless of significant results or not, due to the characteristics of the preferred A shares. The results must also be viewed in the light of the models low R2 compared to the other models, implying less explanatory value of results.

Table 7 – Difference in difference Altera Infrastructure vs FOSSIL control group

	AI	
	IO	ARB
Institutional investor (Dep. Var)		
GBI	0.0279**	0.0311**
	(1.96)	(2.28)
Constant	-0.2097***	-0.1501***
	(-29.49)	(-21.97)
Equity price volatility (Dep. Var)		
Institutional investor	-0.0030	-0.0014
	(-0.17)	(-0.07)
GBI	0.0013	0.0012
	(0.48)	(0.46)
TURN	0.6283***	0.6258***
	(2.71)	(2.70)
Constant	-0.0021	-0.0017
	(-0.54)	(-0.57)
Indirect effect	-0.0001	-0.0000
Total effect	0.0012	0.0012
R2 Institutional investor	0.0604	0.0796
R2 Equity price volatility	0.1391	0.1381
R2 total	0.1878	0.2039
Observations	28	28

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01
AI - Altera infrastructure, GBI - Green Bond Issuance,
TURN - Average daily turnover of outstanding shares

Summary main findings:

In short, the findings in Table 5, 6, and 7 confirm that the institutional investors are not one homogenous group. Arbitrageurs are found to be the major institutional investors in the shipping industry. This is consistent with Drobetz et al. (2021) whose research show that short-term arbitrageurs are the main drivers for the positive institutional ownership effect on firm performance in the shipping industry. This might be due to the cyclical nature of the industry, where arbitrageurs to a larger degree try to time the cycles by chasing short-term gains.

When compared to their peers, the relative increase in norm constrained investors is found to have the largest impact reduction in equity risk for the three equities in the period after issuance, the results form Altera Infrastructure is inconclusive. This finding implies that, in general norm constrained institutional investors in shipping companies can help stabilize equity prices after green bonds are issued. This result is consistent with Ruiz-Mallorquí and

Santana-Martín (2011) research that norm constrained institutional investors can stabilize equity prices by effectively monitor firms and by minimizing information asymmetries and agency problems. In contrast, arbitrageurs usually destabilize equity prices by seeking quick profits (David & Kochhar, 1996). Also, the results are consistent with the literature review on green bonds discussed, confirming that institutional ownership is increased in most cases, and equity risk reduced in the period after green bond issuance.

In conclusion, the main findings provide no clear evidence of an indirect effect or mediating of institutional ownership on equity risk in the shipping industry after green bond issuance. However, results shows that the total reduction in equity price volatility for the three equities in the period after green bond issuance is highly significant compared to both the Asian and European control group. Further thought concerning causality are discussed in chapter 6.

5.3 Idiosyncratic Risk

To capture unsystematic risk and to further demonstrate that the reduction in equity price volatility is directly attributed to firm specific reasons, we supplement our main results based on total equity risk (SD) with additional tests concerning idiosyncratic risk (IR). By doing so, we can better capture the effect of green bond issuance on unsystematic risk that occurs in a particular equity in the period following issuance.

Table 8 compares total risk from Table 3 with idiosyncratic risk over the five year sample period. The results show that shipping companies primarily face unsystematic risk. This can be attributed to the cyclical nature of shipping, where the main drivers of valuation, freight rates, are determined by many complex variables other than the world economy (Stopford, 2008) reflected in the MSCI.

Table 8 – Summary statistics of total and idiosyncratic risk

Variable	Obs	Mean	Median	Min	Max
MSCI					
SD	60	0.0058	0.0043	0.0016	0.0377
SD	28	0.0062	0.0053	0.0019	0.0377
Evergreen					
SD	60	0.0144	0.0130	0.0075	0.0264
IR	60	0.0139	0.0129	0.0074	0.0238
NYK					
SD	60	0.0146	0.0133	0.0087	0.0247
IR	60	0.0141	0.0130	0.0080	0.0240
MOL					
SD	60	0.0168	0.0148	0.0099	0.0298
IR	60	0.0162	0.0146	0.0098	0.0280
Altera Infrastructure					
SD	28	0.0162	0.0128	0.0065	0.0412
IR	28	0.0164	0.0136	0.0075	0.0364
ASIA					
SD	60	0.0153	0.0150	0.0068	0.0308
IR	60	0.0150	0.0145	0.0068	0.0292
EUROPE					
SD	60	0.0177	0.0170	0.0105	0.0327
IR	60	0.0158	0.0151	0.0088	0.0288
FOSSIL					
SD	28	0.0187	0.0179	0.0091	0.0405
IR	28	0.0173	0.0160	0.0090	0.0362

Evergreen – Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA – Asian control group, EUROPE - European control group, FOSSIL - Fossil control group, SD – Total risk, IR - Idiosyncratic risk

The main results presented in Table 9, 10 and 11 are in line with those reported in Table 5, 6, and 7, suggesting that after subtracting market volatility, Evergreen, NYK and MOL continue to load significantly and negatively on the individual equity price volatility when compared to the Asian and European control group, providing further support for the risk-mitigating effect of green bond issuance.

Evergreen, NYK, MOL:

Even though the results in section 5.2 support the notion that institutional ownership increase in the period following green bond issuance compared to the Asian control group, the results also here show that there is no clear indirect effect of institutional ownership on idiosyncratic risk. However, the total effect of green bond issuance on idiosyncratic volatility is negative and highly significant for the three equities, meaning that unsystematic risk is reduces in in the period following green bond issuance compared to the Asian control group.

As there is no clear increase in institutional ownership compared to the European control group, there is also here no clear indirect effect of institutional ownership on idiosyncratic risk. However, the total effect of green bond issuance on idiosyncratic volatility is also negative and highly significant for the three equities, meaning that unsystematic risk is also reduces in the period following green bond issuance when compared to the European control group. It is not possible to say that this reduction alone is a product of the increase in institutional ownership based on the model.

In general, these results also suggest that shipping companies with a larger proportion of norm-constrained institutional investors could also enjoy lower idiosyncratic risk.

Altera infrastructure:

As mentioned earlier there is a relative increase in institutional ownership, but still no significant indirect effect or total effect on idiosyncratic risk when compared to the fossil control group, making it difficult to draw any causal inference with Altera Infrastructure. Also, the models' explanatory value (R2) is still lower than the other models. Because of this, and because there are no comparable valuation multiples for them due to being acquired shortly after issuance, we exclude Altera Infrastructure for further tests concerning cost of equity and valuation.

Table 9 – Difference in difference three equities vs ASIA control group (idiosyncratic risk)

	Evergreen vs ASIA			NYK vs ASIA			MOL vg ASIA		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
Institutional investor (Dep. Var)									
GBI	0.0193***	0.0108***	0.0085*	0.0302**	0.0419***	-0.0118	0.0271**	-0.0023	0.0295***
	(3.28)	(4.44)	(1.83)	(2.29)	(11.98)	(-1.04)	(2.27)	(-0.49)	(3.54)
Constant	-0.1077***	0.0135***	-0.1213***	0.1007***	0.0381***	0.0626***	0.2235***	0.0824***	0.1412***
	(-25.80)	(7.81)	(-36.97)	(11.35)	(16.16)	(8.24)	(27.70)	(25.68)	(25.14)
Idiosyncratic risk (Dep. Var)									
Institutional investor	0.0784**	0.0488	0.0932**	-0.0077	-0.0677*	-0.0040	0.0067	0.0184	0.0079
	(2.46)	(0.58)	(2.55)	(-0.80)	(-1.91)	(-0.35)	(0.58)	(0.65)	(0.46)
GBI	-0.0052***	-0.0047***	-0.0047***	-0.0044***	-0.0018	-0.0046***	-0.0031***	-0.0029***	-0.0032***
	(-3.96)	(-3.24)	(-3.71)	(-4.32)	(-1.00)	(-4.73)	(-2.87)	(-2.78)	(-2.73)
TURN	0.1017	0.1912*	0.1447*	0.4997***	0.4746***	0.5089***	0.5548***	0.5399***	0.5569***
	(1.12)	(1.93)	(1.77)	(4.36)	(4.22)	(4.44)	(4.36)	(4.36)	(4.27)
Constant	0.0091***	0.0002	0.0121***	-0.0011	0.0009	-0.0017	-0.0019	-0.0019	-0.0016
	(2.64)	(0.12)	(2.71)	(-0.75)	(0.50)	(-1.34)	(-0.67)	(-0.74)	(-0.56)
Indirect effect	0.0015**	0.0005	0.0008	-0.0002	-0.0028*	0.0000	0.0002	-0.0000	0.0002
Total effect	-0.0037***	-0.0042***	-0.0039***	-0.0046***	-0.0046***	-0.0046***	-0.0030***	-0.0030***	-0.0030***
R2 Institutional investor	0.1521	0.2474	0.0531	0.0804	0.7051	0.0178	0.0789	0.0040	0.1726
R2 Idiosyncratic risk	0.2255	0.1748	0.2342	0.4218	0.4395	0.4208	0.3092	0.3015	0.3090
R2 total	0.3179	0.3757	0.2320	0.4433	0.7776	0.4306	0.3635	0.2989	0.4259
Observations	60	60	60	60	60	60	60	60	60

