LUND UNIVERSITY
School of Economics and Management

Determinants of Capital Structure:

Evidence from the Global Renewable Energy Sector

BUSN 89 Degree Project in Corporate and Financial Management - Master Level

May, 2015

Supervisor:

Naciye Sekerci

Authors:

Biser Georgiev

Eliza Mitreva

Abstract

Title:	Determinants of Capital Structure: Evidence from the Global Renewable Energy Sector
Seminar Date:	03 – 04 June 2015
Course:	BUSN 89 Degree Project in Corporate and Financial Management Master Level (15 ECTS)
Authors:	Biser Georgiev and Eliza Mitreva
Supervisor:	Naciye Sekerci
Key words:	capital structure determinants; renewable energy companies; leverage; trade-off theory; pecking order theory
Purpose:	The main purpose of this master thesis is to determine the factors that significantly influence the capital structure decisions in the global renewable energy sector during the period 2005-2013.
Methodology:	This study is implemented through a quantitative approach, using a panel data model, in which leverage is the dependent variable, controlled by a set of firm-specific, industry-specific, tax-related and macroeconomic independent variables.
Theoretical Perspectives:	The study is inspired by prior researches, which test capital structure determinants and whether the trade-off or the pecking order theory explains companies' leverage decisions better.
Empirical Foundation:	67 renewable energy companies, part of RENIXX ® (Renewable Energy Industrial Index) during the period 2005-2013. All data was obtained from Thomson Reuters Eikon and Datastream.
Conclusions:	Our regression analysis reveals that the determinants which are positively and significantly correlated with leverage are size, tangibility and median industry leverage. We find that profitability, market-to-book assets, SG&A expenses to revenues, dividends to assets, listed firms dummy and common law dummy are in negative and significant relation with leverage. Overall, the global financial crisis did not have a strong impact on the majority of determinants affecting capital structure decisions in the studied sector. Our results are consistent with the framework of the dynamic trade-off theory.

Acknowledgements

We would like to thank our supervisor Naciye Sekerci for the guidance throughout the process of writing the thesis. Additionally, we would like to thank David Salomon and Hendrik Ilchmann, whose constructive feedback enabled to increase the quality of our research.

Table of contents

List of Tables

List of Figures

1. Introduction

The capital structure of a firm represents a combination of debt and equity sources of funding that allows the company to finance its overall operations and growth. Furthermore, decisions about leverage level, most commonly expressed by debt-to-total capital and debt-to-assets ratios, affect significantly the risk profile of an entity. Investigating capital structure policies is a continuing concern in the field of corporate finance ever since the publication of Modigliani-Miller theorem (1958). From this time onwards, researchers have developed various capital structure models with the concepts of the trade-off and pecking order theories taking a central place (Kraus and Litzenberger, 1973; Myers, 1984; Myers and Majluf, 1984). The trade-off theory postulates that company's leverage decision is based on a trade-off between tax shield from debt financing and expected costs of future financial distress and bankruptcy. According to the pecking order theory, firms prefer internal to external financing and debt to equity due to adverse selection problems. Recently, a considerable literature has grown around the theme of capital structure determinants. Most prominent studies in the field are by Titman and Wessels (1988), Harris and Raviv (1991), Rajan and Zingales (1995) and Frank and Goyal (2009), who provide empirical evidence for the effect of various factors in predicting leverage levels, and serve as an inspiration for the current master thesis.

In the light of the financial crisis of 2008, capital structure decisions have turned out to be crucial for the survival of numerous companies, which paired with the raising importance of sustainability on a global scale, have drawn our attention to the renewable energy sector. First, this recent shock might have changed companies' preferences for external and internal financing, which has increased the interest in investigating the effect of the crisis on capital structure determinants in different settings (Harrison and Widjaja, 2014; Proença, Laureano and Laureano, 2014). Second, the increasingly rapid advance in the global renewable energy sector in the past decade has led to series of publications regarding financing corporate growth, institutional investment opportunities and relevant risk management instruments in this field (Ettenhuber, 2013; Nelson and Pierpont, 2013; United Nations Environment Programme, 2004). Third, a notable empirical analysis by Brunnschweiler (2010), based on a panel data set of 119 non-OECD countries during the period 1980-2006, test the effect of financial intermediation on renewable energy generation. The author highlights that her

empirical results confirm the substantial positive influence of commercial banking development on the newer non-hydropower renewable energy technologies such as wind, solar, geothermal and biomass (Brunnschweiler, 2010). So far, however, there has been little discussion from a research perspective about the determinants of capital structure in the global renewable energy sector. Thus, we identify a knowledge gap that indicates a further need for detailed analysis.