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA - Asian control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Table 10 – Difference in difference three equities vs EUROPE control group (idiosyncratic risk)

	Evergreen vs EUROPE			NYK vs EUROPE			MOL vg EUROPE		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
Institutional investor (Dep. Var)									
GBI	-0.0149***	-0.0080***	-0.0070*	0.0004	0.0251***	-0.0247**	-0.0026	-0.0192***	0.0165*
	(-3.02)	(-2.65)	(-1.69)	(0.03)	(7.67)	(-2.37)	(-0.22)	(-4.04)	(1.93)
Constant	-0.0672***	0.0277***	-0.0950***	0.1374***	0.0505***	0.0869***	0.2603***	0.0947***	0.1655***
	(-19.16)	(12.97)	(-32.46)	(17.54)	(22.93)	(12.36)	(32.14)	(29.63)	(28.75)
Idiosyncratic risk (Dep. Var)									
Institutional investor	0.0165	0.0645	-0.0167	-0.0273**	-0.1450***	-0.0196	-0.0032	-0.0089	-0.0036
	(0.39)	(1.09)	(-0.38)	(-2.36)	(-3.74)	(-1.48)	(-0.24)	(-0.25)	(-0.20)
GBI	-0.0045***	-0.0042***	-0.0050***	-0.0037***	-0.0001	-0.0042***	-0.0021*	-0.0022*	-0.0020*
	(-2.97)	(-3.01)	(-3.73)	(-3.42)	(-0.08)	(-3.66)	(-1.82)	(-1.71)	(-1.70)
TURN	0.2434***	0.2305***	0.2744***	0.5813***	0.5457***	0.5693**	0.6411***	0.6483***	0.6336***
	(3.06)	(3.39)	(4.00)	(2.62)	(2.62)	(2.50)	(3.47)	(3.31)	(3.57)
Constant	0.0005	-0.0024	-0.0023	-0.0020	0.0019	-0.0040	-0.0037	-0.0038	-0.0039
	(0.15)	(-1.32)	(-0.53)	(-0.72)	(0.63)	(-1.47)	(-1.12)	(-1.24)	(-1.25)
Indirect effect	-0.0002	-0.0005	0.0001	-0.0000	-0.0036***	0.0005	0.0000	0.0002	-0.0001
Total effect	-0.0048***	-0.0047***	-0.0049***	-0.0037***	-0.0037***	-0.0037***	-0.0021**	-0.0021**	-0.0021**
R2 Institutional investor	0.1323	0.1046	0.0456	0.0000	0.4953	0.0854	0.0008	0.2139	0.0587
R2 Idiosyncratic risk	0.2937	0.2937	0.3266	0.3385	0.4087	0.3005	0.2338	0.2370	0.2303
R2 total	0.3689	0.3319	0.3569	0.2945	0.5495	0.3599	0.2340	0.3963	0.2709
Observations	60	60	60	60	60	60	60	60	60

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, EUROPE - European control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Table 11 – Difference in difference Altera Infrastructure vs FOSSIL control group (idiosyncratic risk)

	AI	
	IO	ARB
Institutional investor (Dep. Var)		
GBI	0.0279**	0.0311**
	(1.96)	(2.28)
Constant	-0.2097***	-0.1501***
	(-29.49)	(-21.97)
Idiosyncratic risk (Dep. Var)		
Institutional investor	0.0010	0.0025
	(0.06)	(0.14)
GBI	0.0013	0.0012
	(0.55)	(0.52)
TURN	0.7255***	0.7246***
	(3.44)	(3.44)
Constant	0.0005	0.0007
	(0.15)	(0.25)
Indirect effect	0.0000	0.0001
Total effect	0.0013	0.0013
R2 Institutional investor	0.0604	0.0796
R2 Idiosyncratic risk	0.2071	0.2685
R2 total	0.2532	0.2685
Observations	28	28

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

AI - Altera infrastructure, GBI - Green Bond Issuance,
TURN - Average daily turnover of outstanding shares

5.4 Impact on Valuation

As the results show no clear mediating effect of green bond issuance on equity risk through institutional ownership, we use the difference in total equity return volatility to calculate the relative change in cost of equity between the three equities and their two control groups following issuance, illustrated in Table 12 and 13. By doing so, we check if the relative change in difference in total equity risk found in 5.2 is synonymous with a relative change in cost of equity, and subsequent we check if the change in cost of equity can explain any relative difference in enterprise valuation. The assumption for the cost of equity calculations is that cost of debt and debt-to-equity ratios remain unchanged throughout the sample period. The unchanged debt-to-equity ratio assumption holds fairly well when comparing the average debt-to-equity ratio of the three equities with both control groups, illustrated below:

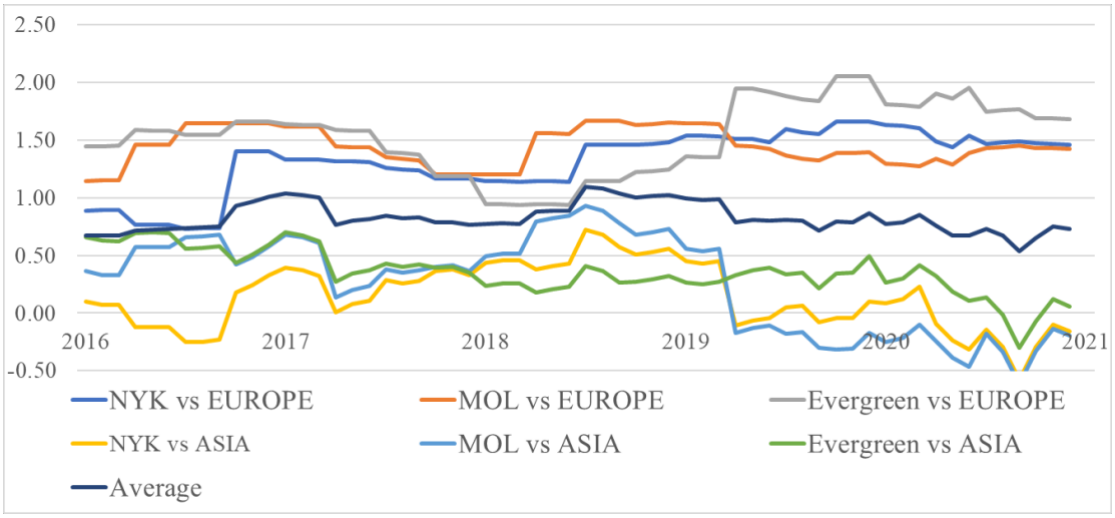

Figure 4 – Difference in debt-to-equity ratio

The results in Table 13 show that Evergreen has a relative reduction in daily cost of equity compared to both the Asian and European control groups in the period following green bond issuance. The results also show that Evergreen experience an expansion in both P/S and EV/S multiples in the period following issuance compared to the Asian control group, both significant at the 5% level. When compared to the European control group, both P/S and EV/S multiples also expand, significant at the 1% level.

For NYK the results also show that daily cost of equity is reduced when compared to both control groups. The results further show that the EV/S multiple experience a relative expansion, significant at the 10% level when compared to the Asian control group. When compared to the European control group both P/S and EV/S multiples expand for NYK, significant at the 5% and 1% level.

Table 12 – Cost of capital calculation inputs for Equation (5) and (6)

ASIA vs:	Total effect (i-cg) Table 5	Total effect (i), Table 4	Total effect (cg) "Appendix 8"	Correlation (R_i, R_m)	Correlation (R_{cg}, R_m)	Return MSCI	Std.Dev MSCI
Evergreen	-0.0038***	non-sig	0.0047***	0.4531	0.2103	0.0004	0.0058
NYK	-0.0046***	non-sig	0.0048***	0.6251	0.2103	0.0004	0.0058
MOL	-0.0029***	non-sig	0.0048***	0.6608	0.2103	0.0004	0.0058

EUROPE vs:	Total effect (i-cg) Table 6	Total effect (i) Table 4	Total effect (cg) "Appendix 8"	Correlation (R_i, R_m)	Correlation (R_{cg}, R_m)	Return MSCI	Return MSCI
Evergreen	-0.0055***	non-sig	0.0061***	0.4531	0.4000	0.0004	0.0058
NYK	-0.0041***	non-sig	0.0055***	0.6251	0.4000	0.0004	0.0058
MOL	-0.0023*	non-sig	0.0055***	0.6608	0.4000	0.0004	0.0058

* p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, EUROPE - European control group, ASIA - Asian control group. (i-cg): difference in difference between equity (i) and control group (cg). Correlation (Ri, Rm): correlation between equity (i) and MSCI. Correlation (Rcg, Rm): correlation between control group (cg) and MSCI. Return MSCI is the average daily return during the period. Std.Dev MSCI is the average daily standard deviation of the MSCI during the sample period. "Appendix 8" – shows average numbers for the three equities, real numbers listed in this table

Table 13 – Difference in Cost of Equity and Valuation

ASIA vs:	Difference in Cost of Equity	Difference in P/S	Difference in EV/S
Evergreen	-0.0041%	0.0188**	0.0649**
NYK	-0.0063%	-0.0015	0.0282*
MOL	0.0017%	-0.0104	0.0171

EUROPE vs:	Difference in Cost of Equity	Difference in P/S	Difference in EV/S
Evergreen	-0.0153%	0.0437***	0.1127***
NYK	-0.0094%	0.0584**	0.1357***
MOL	-0.0006%	0.0202	0.0592*

* p<0.10, ** p<0.05, *** p<0.01

Difference in P/S and EV/S multiple valuation: positive number = expansion, negative = contraction, relative to the respective control group in the period following green bond issuance.

For illustration: Cost of equity calculations using equation (6) and (7), Evergreen vs ASIA:

$$\Delta R_{i,cg,t} = \frac{0.0004}{0.0058}(0.4531 * (0.0047\text{-}0.0038) - 0.2103*0.0047) = -0.0041\%$$

For MOL the results show a relative increase in daily cost of equity compared to the Asian control groups, and a slight increase when compared to the European. The relative valuation for MOL does not yield any significant differences when compared to the Asian control group. However, when compared to the European control group EV/S multiple expand, significant at the 10%.

In short, five of six relative changes in cost of equity are reductions, and all significant results on changes in relative valuation multiples are expansions. But the assumption of no change in cost of debt weakens any conclusion connecting potential reduction in cost of equity and increased valuation. However, if companies are homogenous, which we argue our sample are, increased relative leverage should increase both cost of debt and cost of equity, while reduced relative leverage should reduce cost of debt and cost of equity, all else equal. As illustrated in Figure 4, the relative debt-to-equity ratio for the three equities increase or remains equal when compared to the European control group after green bond issuance, while relative debt-to-equity ratio is reduction when compared to the Asian control group. Because of these diverging trends we conclude that the reduction in cost of equity in the period following green bond issuance gives a correct picture of reality, and that this reduction in cost of equity is associated with increased valuation through multiple expansion. The results are consistent with the literature review, linking green project investment to reduced equity risk and increased enterprise valuation.

A study by H.-D. Kim, Y. Kim, Mantecon, and Song (2019) on US firms found that investment horizon of institutional investors is negatively correlated with the number of loan covenants and loan spreads. In other words, it could be that an increased institutional ownership reduces cost of debt, and in that way cost of equity is reduced as more capital goes to equity investors. However, this argument falls short when comparing Evergreen and NYK to the European control group as their relative debt-to-equity ratio worsens, while relative institutional ownership remains unchanged, and subsequently equity risk is significantly reduced.

6. Discussion

So far, we have shown that for three of four green bond issuing shipping companies, equity risk is reduced, and in some cases, institutional ownership increased in the period following issuance when compared to peers. The results are also robust, appendix 9-12 reports the lagged-bootstrapped results equivalent to the results found in Table 4, 5, 6 and 7. The results remains fairly unchanged, which implies that other variables excluded from the model does not bias the equity price volatility significantly, and the endogeneity problem is addressed by confirming that historical level of institutional ownership and turnover are associated with equity risk, as expected. However, there is no clear significant mediating effect, which could imply further problems with omitted variable bias. To say anything about causal inference we need to address these variables and other potential economic or behavioral explanations for the results.

This chapter first explores the dropped variables mentioned in the methodology section, and their impact on the dependent variables in the SEM model by using, among other, the Pearson correlation matrixes in Appendix 1-7. Second, we discuss the event horizon, and use of green bonds proceeds in relation to the climate bond initiative (CBI) criteria for alignment with the Paris Agreement as an explanation for potential mediocre increase in institutional ownership. Finally, we discuss recent trends and developments in green project financing in shipping, before addressing limitations of the thesis.

6.1 Dropped variables

Variables which are inconsistent is uninterpretable and have been excluded from the model (Antonakis et al., 2014). The variables below have been tested in this study but are dropped due to, among other, loading inconsistently in the correlation matrix. Nevertheless, they might affect institutional ownership and equity risk, which is why they are addressed below. For Pearson correlation, see Appendix 1-7. For data description of dropped variables, see Appendix 13.

- According to the literature, increased **ownership concentration (CON)** in shipping firms is associated with increased firm performance. However, ownership concentration loads significantly and in different direction throughout the correlation matrixes. This can be attributed to ownership concentration being significantly higher in the Asian and European control groups and does not change much in the three equities during the sample period.

- Increased **ESG score** could be a potential explanation for some of the increased institutional ownership seen in the three equities. As discussed in the literature review, ESG related corporate initiatives are associated with higher institutional ownership. ESG score derived from Eikon loads consistently on institutional ownership. However, they do not load consistently on total risk (SD) and idiosyncratic risk (IR). This can be attributed to ESG score being reported annually, and also missing from some sample companies.

- Green focus (GF). Because data related to ESG is limited, we follow Sjøstedt and Parow (2019) and perform a green focus textual analysis on the annual report of Evergreen, NYK, MOL, and the companies in the Asian and European control groups over the five year sample period. The rationale behind the analysis is that increased institutional ownership and/or reduction in equity risk could be attributed to an overall green focus signaled through the annual report. The number of times green focus words: Green, Sustainable, ESG, Emission, and Environment, are used in each annual report are summarized for each company. The results show that over the five year sample period, green focus on average grew annually by 7% for the three equities, 8% for the Asian and 30% for the European control group. Illustrated below:

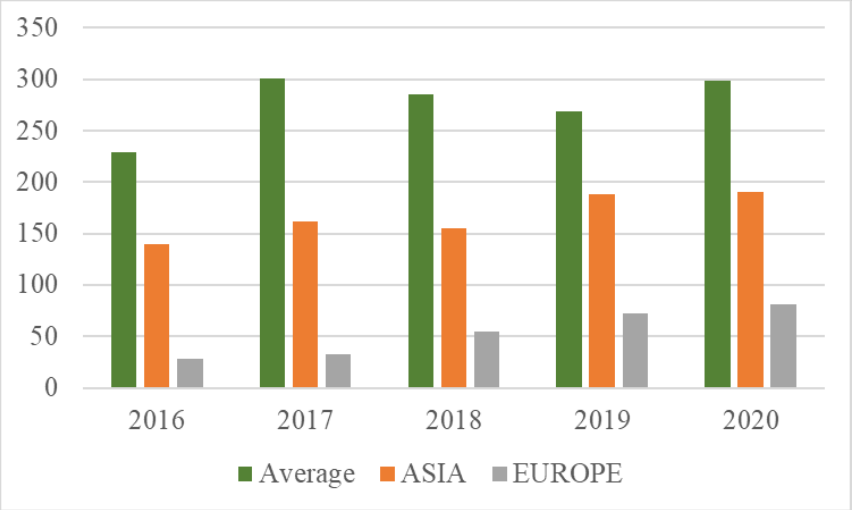

Figure 5 – Green focus textual analysis results

Because of the growth in green focus is higher in the control groups, it is difficult to say that green focus is responsible for the relative change in institutional ownership seen in some of the results, even though green focus loads positively and consistently on institutional ownership in the three equities. However, it could be that higher green focus is associated lower equity risk and higher valuation through better reputation. This relationship is studied in a recent 2020 study by Rehman et al. (2020), where they find that CSR initiatives are

associated with better reputation, which then are associated with lower equity risk and higher valuation. The reputation effect in shipping companies could be subject for further studies.