The aim of this master thesis is to determine the factors that significantly influence capital structure decisions in the global renewable energy sector during the period 2005-2013. The main focus of our research is to test the power of firm-specific factors such as profitability, size, growth, nature of assets and financial management policy, as well as tax-related and industry-specific indicators on the leverage preferences of 67 renewable energy companies, part of the RENIXX ® (Renewable Energy Industrial Index). We consider the entities included in this index as a representative sample of the world market since this is the first global stock index that comprises the share performance of the world's largest companies with more than 50 per cent of revenues coming from renewable energy (Renewable-energy-industry.com, 2015). In order to measure the power of capital structure determinants, the approach to empirical research adopted in this thesis includes constructing and analyzing a panel data regression model with leverage as the dependent variable. To add further depth to our research, and to confirm the robustness of our results, several definitions of leverage are implemented. Furthermore, the analysis on the relation between capital structure and its determinants is twofold: first, based on the full sample, and second, on three sub-periods: 2005-2007 (pre-crisis); 2008-2010 (crisis); 2011-2013 (post-crisis). The latter is incorporated with the aim to investigate whether the financial crisis had any impact on the association between leverage and its determining factors. In addition, we conduct a comparative test of the trade-off and pecking order theories' factor predictions. Thus, we are able to determine which theory motivates capital structure choices in the global renewable energy sector better. Finally, taking into consideration that the companies in our sample are spread across 17 countries with either common or civil law system (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1997; 1998), we examine whether the legal tradition has an impact on financing decisions.

To our knowledge, the present study explores, for the first time, the effects of different factors on leverage decisions in the largest renewable energy companies. To date, research investigating the capital structure determinants has focused on a set of firms in a particular

country or region. To be more specific, previous publications tend to analyse the publicly traded enterprises from various industries in developed countries such as the United States (Bradley, Jarrell and Kim, 1984; Castanias, 1983; Titman and Wessels, 1988; Frank and Goyal, 2009) or G-7 countries (Rajan and Zingales, 1995). When the analysis is on an industry level, researchers still tend to concentrate on traditional and leading sectors for the specific examined country (Banerjee and De, 2014). However, the current paper aims to shed light on the significant capital structure factors on a global scale. Furthermore, by studying companies from all around the world, we are able to investigate the effect of different legal traditions on leverage decisions. Thus, we contribute to the capital structure literature by examining the central determinants of leverage choices in one of the most challenging, high-technological and fast developing sectors nowadays– the global renewable energy sector.

1.1. The Global Renewable Energy Sector

The global renewable energy sector consists of wind energy, solar power, bioenergy, geothermal energy, hydropower and fuel cells companies. In nowadays global economy, these renewable technologies have become a central matter of interest as an alternative to the finite sources such as carbon-based organically-derived fuels. Moreover, the adoption of renewable energy generation is a strategic measure to reduce emissions of the greenhouse gases, the key target of the Kyoto Protocol (United Nations, 1997). The main advantages of the new technologies include sustainability, significant socio-economic benefits, minimal impact on the environment, reduced cost of operations and less need for maintenance. Despite the reliability of supply and high initial capital requirements for construction, the global renewable energy sector has become a constantly growing market since 2004 (Renewables 2014 Global Status Report, 2014).

The renewable technologies would account for around half of the total electricity generation growth to 2040. The most significant expansion in renewable technologies is observed in non-OECD countries, led by China, India and Latin America (International Energy Agency, 2014, p.4). However, the European Union energy policy strongly promotes renewable sources and requires all EU member countries to fulfil at least 20 per cent of their total energy needs and 10 per cent of their transport fuel needs with renewables by 2020 (Directive 2009/28/EC of the European Parliament and of the Council, 2009). Although, the renewable energy projects used to rely strongly on subsidies in the past, the recent cost

reductions in the sector have decreased the need for governmental financial support. Thus, according to "*Global Trends in Renewable Energy Investment 2014"* report, the competitiveness of the sector has been considerably improved (Frankfurt School of Finance & Management, 2014). All of the trends mentioned above indicate that the renewable sources of energy gain solid ground as an attractive market on a global scale.