- Age of companies and **market capitalization** also does not load consistently.

- Debt-to-equity (DE). As discussed thoroughly in section 5.4, increased leverage is in theory synonymous with increased risk. However, debt-to-equity does not load consistently on total risk or idiosyncratic risk. This means that in our sample, increased debt-to-equity would in some cases reduce equity risk if included in the model, which is not consistent with economic theory. Also, the relative change in debt-to-equity ratio between Evergreen, NYK, and MOL compared to the Asian control group is decreasing, meaning that debt-to-equity increase in the Asian control group in the period following issuance. This could be a possible explanation for the change in equity risk had it not been for the relative change in debt-to-equity trends in the opposite direction for the European control group, where equity risk is also reduced significantly.

Even though the exclusion of the above variable increases validity of the model, it does not change the fact that they could potentially explain some of the results by being relevant in independent cases. A green minded institutional investor contemplating entering shipping would most likely review ESG scores and glance through the annual report to get a feel for "green focus" before investing. Some arbitrageurs will probably prefer high debt-to-equity ratios, as the potential rewards are higher if they time the shipping cycle correctly, while norm constrained investors have a different risk profile. Also, ownership concentration on firm performance in shipping companies are probably relevant in many cases, but because ownership concentration in the three equities is low, the results are inconclusive.

In summary, only turnover stands out as being supported by theory and loads significantly in the same direction across the entire sample on equity risk. As expected, green bond issuance time trend dummy (GBI) is to various degrees positively correlated with the measures of institutional ownership for the three equities, these correlations are also significant. Total and idiosyncratic risk (SD and IR) are both significantly and negatively correlated with the GBI variable. These findings are in alignment with the theory and the results, suggesting that green bond issuance could help stabilize equity prices and, in some cases, increase institutional ownership, even though mediation effects are non-significant. Also as expected, Altera Infrastructure's GBI variable shows no such effects.

6.2 Event window

To better understand potential explanation of non-significant mediating effects, we first explore the time horizon of the study, before looking at the use of bond proceeds in detail.

This study does not explore short-term effects, such as announcement effects, but the fundamental change in shipping companies' ownership structure and risk profile after funding green projects by issuance of green bonds, in the longest period possible following issuance. Figure 6 shows the changes in institutional ownership for NYK and MOL combined decreases slightly after issuance before increasing again, while institutional ownership in the control groups decline steadily in the period following issuance.

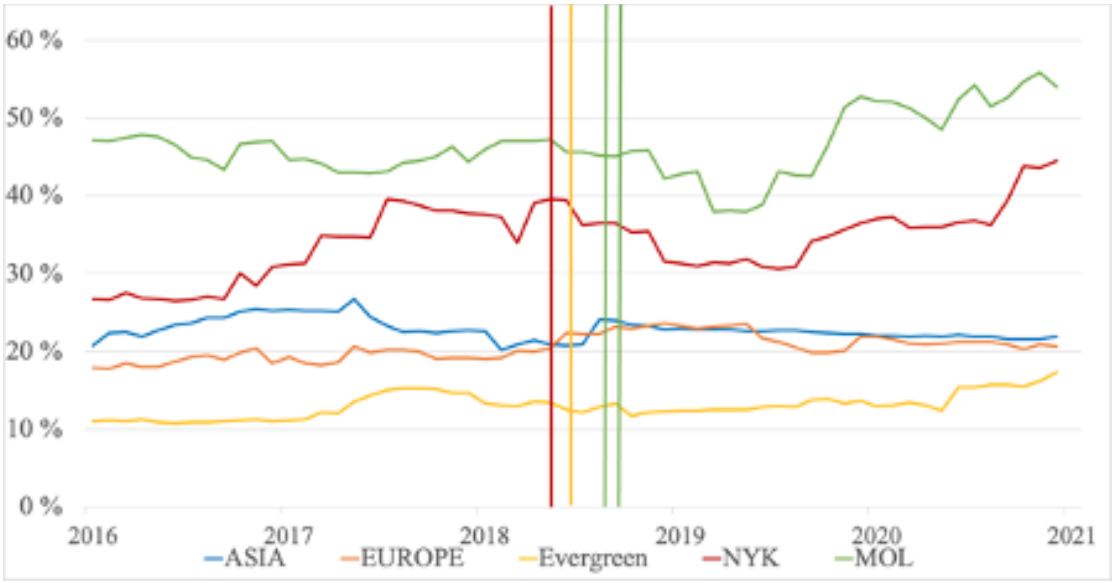

Figure 6 – Institutional ownership development Evergreen, NYK, MOL, ASIA, and EUROPE
Lines represent green bond issuance dates

Figure 7 shows changes in institutional ownership for Altera Infrastructure compared to the fossil control group, where Altera Infrastructure institutional ownership of their preferred A shares remains flat after issuance, while the institutional ownership in the fossil control group continue to decline. From this we can infer that the results concerning institutional ownership is highly dependent on the event window studied. It is not possible to say with certainty that issuance of green bonds in shipping leads to an increase in institutional ownership, even though total institutional ownership between the three equities increased relative to the Asian control group, which is the most comparable control group in respect to geographical origin and market capitalization.

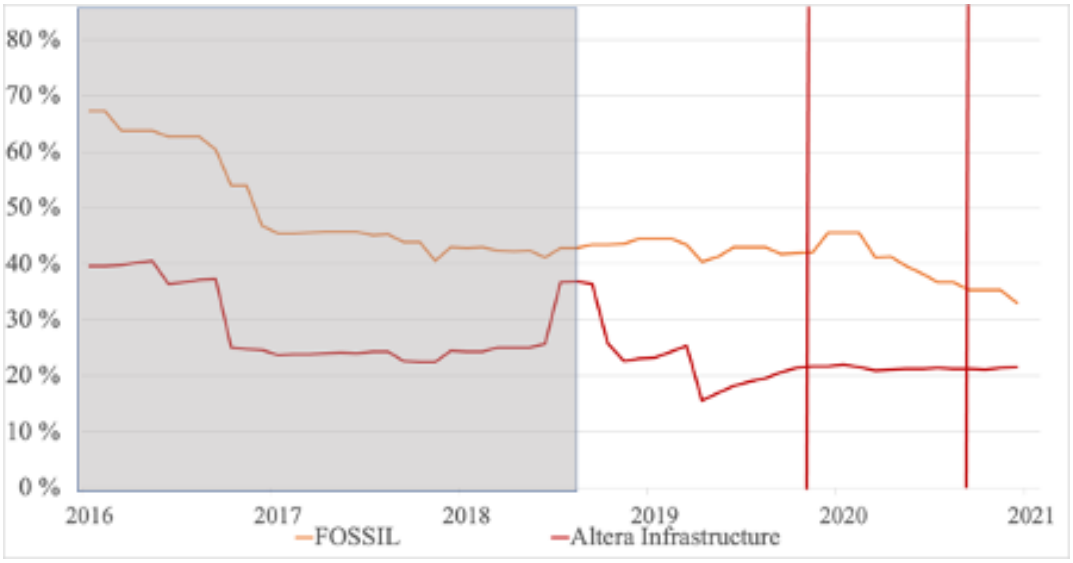

Figure 7 – Institutional ownership development Altera Infrastructure and FOSSIL control group

Lines represent green bond issuance dates. Grey area excluded from calculations

Considering that the literature on institutional ownership and firm performance is not consistent, it is not surprising that the results concerning institutional ownership is inconclusive.