1.2. Thesis Outline

Taking into consideration the raising importance of renewable energy and the identified empirical gap, we consider that a deeper analysis of the determinants of capital structure in the leading technological companies in this field is a relevant and fascinating problem from both theoretical and practical perspective. The remaining part of the master thesis proceeds as follows. Section 2 presents the literature review of related theoretical and empirical studies on capital structure and its determinants. Section 3 concentrates on the methodology and data used for our empirical research. Section 4 presents our findings, and analysis and discussion of the results. Finally, section 5 is concerned with conclusions and recommendations for further research.

2. Literature Review

2.1. Modigliani-Miller Theorem

The first serious discussion and analysis of capital structure emerged during the 1950s with Modigliani and Miller (1958) Nobel Prize winning paper "The cost of capital, corporation finance and the theory of investment". In this landmark study the two authors formulate five key assumptions, which characterize an ideal capital market:

1) absence of frictions in capital markets (no taxes, transaction and bankruptcy costs);
2) all investors share homogeneous expectations regarding the expected return on investments (insiders and outsiders have access to the same information);
3) atomistic competition (the market is consisted of many small firms, which do not have the power to affect prices through trading or any other activity);
4) no agency costs (companies have fixed and known investment program which maximizes shareholder value);
5) fixed financing decisions.

Having defined the ideal capital market setting, Modigliani and Miller derive the capital structure irrelevance proposition, stating that the market value of any firm is unaffected by the amount of leverage employed in financing its assets (Modigliani and Miller, 1958). Even though the assumptions presented by the two authors are not observable in the real world, their paper contributes to a greater understanding of corporate financing decisions (Frank and Goyal, 2008).

Modigliani and Miller's work sparked further research which aimed to test departures from the ideal capital market assumptions. Frank and Goyal (2008, p.140) summarizes that when certain conditions, such as: "taxation, transaction costs, bankruptcy costs, agency conflicts, adverse selection, lack of separability between financing and operations, time-varying financial market opportunities, and investor clientele effects", are taken into consideration, Modigliani-Miller theorem becomes inapplicable. The studies of these departures, however, have resulted in the formulation of many capital structure theories, with the two most notable being the trade-off and pecking order theories.

2.2. Trade-off Theory

Five years after the publication of "The cost of capital, corporation finance and the theory of investment", Modigliani and Miller (1963) issued a correction study, which adds corporate taxation and its related tax advantages to the original capital structure irrelevance proposition. Since the two authors do not identify any offsetting cost of debt, their results suggest the utmost 100 per cent debt financing as the most value adding (Frank and Goyal, 2008). A broader perspective has been adopted by Kraus and Litzenberger (1973) who argue that there is a trade-off between tax shield benefits and expected costs of future bankruptcy penalties. Later studies, researching the problem from an agency perspective, identify that debt mitigates overinvestment problems of free cash flow and disciplines management to better work in shareholders' interests (Jensen and Meckling, 1976; Jensen, 1986). The rationale behind the findings of these authors is that failure in debt repayment triggers bankruptcy. A study by Stulz (1990) highlights that even though debt plays an integral role in the alleviation of the overinvestment problem, it increases the underinvestment costs. Therefore, for every company there is a unique capital structure that balances between these two issues (Stulz, 1990).

Frank and Goyal (2008) differentiate between static and dynamic trade-off theories. According to the authors, the former states that a company determines its leverage by considering the trade-off between the benefits and costs of debt only in a single period. On the other hand, the latter considers a longer time frame and the roles of expectations and adjustment costs. These cause the company to strategically deviate from its target capital structure and to adjust towards it over time (Frank and Goyal, 2008).

2.3. Pecking Order Theory

While a considerable amount of research has been published on the pecking order theory, it was initially formulated by Myers (1984). He claims that, before all, companies prefer internal sources of funds (retained earnings) and then, debt to equity if external financing is required. In another major study from the same year, Myers and Majluf (1984) motivate this ranking through Akerlof's adverse selection model. Myers and Majluf (1984) argue that from investors' perspective equity is associated with the highest adverse selection problem, while debt has a severely lower one and retained earnings completely avoid this issue. The authors explain that market participants expect management to have superior

information. Thus, an equity issue would signal that the company is overvalued, which would result in a stock price drop (Myers and Majluf, 1984). Knowing this, insiders would also prefer to use retained earnings whenever possible, then debt, and as a last resort- equity (Frank and Goyal, 2009). Finally, Copeland, Weston and Shastri (2005) point out that the pecking order theory is dynamic and highly dependent on the company's history.

In an analysis of the pecking order theory, Helwege and Liang (1996) test its validity by examining the sources of funds of companies that went public in 1983 and operated in the period 1984-1992. In support of the pecking order theory, they provide evidence that firms with surplus avoid external financing. However, Helwege and Liang (1996) identify that when internal financing is insufficient, companies tend to issue equity, even if bank loans are obtainable. Another interesting result is that information asymmetry variables are insignificant determinants of whether debt or equity financing should be employed. Helwege and Liang (1996) conclude that they do not find supporting proof of a pecking order in external capital financing decisions.

A significant analysis and discussion on the pecking order theory was presented by Frank and Goyal (2003). They test it by looking at 768 public companies which operated continuously for at least 19 years in the period 1971-1998. Contradicting the pecking order theory, Frank and Goyal (2003) report that external sources of funds are largely used and internal financing is only a small fraction of a company's investment spending. Another inconsistency with the theory, identified by the authors, is that debt financing does not exceed equity issues. In addition, the latter follows budget shortfalls more closely compared to debt issues. Finally, Frank and Goyal (2003) results highlight that in their sample the pecking order actually work best for large firms, which opposes the theory's initial implication of best fit to small high-growth companies.

2.4. Trade-off Theory versus Pecking Order Theory

Graham and Harvey (2001) use a survey to assess the various practices in corporate finance related to capital budgeting, cost of capital and capital structure. Their study is based on the responses from 392 chief financial officers. The authors find out that 44 per cent reported that their companies had a target capital structure, while 37 per cent had a flexible one and 19 per cent- no target range. Furthermore, their results indicate moderate importance of interest deductibility, foreign taxation, cash flow volatility and financial flexibility

(maintaining low distress costs), which are all in line with the static trade-off theory. When it comes to the pecking order theory, there is evidence that large companies consider the level of undervaluation important for equity issues, while the same is not valid for small and non-dividend paying ones. Overall, from their sample Graham and Harvey (2001) conclude that both the trade-off and the pecking order theories enjoy moderate support in the real world.

Another key study comparing the models of capital structure under the static trade-off and pecking order theories is that of Shyam-Sunder and Myers (1999). Their research uses a sample of 157 firms, operating continuously in the period 1971-1989. In order to juxtapose the two theories, Shyam-Sunder and Myers (1999) construct two simple models:

a) Pecking order model

$$\Delta D_{i,t} = \alpha + \beta_i DEF_{i,t} + \epsilon_{i,t} \ ,$$

with newly-issued or retired debt on the LHS. DEF stands for the cash flow deficit and is the sum of dividend payments, capital expenditures, Δ in working capital, the current portion of debt, and operating cash flows, net of tax and interest. Shyam-Sunder and Myers (1999) explain that DEF would be covered with debt only, since under the pecking order theory there is no incentive to issue equity due to its high information asymmetry. Therefore, in order the theory to hold, the expected value of the intercept α is zero and one for the slope β_i.

b) Trade-off target adjustment model

$$\Delta D_{i,t} = \alpha + \beta_i \left(D^*_{i,t} - D_{i,t-1}\right) + \epsilon_{i,t} \ ,$$

where $D^*_{i,t}$ is the target capital structure of the company.

Shyam-Sunder and Myers (1999) conclude that the pecking order theory (close to one β_i=0.75 and *R*-squared of 68 per cent) provides significantly better explanation of capital structure decisions compared to the trade-off (β_i=0.33 and *R*-squared of 21 per cent).

2.5. Capital Structure Determinants

The current section presents the predictions postulated by the trade-off and pecking order theories regarding the most widespread researched capital structure determinants. First, we summarize the theoretical framework, and then, additional empirical evidence about the actual correlation between different factors and company's leverage is provided.

2.5.1. Theoretical Predictions

After carefully examining the relevant literature, we have identified that the vast majority of researchers tend to focus on the same leverage determinants. The latter are divided into the following major groups: firm-specific, industry-specific, tax-related and macroeconomic, with the aim to provide a theoretical and well-structured explanation for factors' influence on the capital structure decisions.

Firm-specific determinants

1) Profitability

The pecking order theory predicts a negative correlation between profitability and leverage. The major assumption is that in the short run dividends and investments are fixed, and profitable companies prefer internal financing over external, and debt to equity when external sources of funding are used (Myers and Majluf, 1984). Thus, an increase in profits would result in a decrease in leverage. Findings from numerous studies prove the negative relation between company's profitability and its leverage (Kester, 1986; Titman and Wessels, 1988; Fama and French, 2002). Conversely, the static trade-off theory predicts a positive correlation between profitability and debt levels due to the expected tax benefits and lower costs of financial distress (Frank and Goyal, 2008). This theory postulates that more profitable companies are associated with lower bankruptcy costs. Thus, such firms are also able to maintain a higher debt level. The positive relation between profitability and leverage finds confirmation in several researches (DeAngelo and Masulis, 1980; Jensen, 1986). On the other hand, the dynamic trade-off theory suggests that leverage is negatively associated to profitability mainly due to the fact that companies could finance their activities with accumulated internal funds, such as retained earnings. Thus, generating higher operating profit would support company's decision to reduce its debt financing. Furthermore, recent researches discuss the negative correlation between profitability and debt levels, pointing out