6.3 Bond specific reason for non-significant mediating effects

Already touched upon in the data description, the use of proceeds primarily goes toward mandatory pollution prevention measures imposed by the international maritime organization (IMO). For instance, regulation concerning use of scrubbers, or use of low SOx fuels, went into force January 1, 2020. Also, BWMS have been mandatory for ocean going vessels for years prior to green bond issuance. For shipping, it is important to note that the criteria for being in alignment with the Paris Agreement in regard to carbon-intensity is higher than what IMOs goals for carbon reduction by 2050 are. This could be a contributing factor the general lack of more significant interest by institutional investors when shipping companies invest in green projects. The investment in green shipping projects might be seen by some as greenwashing because building a highly technical green (and expensive) dry bulk vessel might not make financial sense in the current regulatory environment, unless third parties are willing to bear the cost by increased freight rates. Bonds in alignment with the Paris Agreement can become certified by the climate bond initiative (CBI), which is a recognized non-profit London based organization. Criteria for the alignment in shipping was created in October 2020, as of May 2021 there are no green shipping bonds certified by CBI.

6.4 Green economic trends in shipping

Considering the recent world-wide multiple expansion of green companies, it is easy to draw a parallel to the dotcom mania at the start of the millennia. In a recent article by The Economist (2021), they address the question if we are in a green bubble, concluding that there will be winners and losers in the energy transition, and that it is important to note that two decades after the dotcom bust tech firms make up 38% of the S&P 500. When considering that investments in ESG related funds moved up from USD 38 billion in the first quarter of 2020, to USD 178 billion during the first quarter of 2021, there is definitely capital ready to be employed in shipping companies willing to take on green projects. A resent example of this (February 2021) is the acquisition of one of Norway leading transportation companies, Torghatten ASA, by the private equity firm EQT and the Norwegian government owned climate fund Nysnø, at a premium of 48% over 12-month volume weighted average price (EQT, 2020). Torghatten primarily operates ferries and have increased investment in electrifying its fleet in recent years.

The current trend in 2021 also indicate that shipping companies are starting to take notice of potential benefits from implementing green projects. As of May 2021, four new shipping companies have issued bonds linked to sustainability targets. One of these sustainable linked bonds was issued in January 2021 by one of the world's leading chemical tanker company, Odfjell SE. The bond, which primarily went to refinance old debt, was oversubscribed. Odfjell has set higher carbon intensity reduction targets than IMO and have started running several improvement and efficiency programs.

Another green financing possibility are sustainable linked loans. The use of these types of financing have accelerated in the last year, eight shipping companies received loans related to sustainability in 2020, while four companies have received sustainable linked loans so far this year. It remains to be seen if investors reward Odfjell's and these companies' commitment to decarbonization and sustainability, but the sustainable bond and loan is definitely a step in the right direction.

For Altera Infrastructure, causality inference is difficult to draw as we do not have the common equity to proxy for equity risk. However, as preferred shares in general are less risky than common equity, one would expect the preferred to be less volatile than the fossil control group. That is the case in the entire sample, but not the case after green bond issuance. From this we infer that equity investors in fossil related industries does not reap any direct benefits from

issuing green bonds. However, Brookfield Asset management, who already had a large equity stake in then Teekay Shuttle Tankers, acquired the remaining shares and merged them into their holding company only months after issuance. The initial offer of cash (or equity) consideration was equal to 33.6% premium on the offer date (Teekay, 2019). But the initial offer was made before the green bond announcement, so it is not possible to say this is attributed to the green bond. After the merger Brookfield changed the name to Altera Infrastructure, as they plan to focus on more environmental and sustainable projects in the future. This trend in rebranding, or greenwashing, of primarily fossil related companies have also increased in recent years, with Equinor being the largest example in Norway. Other companies, such as BW offshore, who owns and operates several FPSOs[2], recently (May 2021) developed a green bond framework where use of proceeds will go towards focus on renewable energy project. If these, and other fossil related rebranding's bears any financial fruits could be an interesting topic for further research. In one case the results are in, Ørsted (formerly DONG Energy) as we write is the second most valuable company on the Copenhagen stock exchange, up approximately 400% since 2017.

6.5 Further limitations – Evergreen, NYK, MOL

Our original plan to estimate the change in cost of equity as a product of differences in equity risk resulting from the mediating, or indirect, effect of green bond issuance on equity risk through institutional ownership fell short, as lack of significance rendered further calculations worthless. Therefore, cost of equity calculations is based on relative changes in total risk which is endogenous on expected return. Further, relative reduction in cost of equity and increase in valuation could also, among other reasons, be a product of changes in cost of debt. However, we argue that this is not the case as debt-to-equity ratios trend in the opposite direction in both control groups, and cost of equity is reduced while valuation is increased when compared to both. Also, considering the five year sample period the explanatory power of the model could probably increase if checking for longer periods lagged periods than one month. Finally, problems concerning small sample size must be highlighted as our treatment group only consist of four green bond, four companies. Even though total equity risk is reduced, and the results are significant, this could simply be a coincident, which is why further research on

[2] Floating Production Storage and Offloading - vessel

green project financing in shipping over different periods should be performed when the sample size have grown. As mentioned above, sustainability linked bonds, green loans etc. can be included in such a study, as these instruments have increased rapidly in use since starting writing this thesis. Also, shipping firm's reputation could be a potential latent variable used in further SEM structures concerning shipping and equity risk.

7. Conclusion

The purpose of this thesis was to increase knowledge about green project financing in shipping by investigating if companies are rewarded by increased institutional ownership and reduced equity risk following green bond issuance. For the fossil transportation company, Altera infrastructure, the results are inconclusive. But for the three other green bond issuing companies; Evergreen, NYK, and MOL (referred to as the three equities) the results show that in the years following green bond issuance, institutional ownership increased significantly relative to one of two control groups (Asian). The results also show that these institutional investors are not one homogenous group. The natural arbitrageurs are the largest institutional investors in shipping, while the norm-constrained institutions are the prominent responsible investors where the results are significant.

Also, we find no stand-alone reduction in equity risk in the period following issuance for any of the three equities. However, total reduction in equity risk is highly significant for all three equities when compared to both control groups. These results hold when controlling for alternative measures of firm risk, various model specifications, and using lagged variables with bootstrapping techniques.

Furthermore, as the three equities all have significant reductions in relative total risk, we explore if the difference in risk is associated with a reduction in cost of equity and increased relative valuation. The results show that relative cost of equity is reduced in two of three equities when compared to the first control group (Asian), and three of three when compared to the second (European). The results also show that when using multiple valuation techniques, all significant difference in valuation are expansions when compared to both control groups. From this we conclude that total equity risk is reduced, and valuation is increased in the period following green bond issuance for the three equities.

This thesis contributes to the recent literature on green bonds by providing evidence of reduced equity risk and increased valuation in shipping companies in the period following green bond issuance. The implications of these findings are that equity owners in shipping companies could potentially benefit from implementation of green projects through issuance of financing instruments like green bonds.

For the three equities: Even though the increase in institutional ownership is significant when compared to one of the two control groups, the results show no significant mediating effects of institutional ownership on equity risk. The reason being that the relative increase in

institutional ownership over the event windows is quite small, ranging from 1.9% to 3.0%. Also, in two of three equities institutional ownership first decline slightly after green bond issuance before increasing. Because of this, drawing causal inference of green bond issuance on increased institutional ownership is not possible as the level of institutional ownership is highly dependent on the event window studied.

Other limitations, and suggestions for further research can be found in chapter 6.