that if a company becomes more profitable and thus, more valuable, while still maintaining fixed debt level, its debt ratios would become lower (Hennessy and Whited, 2005; Titman and Tsyplakov, 2007; Strebulaev, 2007; Kayhan and Titman, 2007).

2) Firm Size

Generally, the pecking order theory is construed to predict a negative relation between size and leverage. The main explanation is that large companies are associated with lesser adverse selection problem and could access equity markets more easily in comparison to small firms (Myers, 1984). The trade-off theory, on the other hand, predicts a positive correlation between firm size and debt level. Overall, large companies are typically better diversified and enjoy more stable earnings, which enable them to maintain higher debt ratios without increasing financial distress costs (Ogden, Jen and O'Connor, 2003). Furthermore, such companies are less likely to go bankrupt due to their low volatility and information asymmetry. As a result, large entities benefit from better access to debt markets (Rajan and Zingales, 1995). Numerous researches provide empirical evidence for the positive correlation between company size and its leverage (Warner, 1977; Titman and Wessels, 1988; Rajan and Zingales, 1995; De Jong, Kabir and Nguyen, 2008).

3) Growth

The pecking order theory predicts a positive relationship between growth and leverage. The reason behind is that high growth companies need to accumulate more external funds to finance their investment since internal sources are usually insufficient (Copeland et al. 2005). Conversely, the trade-off theory suggests that growth decreases free cash problems, but intensifies agency problems related to debt and escalates costs of financial distress (Frank and Goyal, 2009). Thus, this theory postulates a negative relation between growth and leverage. The market-to-book ratio is the most commonly used and highly reliable measure for companies' growth opportunities (Adam and Goyal, 2008). The findings from empirical researches prove the negative correlation between the market-to-book ratio and leverage (Hovakimian, 2006; Flannery and Rangan, 2006). Other proxies for growth include capital expenditures to assets ratio and change in log assets, which are indicative for firm's historical growth. Under the pecking order theory, capital expenditures as cash outflows directly increase the financing deficit (Shyam-Sunder and Myers, 1999). Thus, this theory suggests a positive correlation between capital expenditures and firm's debt level. Conversely, the trade-

off theory predicts a negative relation. As previously stated, the main reason lies in the higher expected costs of financial distress.

4) Nature of Assets

Tangibility, measured usually as fixed assets to total assets ratio, is the most commonly used proxy for the nature of company's assets. The pecking order theory predicts a negative correlation between tangibility and leverage. The major explanation is that tangible assets are characterized with low information asymmetry and thus, decrease the costs of equity issuance (Frank and Goyal, 2009). In contrast, the trade-off theory postulates that company's leverage increases with tangibility. The reason behind is that fixed assets, being easier to value in comparison to intangibles, are used as collateral. Thus, the agency costs related to debt are reduced (Rajan and Zingales, 1995). According to Harris and Raviv (1991), companies with higher liquidation value, which are associated with more tangible assets, will maintain higher leverage. The portion of particular expenses to revenues could also be used as proxies of the nature of firm's assets. For instance, companies with relatively high selling, general and administrative (SG&A) and research and development (R&D) expenditures are associated with more intangible assets and as a consequence, lower debt level (Long and Malitz, 1985; Frank and Goyal, 2009).

5) Policy and Decision Factor

Researchers place emphasis on the impact of financial policy, such as dividend payments, on company's capital structure decisions. The pecking order theory states that the dividend payout ratio is negatively related with leverage (Myers, 1984). Conversely, the trade-off theory suggests that when levered companies pay more dividends, their debt ratio tends to increase as well (Ogden et al. 2003). However, when analysing the dividend and debt policies of companies, Fama and French (2002) provide findings consistent with both theories. For instance, the researchers conclude that more profitable companies pay more dividends and firms with more investments have lower dividend payout ratio. On the other hand, the authors point out that "short-term variations and earnings are absorbed by debt", which is consistent with the pecking order theory (Fama and French, 2002, p.1).

Industry-specific determinants

A company's capital structure decisions are affected not only by particular characteristics of the firm, but also by industry specific conditions. Overall, the industry

factors incorporate related, but otherwise omitted features that are common for all companies in the sector (Frank and Goyal, 2009). In addition, researches provide evidence of the strong industry effect on companies' debt ratios (Schwartz and Aronson, 1967; Bradley et al. 1984). Furthermore, the median industry leverage is a widespread proxy for target capital structure (Gilson, 1997; Hull, 1999). Under the trade-off theory, a positive correlation between the industry median leverage and a firm's debt level is expected, while the pecking order theory does not make a clear prediction. However, researchers prove empirically that companies tend to adjust their leverage towards the industry median level (Hovakimian, Opler and Titman, 2001).

Tax-related determinants

Tax related determinants play a key role in the framework of the trade-off theory. The tax benefits of debt increase with higher tax rates. Thus, in order to fully take advantage of the tax shields, companies are willing to issue additional debt. For that reason, the trade-off theory predicts a positive correlation between tax rates and leverage (Haugen and Senbet, 1986). Surprisingly, when using effective tax rate as one of the major tax-related determinants, studies provide empirical evidence about its negative relation with leverage (Antoniou, Guney and Paudyal, 2008; Karadeniz, Kandir, Balcilar and Onal, 2009). DeAngelo and Masulis (1980) introduce nondebt tax shields as substitute for the tax benefits of debt. Thus, proxies for the former such as depreciation expenses, net operating loss carryforwards and investment tax credits are expected to decrease company's leverage (Frank and Goyal, 2009).

Macroeconomic determinants

The stability of the economic environment has a strong influence on companies' capital structure decisions (De Jong et al. 2008). The most commonly examined macroeconomic determinants are expected inflation and GDP growth. The trade-off theory predicts a positive correlation between inflation and leverage. When inflation is expected to be higher, the tax deductions on debt increase as well (Taggart, 1985). The pecking order theory does not provide an explicit prediction regarding the association between inflation and leverage. However, the empirical evidence proves that expected inflation tends to be positively related to firm's debt level (Frank and Goyal, 2009; Köksal and Orman, 2014). Regarding GDP growth, under the trade-off theory firms are more willing to issue additional debt during economic expansions due to increased taxable income and decreased expected

bankruptcy costs. On the other hand, the pecking order theory suggests a negative correlation between economic growth and company's debt financing as the internal funds tend to rise during expansions (Frank and Goyal, 2009).

2.5.2. Empirical Evidence

In order to test the influence of different factors on capital structure decisions, researchers have developed numerous empirical models. To start with, Harris and Raviv (1991) introduce a wide list of potential leverage determinants, including exogenous and endogenous factors as well as announcements of security issue. Moreover, the authors review relevant publications and relate these factors to capital structure theories based on agency costs, asymmetric information, market interactions and corporate control models (disregarding tax-based theories). Overall, Harris and Raviv (1991) summarize that previous studies (Bradley et al. 1984; Castanias, 1983; Kester, 1986; Marsh, 1982; Titman, 1984) provide empirical evidence that fixed assets, nondebt tax shields, growth opportunities and firm size are positively related to the level of leverage. Conversely, the latter tends to decline with volatility, advertising costs, R&D expenditures, profitability and bankruptcy probability (Harris and Raviv, 1991). Furthermore, Titman and Wessels (1988) present a factor-analytical technique, highlighting that firm's leverage is negatively related to the uniqueness of the business. In contrast with the above mentioned empirical researches, the results by Titman and Wessels (1988) indicate that debt levels are not affected by nondebt tax shields, volatility, collateral value or future growth. In the view of all that has been mentioned so far, one may suppose that advocates of particular theories could find contradictory evidence from prior empirical studies.

In another major study, Rajan and Zingales (1995) conduct a four-factor regression model to compare the power of determinants that influence the capital structure decisions in G-7 countries. The basic regression model in this paper is the following:

$$Leverage_{[Firm\ i]} = \alpha + ß_1 Tangibility_i + ß_2 Market - to - book\ Ratio_i + ß_3 Log\ Sales_i + ß_4 Profitability_i + \varepsilon_i$$

The authors identify market-to-book ratio, tangibility, profitability and sales as main determinants and conclude that on aggregate level the company's leverage tend to be similar across G-7 countries. On the other hand, even after distinguishing between bank-oriented countries (Japan, Germany, France and Italy) and market-oriented ones (United States, United

Kingdom and Canada), this trend could not be explained simply by the underlying institutional differences (Rajan and Zingales, 1995). The provided results prove that market-to-book ratio and profitability are negatively correlated to leverage. The authors consider that these negative relationships are driven mainly by large equity issuers in the observed countries. Conversely, tangibility has a positive influence on leverage as tangible assets are collateralizable and thus, decrease the agency costs of debt. However, this study does not identify a particular tendency in the association between company size and its leverage, while additionally disregarding industry specific and macroeconomic factors.