8. Appendix

Appendix 1 – Evergreen Marine Corp. correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	ESG	GF	DE	AGE	MCAP
IO	1.0000												
NORM	0.7135*	1.0000											
ARB	0.8612*	0.2583*	1.0000										
SD	0.4018*	0.2473	0.3746*	1.0000									
IR	0.4109*	0.2753*	0.3668*	0.9861*	1.0000								
GBI	0.3203*	0.1505	0.3324*	-0.0013	-0.0393	1.0000							
TURN	0.6506*	0.5518*	0.4968*	0.6225*	0.6040*	0.1912	1.0000						
CON	-0.4277*	-0.1114	-0.5089*	-0.1016	-0.0627	-0.8900*	-0.2994*	1.0000					
ESG	0.5783*	0.2077	0.6467*	0.0799	0.0574	0.8402*	0.2467	-0.8614*	1.0000				
GF	0.4609*	0.1710	0.5114*	0.0471	0.0137	0.8684*	0.2816*	-0.9149*	0.7972*	1.0000			
DE	0.2513	0.0945	0.2779*	0.0560	0.0336	0.5562*	0.1418	-0.5059*	0.3343*	0.6995*	1.0000		
AGE	0.5862*	0.2161	0.6515*	0.1701	0.1412	0.8558*	0.3596*	-0.9546*	0.8622*	0.9400*	0.5610*	1.0000	
MCAP	0.7766*	0.5296*	0.6865*	0.4865*	0.4811*	0.3130*	0.9197*	-0.4533*	0.4806*	0.4240*	0.1312	0.5303*	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period Evergreen, TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * p<0.05

Appendix 2 – Nippon Yusen Kabushiki Kaisha (NYK) correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	ESG	GF	DE	AGE	MCAP
IO	1.0000												
NORM	0.5129*	1.0000											
ARB	0.8982*	0.0834	1.0000										
SD	-0.3200*	-0.3412*	-0.1968	1.0000									
IR	-0.0552	0.0284	-0.0787	0.0683	1.0000								
GBI	0.2353	0.8268*	-0.1502	-0.1345	-0.1735	1.0000							
TURN	-0.0477	-0.3355*	0.1164	0.5336*	0.5551*	-0.2834*	1.0000						
CON	0.7127*	0.5595*	0.5409*	-0.4670*	-0.4444*	0.3650*	0.0549	1.0000					
ESG	0.3694*	0.5169*	0.1642	0.1172	0.1179	0.6183*	-0.0242	0.2060	1.0000				
GF	0.4099*	0.6930*	0.1210	-0.4609*	-0.4571*	0.7208*	-0.2939*	0.5958*	0.4925*	1.0000			
DE	0.5510*	0.8181*	0.2208	-0.3413*	-0.3551*	0.7682*	-0.0701	0.7387*	0.6487*	0.7980*	1.0000		
AGE	0.5724*	0.8724*	0.2178	-0.1877	-0.2117	0.8587*	-0.2697*	0.5901*	0.6846*	0.7677*	0.8465*	1.0000	
MCAP	0.1536	-0.5563*	0.4632*	-0.0038	0.0291	-0.7013*	0.1953	-0.0804	-0.4274*	-0.4156*	-0.4758*	-0.5365*	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period NYK, TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * p<0.05

Appendix 3 – Mitsui O.S.K. Lines (MOL) correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	ESG	GF	DE	AGE	MCAP
IO	1.0000												
NORM	0.7151*	1.0000											
ARB	0.9155*	0.3734*	1.0000										
SD	0.3272*	0.4346*	0.1841	1.0000									
IR	0.1138	0.0201	0.1394	-0.0644	1.0000								
GBI	0.2279	-0.2892*	0.4689*	0.0747	0.0399	1.0000							
TURN	0.2560*	0.4189*	0.0986	0.7179*	0.7188*	-0.0931	1.0000						
CON	0.2646*	0.3281*	0.1623	-0.2197	-0.2229	-0.4653*	-0.3038*	1.0000					
ESG	0.3177*	0.1390	0.3417*	-0.1965	-0.1769	0.3539*	-0.1319	0.0648	1.0000				
GF	0.4854*	0.0862	0.5945*	0.0927	0.0569	0.8366*	0.0237	-0.3317*	0.5584*	1.0000			
DE	0.0260	-0.2357	0.1702	-0.1481	-0.1383	0.4269*	-0.2720*	-0.0661	0.4754*	0.3123*	1.0000		
AGE	0.3826*	-0.0945	0.5621*	-0.0597	-0.0972	0.8587*	-0.1692	-0.2459	0.5269*	0.9431*	0.4311*	1.0000	
MCAP	-0.2486	-0.1661	-0.2343	-0.6594*	-0.6483*	-0.4853*	-0.4524*	0.5416*	0.1282	-0.4152*	-0.1193	-0.3110*	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period MOL, TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * $p<0.05$

Appendix 4 – Altera Infrastructure correlation matrix

	IO	ARB	SD	IR	TURN	GBI	CON	AGE	MCAP
IO	1.0000								
ARB	1.0000*	1.0000							
SD	0.0206	0.0206	1.0000						
IR	-0.0130	-0.0130	0.6179*	1.0000					
GBI	-0.3786*	-0.3786*	0.1546	0.1335	1.0000				
TURN	-0.0335	-0.0335	0.5650*	0.5818*	-0.1051	1.0000			
CON	-0.5900*	-0.5900*	0.0846	0.1153	0.8208*	-0.1706	1.0000		
AGE	-0.6616*	-0.6616*	0.0936	0.1394	0.7348*	-0.1018	0.9578*	1.0000	
MCAP	0.0542	0.0542	-0.7348*	-0.7299*	-0.4136*	-0.2338	-0.3485*	-0.3386*	1.0000

SD - Standard deviation, IDI. RISK - Idiosyncratic risk, GBI - Green bond issuance period Altera Infrastructure, TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * $p<0.05$

Appendix 5 – Asian control group correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	ESG	GF	DE	AGE	MCAP
IO	1.0000												
NORM	0.7390*	1.0000											
ARB	0.9237*	0.4246*	1.0000										
SD	-0.0476	-0.2211	0.0618	1.0000									
IR	-0.0532	-0.2865*	0.0915	0.5664*	1.0000								
GBI	-0.3028*	-0.7091*	-0.0038	0.3122*	0.2988*	1.0000							
TURN	-0.1166	-0.0355	-0.1365	0.6454*	0.6510*	-0.1871	1.0000						
CON	-0.1387	-0.0545	-0.1554	-0.6054*	-0.6216*	0.1075	-0.6652*	1.0000					
ESG	0.2553*	-0.0433	0.3678*	0.1221	0.1494	0.3338*	-0.0074	-0.0507	1.0000				
GF	-0.3150*	-0.6139*	-0.0743	0.1976	0.1912	0.8102*	-0.1983	0.0599	0.3996*	1.0000			
DE	-0.1889	-0.5116*	0.0370	0.3553*	0.3631*	0.7478*	-0.0612	-0.2448	0.4109*	0.8479*	1.0000		
AGE	-0.4804*	-0.7539*	-0.2169	0.2683*	0.2494	0.8669*	-0.1228	0.0856	0.4224*	0.9221*	0.7973*	1.0000	
MCAP	-0.1770	0.0109	-0.2441	-0.2346	-0.2363	-0.2717*	0.2581*	0.2342	0.2719*	-0.0646	-0.2679*	-0.0139	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period (average three equities), TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * $p<0.05$

Appendix 6 – European control group correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	ESG	GF	DE	AGE	MCAP
IO	1.0000												
NORM	0.6675*	1.0000											
ARB	0.8276*	0.1344	1.0000										
SD	0.0917	0.2648*	-0.0775	1.0000									
IR	0.2039	0.1794	0.1362	0.5350*	1.0000								
GBI	0.7452*	0.5437*	0.5818*	0.3537*	0.3648*	1.0000							
TURN	-0.4185*	-0.1823	-0.4195*	0.4540*	0.3560*	-0.3227*	1.0000						
CON	-0.4845*	-0.3942*	-0.3476*	0.0294	0.0131	-0.2397	0.1694	1.0000					
ESG	0.4910*	0.0270	0.6330*	-0.1180	-0.0026	0.5377*	-0.3919*	-0.0103	1.0000				
GF	0.6324*	0.4774*	0.4816*	0.3512*	0.3983*	0.9027*	-0.2113	-0.2592*	0.5599*	1.0000			
DE	0.3597*	0.2494	0.2907*	0.2763*	0.3798*	0.6352*	-0.1416	-0.3683*	0.5631*	0.7623*	1.0000		
AGE	0.6085*	0.4161*	0.4961*	0.3300*	0.3833*	0.8669*	-0.2224	-0.2666*	0.6038*	0.9839*	0.8010*	1.0000	
MCAP	-0.0810	-0.1111	-0.0240	-0.1924	-0.0605	-0.0378	-0.1701	-0.0522	0.2753*	0.1429	0.3857*	0.2608*	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period (average three equities), TURN - Turnover, CON - Ownership concentration, GF - Green focus, DE – debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * $p<0.05$

Appendix 7 – Fossil control group correlation matrix

	IO	NORM	ARB	SD	IR	GBI	TURN	CON	AGE	MCAP
IO	1.0000									
NORM	0.4438*	1.0000								
ARB	0.9990*	0.4041*	1.0000							
SD	0.3367*	0.5978*	0.3144*	1.0000						
IR	0.3474*	0.5131*	0.3296*	0.5555*	1.0000					
GBI	-0.4429*	0.3453*	-0.4689*	0.3851*	0.4252*	1.0000				
TURN	0.0327	0.5746*	0.0053	0.8406*	0.8328*	0.6112*	1.0000			
CON	-0.3761*	-0.4997*	-0.3594*	-0.2557*	-0.2184	0.2232	-0.1864	1.0000		
AGE	-0.7792*	-0.0339	-0.7937*	0.0231	0.0141	0.7348*	0.3097*	0.2084	1.0000	
MCAP	-0.1004	-0.1758	-0.0938	-0.5325*	-0.5144*	-0.3131*	-0.3756*	-0.1733	-0.2546*	1.0000

SD - Standard deviation, IR - Idiosyncratic risk, GBI - Green bond issuance period Altera Infrastructure, TURN - Turnover,
CON - Ownership concentration, GF - Green focus, DE - debt-to-equity ratio. AGE - Age of firm, MCAP - Market capitalization, * $p<0.05$

Appendix 8 – ASIA, EUROPE, FOSSIL Control groups

	ASIA			EUROPE			FOSSIL		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
IO, NORM, ARB (Dep. Var)									
GBI	-0.0084**	-0.0084***	-0.0001	0.0246***	0.0102***	0.0145***	-0.0854***	0.0032***	-0.0885***
	(-2.46)	(-7.79)	(-0.03)	(8.66)	(5.02)	(5.54)	(-3.83)	(2.85)	(-4.11)
Constant	0.2321***	0.0455***	0.1866***	0.1928***	0.0318***	0.1610***	0.4806***	0.0596***	0.4211***
	(97.48)	(61.09)	(100.36)	(97.63)	(22.56)	(88.97)	(43.09)	(106.62)	(39.11)
Std. Dev (Dep. Var)									
IO	0.0764**	0.2402**	0.0863**	-0.0480	0.0642	-0.1005*	0.0285***	0.3094**	0.0295***
	(2.41)	(2.33)	(2.12)	(-1.00)	(1.00)	(-1.96)	(4.61)	(2.16)	(4.64)
GBI	0.0056***	0.0069***	0.0049***	0.0072***	0.0055***	0.0074***	0.0006	-0.0034**	0.0007
	(6.20)	(5.61)	(5.73)	(4.76)	(4.39)	(6.05)	(0.40)	(-2.51)	(0.49)
Turnover	1.1435***	1.1590***	1.1258***	12.1136***	12.7028***	11.5132***	1.3752***	1.4764***	1.3816***
	(9.60)	(9.58)	(9.43)	(5.99)	(6.54)	(5.79)	(10.09)	(9.32)	(10.21)
Constant	-0.0106	-0.0039	-0.0089	0.0095	-0.0025	0.0172*	-0.0029	-0.0081	-0.0017
	(-1.41)	(-0.80)	(-1.15)	(0.93)	(-0.76)	(1.84)	(-1.03)	(-0.98)	(-0.66)
Indirect effect	-0.0006*	-0.0020**	-0.0000	-0.0012	0.0007	-0.0015*	-0.0024***	0.0010*	-0.0026***
Total effect	0.0048***	0.0048***	0.0048***	0.0060***	0.0061***	0.0054***	-0.0018	-0.0024*	-0.0019
R2 IO, NORM, ARB	0.0917	0.5028	0.0000	0.5554	0.2956	0.3385	0.1961	0.1192	0.2199
R2 SD	0.6627	0.6660	0.6499	0.4777	0.4943	0.4852	0.7653	0.7226	0.7670
R2 total	0.6915	0.8327	0.6404	0.7578	0.6160	0.6583	0.8095	0.7318	0.8169
Observations	60	60	60	60	60	60	60	60	60

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

ASIA - Asian control group, EUROPE – European control group, FOSSIL - Fossil fuel control group

GBI - Green Bond Issuance (ASIA, EUROPE), average for Evergreen NYK, and MOL (not the same numbers used in calculations). TURN - Average daily turnover of outstanding shares

Appendix 9 – Green bond companies results lagged

	Evergreen			NYK			MOL			AI
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB	IO
lag. Institutional investor (Dep. Var)										
lag.GBI	0.0097**	0.0023	0.0074**	0.0197	0.0333***	-0.0136	0.0193	-0.0102**	0.0296***	-0.0546***
	(2.32)	(1.04)	(2.49)	(1.63)	(11.53)	(-1.31)	(1.63)	(-2.09)	(4.28)	(-5.41)
Constant	0.1254***	0.0594***	0.0660***	0.3345***	0.0838***	0.2508***	0.4548***	0.1273***	0.3275***	0.2682***
	(41.23)	(50.84)	(28.54)	(36.21)	(30.03)	(34.16)	(160.98)	(117.34)	(143.87)	(26.77)
Equity price volatility (Dep. Var)										
lag.Institutional investor	0.0398	-0.0346	0.0764	-0.0273**	-0.1617***	-0.0221	0.0242*	0.0836**	0.0213	0.0260
	(0.83)	(-0.34)	(1.11)	(-2.06)	(-3.12)	(-1.42)	(1.96)	(2.00)	(1.17)	(1.16)
lag.GBI	-0.0019	-0.0016	-0.0020*	-0.0008	0.0038*	-0.0017	0.0006	0.0018	0.0004	0.0057*
	(-1.42)	(-1.33)	(-1.78)	(-0.62)	(1.85)	(-1.22)	(0.47)	(1.38)	(0.31)	(1.86)
lag.TURN	0.2016*	0.2542***	0.2008**	0.2042	0.0541	0.2189	0.9610***	0.8647***	1.0167***	1.3494**
	(1.73)	(2.65)	(2.22)	(0.64)	(0.17)	(0.69)	(5.87)	(4.38)	(5.92)	(2.48)
Constant	0.0087	0.0155***	0.0086**	0.0220***	0.0282***	0.0182***	-0.0047	-0.0033	-0.0012	0.0030
	(1.53)	(2.63)	(1.99)	(3.74)	(4.36)	(3.52)	(-0.81)	(-0.69)	(-0.19)	(0.48)
Indirect effect	0.0004	-0.0001	0.0006	-0.0005	-0.0054***	0.0003	0.0005	-0.0009	0.0006	-0.0014
Total effect	-0.0015	-0.0017	-0.0015	-0.0014	-0.0016	-0.0014	0.0010	0.0010	0.0011	0.0042
R2 Institutional investor	0.0930	0.0192	0.1014	0.0467	0.6818	0.0289	0.0540	0.0804	0.2219	0.1394
R2 Equity price volatility	0.2051	0.2735	0.2185	0.1007	0.1709	0.0722	0.3451	0.3368	0.3514	0.1755
R2 total	0.2721	0.2844	0.2832	0.0705	0.6987	0.0795	0.3601	0.3553	0.4887	0.2849
Observations	59	59	59	59	59	59	59	59	59	27

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, AI - Altera infrastructure

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Appendix 10 – Difference in difference three equities vs ASIA control group lagged