A landmark research by Frank and Goyal (2009) made a major contribution to the capital structure determinants literature, resolving the observed problems in prior publications. The authors introduce a significantly improved model, including a wide range of factors influencing both book and market leverage in listed American non-financial firms during the period 1950-2003. In addition to that, different measures of leverage are suggested, based on long-term and total debt. However, the researchers put emphasis on the ratio of total debt to market value of assets. Focusing on the market definition of leverage, Frank and Goyal (2009) find out that a set of six core factors account for more than 27 per cent of the variation in leverage. The empirical analysis proves that the most reliable determinants with a positive effect on market leverage are median industry leverage, tangibility, log of assets and expected inflation. On the other hand, market-to-book assets ratio and profits turn out to have strong negative influence on company's leverage. Additionally, the results indicate that dividend-paying companies tend to maintain lower debt levels. As far as book leverage is concerned, only industry median leverage, tangibility and profitability remain reliable factors, while the effects of market-to-book, firm size and expected inflation turn out to be statistically insignificant (Frank and Goyal, 2009). Overall, in the sample of Frank and Goyal (2009) the capital structure determinants seem consistent with the predictions, provided by the trade-off theory.

In recent years, most of the literature has paid particular attention to capital structure determinants in developing economies and analysis on an industry level (Amidu, 2007; Aamir, Gulzar, Uzma, and Aslam Khan, 2013; Alzomaia, 2014; Banerjee and De, 2014; Köksal and Orman, 2014; Alipour, Mohammadi and Derakhshan, 2015). For instance, Köksal and Orman (2014) conduct a study to investigate the capital structure decisions in Turkish non-financial firms during the period 1996-2009, including public and private as well as manufacturing and non-manufacturing companies of all size in their sample. To determine the

effect on leverage, the authors examine four broad types of variables: firm-specific (profitability, tangibility, growth and business risk), tax-related (potential tax shields), industry-specific (industry median leverage) and macroeconomic factors (inflation and real GDP growth). Their empirical findings indicate that leverage has a positive correlation with firm size, potential debt tax shields, industry medial leverage and inflation. On the other hand, profitability, business risk and real GDP growth decrease debt levels in the examined non-financial companies. Generally, Köksal and Orman (2014) conclude that the capital structure decisions in their sample are more consistent with the predictions of the trade-off theory than the pecking order one.

2.6. Legal Determinants

The legal system plays an essential role on the capital market conditions in a particular country. To be more specific, La Porta et al. (1997; 1998) estimate that investor and creditor protection, ownership concentration and legal enforcement differentiate significantly among countries based on their legal origins. Thus, the authors specify two main categories: common and civil law countries. The former have their legal origin in English case law and include the United States, the United Kingdom, Australia, Canada and the previous English colonies. The latter originates from Roman law and consists of German, Scandinavian and French civil law subfamilies. In order to compare the two main law systems, La Porta et al. (1998) construct measures such as antidirectors right and creditor protection indexes as well as the quality of legal enforcement, including efficiency of judicial system, level of corruption, accounting standards, etc. Overall, their results indicate that countries with common law tend to provide better shareholder and creditor protection, and stronger legal enforcement in comparison to the civil law countries. In addition to that, the former benefit from more liquid and transparent capital markets. Civil law countries, on the other hand, provide poorer investor protection and thus, have relatively smaller debt and equity markets. Similarly, Fan, Titman and Twite (2011) point out that common law countries are associated with better developed capital markets, lower leverage and prevailing long-term debt. Regarding bank-oriented countries, the researchers conclude that their stronger reliance on the large banking sector determine their preference for short-term debt maturity structure (Fan et al. 2011).

2.7. Chapter Summary

Collectively, the studies examined above outline a wide range of factors that determine companies' capital structure decisions. Even though a complete analysis of all possible determinants is beyond the scope of our thesis, we examined the most widespread capital structure factors. Overall, firm-specific indicators such as tangibility, profitability, firm size as well as industry-specific, tax-related and macroeconomic determinants are prevailing in the previous research models. Both the trade-off and the pecking order theories have been the instrumental bases of identifying such factors. Up to now, a number of studies revealed significant support to the trade-off theory, while others provide evidence consistent with the pecking order one. Thus, neither of the theories offers a general explanation for the companies' actual financing decisions. In order to solve these conflicts, authors have put effort in modifying the existing empirical models and using more representative datasets.