	Evergreen vs ASIA			NYK vs ASIA			MOL vs ASIA		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
lag. Institutional investor (Dep. Var)									
lag.GBI	0.0196***	0.0106***	0.0090*	0.0288**	0.0413***	-0.0125	0.0284**	-0.0022	0.0306***
	(3.13)	(4.15)	(1.84)	(2.10)	(12.11)	(-1.14)	(2.35)	(-0.41)	(3.28)
Constant	-0.1081***	0.0137***	-0.1218***	0.1020***	0.0387***	0.0633***	0.2223***	0.0823***	0.1400***
	(-22.40)	(10.35)	(-28.76)	(9.80)	(11.71)	(7.32)	(43.10)	(54.31)	(31.29)
Equity price volatility (Dep. Var)									
lag.Institutional investor	0.0929**	0.0076	0.1221***	-0.0071	-0.0478	-0.0052	0.0097	0.0335	0.0089
	(2.29)	(0.08)	(2.97)	(-0.61)	(-1.04)	(-0.36)	(0.71)	(1.05)	(0.43)
lag.GBI	-0.0051***	-0.0041**	-0.0046***	-0.0044***	-0.0027	-0.0047***	-0.0030**	-0.0026**	-0.0030**
	(-3.21)	(-2.43)	(-3.10)	(-3.72)	(-1.21)	(-4.23)	(-2.45)	(-2.00)	(-2.33)
lag.TURN	0.0086	0.1555	0.0477	0.2300	0.2126	0.2375	0.4175*	0.3968*	0.4144*
	(0.05)	(0.78)	(0.32)	(1.34)	(1.37)	(1.44)	(1.88)	(1.96)	(1.81)
Constant	0.0108**	0.0009	0.0157***	0.0009	0.0021	0.0004	-0.0015	-0.0020	-0.0005
	(2.27)	(0.47)	(2.90)	(0.59)	(1.01)	(0.29)	(-0.38)	(-0.65)	(-0.14)
Indirect effect	0.0018**	0.0001	0.0011	-0.0002	-0.0020	0.0001	0.0003	-0.0001	0.0003
Total effect	-0.0033**	-0.0040**	-0.0035**	-0.0046***	-0.0047***	-0.0046***	-0.0027**	-0.0027**	-0.0027**
R2 Institutional investor	0.1549	0.2379	0.0599	0.0738	0.7030	0.0199	0.0857	0.0036	0.1852
R2 Equity price volatility	0.2392	0.1393	0.2565	0.2654	0.2722	0.2640	0.1832	0.1808	0.1771
R2 total	0.3175	0.3322	0.2229	0.2918	0.7239	0.2783	0.2530	0.1684	0.3277
Observations	59	59	59	59	59	59	59	59	59

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, ASIA - Asian control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Appendix 11 – Difference in difference three equities vs EUROPE control group lagged

	Evergreen vs EUROPE			NYK vs EUROPE			MOL vs EUROPE		
	IO	NORM	ARB	IO	NORM	ARB	IO	NORM	ARB
lag. Institutional investor (Dep. Var)									
lag.GBI	-0.0150***	-0.0084***	-0.0066	-0.0012	0.0244***	-0.0256**	-0.0016	-0.0192***	0.0176*
	(-3.16)	(-2.81)	(-1.48)	(-0.10)	(8.56)	(-2.27)	(-0.11)	(-3.62)	(1.79)
Constant	-0.0672***	0.0282***	-0.0953***	0.1390***	0.0512***	0.0878***	0.2593***	0.0947***	0.1645***
	(-24.65)	(14.93)	(-34.23)	(16.55)	(19.50)	(13.29)	(67.65)	(46.67)	(48.78)
Equity price volatility (Dep. Var)									
lag.Institutional investor	0.0003	-0.0399	0.0215	-0.0099	-0.0868	-0.0040	0.0064	0.0124	0.0086
	(0.01)	(-0.52)	(0.43)	(-0.81)	(-1.52)	(-0.28)	(0.56)	(0.37)	(0.53)
lag.GBI	-0.0059***	-0.0063***	-0.0057***	-0.0046***	-0.0025	-0.0047***	-0.0029**	-0.0026*	-0.0030**
	(-2.99)	(-3.36)	(-3.55)	(-3.76)	(-1.42)	(-2.96)	(-2.33)	(-1.86)	(-2.19)
lag.TURN	0.2818	0.3020**	0.2673*	0.5602*	0.5529*	0.5501	0.3431*	0.3408	0.3558
	(1.55)	(2.01)	(1.81)	(1.66)	(1.69)	(1.63)	(1.79)	(1.33)	(1.63)
Constant	-0.0018	-0.0008	0.0002	-0.0053	-0.0021	-0.0062	-0.0044	-0.0039	-0.0043
	(-0.44)	(-0.34)	(0.04)	(-1.23)	(-0.47)	(-1.50)	(-1.34)	(-1.20)	(-1.31)
Indirect effect	-0.0000	0.0003	-0.0001	0.0000	-0.0021	0.0001	-0.0000	-0.0002	0.0002
Total effect	-0.0059***	-0.0060***	-0.0059***	-0.0046***	-0.0046***	-0.0046***	-0.0029**	-0.0029**	-0.0029**
R2 Institutional investor	0.1314	0.1144	0.0410	0.0002	0.4909	0.0906	-0.0029	0.2114	0.0658
R2 Equity price volatility	0.3262	0.3497	0.3155	0.3173	0.3505	0.3096	0.1386	0.1366	0.1415
R2 total	0.4043	0.4223	0.3329	0.3133	0.5626	0.3628	0.1353	0.2976	0.1976
Observations	59	59	59	59	59	59	59	59	59

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Evergreen - Evergreen Marine Corp., NYK - Nippon Yusen Kaisha Line, MOL - Mitsui O.S.K. Lines, EUROPE – European control group

GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Appendix 12 – Difference in difference Altera infrastructure vs FOSSIL control group lagged

	AI	
	IO	ARB
lag. Institutional investor (Dep. Var)		
lag.GBI	0.0264**	0.0299**
	(2.01)	(2.45)
Constant	-0.2081***	-0.1488***
	(-27.97)	(-20.62)
Equity price volatility (Dep. Var)		
lag.Institutional investor	0.0031	0.0013
	(0.21)	(0.52)
lag.GBI	0.0013	0.6290
	(0.43)	(1.46)
lag.TURN	0.6286	0.0042
	(1.46)	(0.26)
Constant	-0.0009	-0.0009
	(-0.28)	(-0.35)
Indirect effect	0.0001	0.0001
Total effect	0.0014	0.0014
R2 Institutional investor	0.0558	0.0751
R2 Equity price volatility	0.1345	0.1349
R2 total	0.1824	0.1995
Observations	27	27

t statistics in parentheses, * p<0.10, ** p<0.05, *** p<0.01

AI - Altera infrastructure, GBI - Green Bond Issuance, TURN - Average daily turnover of outstanding shares

Appendix 13 – Descriptive table of dropped variables

	Variable	Obs	Mean	Median	Min	Max
CON						
	Evergreen	60	0.0946	0.0930	0.0814	0.1062
	NYK	60	0.0461	0.0472	0.0337	0.0526
	MOL	60	0.0632	0.0665	0.0383	0.0747
	Altera Inf.	28	0.6195	0.5950	0.2750	0.9870
	ASIA	60	0.4398	0.4393	0.3522	0.6003
	EUROPE	60	0.3169	0.3066	0.2951	0.3734
	FOSSIL	28	0.2857	0.2836	0.2064	0.3288
ESG						
	Evergreen	60	56.11	63.52	28.71	71.15
	NYK	60	55.62	48.17	38.13	81.5
	MOL	60	41.87	46.03	0	59.25
	ASIA	60	49.88	50.2	40.16	56.42
	EUROPE	60	47.62	53.66	0	63.73
GF						
	Evergreen	60	157.6	125	80	245
	NYK	60	391.6	400	308	467
	MOL	60	256.8	200	142	432
	ASIA	60	166.9	162.3	139.4	190.4
	EUROPE	60	53.96	54.48	27.98	81.59

Variable	Obs	Mean	Median	Min	Max
DE					
Evergreen	60	2.141	2.072	1.56	2.795
NYK	60	1.928	1.935	1.218	2.402
MOL	60	2.052	2.108	1.544	2.295
ASIA	60	1.785	1.559	1.182	2.805
EUROPE	60	0.6099	0.6264	0.3928	0.8418
AGE					
Evergreen	60	50	50	48	52
NYK	60	133	133	131	135
MOL	60	134	134	132	136
Altera inf.	28	12	12	10	14
ASIA	60	62.2	62.2	60.2	64.2
EUROPE	60	69	69	67	71
FOSSIL	28	49	49	47	51
Market Cap					
Evergreen	60	1871	1782	1222	5145
NYK	60	3139	3169	2123	4459
MOL	60	3055	2996	1990	4358
Altera inf.	28	110.5	113.4	68.91	139.9
ASIA	60	8770	8135	5809	15967
EUROPE	60	36859	35895	28035	58788
FOSSIL	28	2164	2160	1729	2725

CON: Ownership Concentration, ESG: ESG-Score, GF: Green focus textual analysis, DE: Debt-to-equity, AGE: Age of company, Market Cap: average market capitalization

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