3. Methodology

The current chapter presents the steps used in the data collection process, followed by an overview of the constructed sample of renewable energy companies. Then, we introduce several measures of leverage, which are later implemented into our empirical model. After that, we present the definitions of the examined capital structure determinants, followed by a specification of our regression model. Finally, we evaluate its validity and reliability and describe possible limitations.

3.1. Data Collection Method

The first step of the research process was to collect the renewable energy companies' financial reports in order to calculate the variables, described in the next subsections. Thus, we obtained the income statements, balance sheets, cash flow statements and key ratios tables for all companies, included in the RENIXX ® Index, for their last ten years of operations. The source we used is Thomson Reuters Eikon, which is considered to be highly reliable. However, there was missing data for several companies. In these cases, we checked their annual reports in order to assure the accuracy of the information. As our research is focused on the global renewable energy sector, in order to overcome any possible inconsistencies, all financial data was annualized and standardized in US dollars and thousands. Similarly, when accumulating market values via Thomson Reuters Datastream, we converted them in US dollars and thousands.

The second method used to identify the reliability of our data involved a check about the time coverage of the financial reports. The initial sample consisted of 102 companies, but due to data availability limitations we had to exclude some of the entities. Thus, our final sample with most existing observations includes 67 companies for the period 2005-2013 (See Appendix 1). We consider these companies representative since they have been operating for a longer period compared to the 35 excluded. Next, the raw financial data was converted into Microsoft Excel in order to calculate the variables for each company on an annual base and then, transferred to EViews v8.1 to conduct the panel data regression analysis.

3.2. Data Analysis: overview of the examined sample

The representative sample for the global renewable energy sector consists of 67 of the largest companies with more than 50 per cent of revenues coming from this industry (Renewable-energy-industry.com, 2015). They operate in various energy generation fields such as wind, solar, bioenergy, geothermal and hydropower, but for the purpose of our empirical analysis we do not distinguish between these alternative sources and we focus on the global scale. However, the entities are geographically spread across both developed and developing countries with the majority originating from Germany and the United States (25 per cent and 24 per cent of the total number of companies, respectively). Additionally, 13 per cent of the studied firms originate from other European countries. Around 18 per cent of the companies in our sample are registered in tax havens such as the Cayman Islands and Bermuda, but operate in China, Europe and North America.

In order to analyse the impact of different legal systems on capital structure decisions in the global renewable energy sector, the sample was divided into two main groups according to the classification of La Porta et al. (1997; 1998). Thus, we ended up with the following distribution: 60 per cent of the companies are from common law countries and 40 per cent - civil law countries (See Appendix 1). The vast majority of the latter (81 per cent) have German civil law origin. Regarding access to equity capital markets, most of the included companies have been publicly traded for the entire examined period 2005-2013. However, there are several firms that have not been listed for the first few studied years. Following the geographical and legal overview of our sample, we proceed with introducing the measures of leverage, which is the dependent variable in our empirical model.

3.3. Definitions of Leverage

Several different measures of leverage have been implemented in previous researches. In order to prevent possible biases when focusing on a single definition, we considered nine measures of leverage in our empirical tests. Overall, we examined debt with different maturities and thus, we distinguished between total, long-term[1] and short-term leverage, broadening the horizon of our research. The major reason to include short-term debt is the fact that it also incorporates risk for the financial health of a company (Amidu, 2007; Köksal and

[1] Debt with maturity more than 1 year is considered as long-term.

Orman, 2014). In addition to maturity, a further differentiation between book and market value of assets is implemented. Hence, we consider the following three major groups of alternative leverage definitions, based on different denominator in the debt ratios.

Group 1: Debt to book value of total assets ratios: 1.1) Total leverage: total debt to book value of total assets ratio (TL_1), 1.2) Long-term leverage: long-term debt to book value of total assets ratio (LTL_1), 1.3) Short-term leverage: short-term debt to book value of total assets ratio (STL_1);

Group 2: Debt to book value of total capital ratios: 2.1) Total leverage: total debt to book value of total capital ratio (TL_2), 2.2) Long-term leverage: long-term debt to book value of total capital ratio (LTL_2), 2.3) Short-term leverage: short-term debt to book value of total capital ratio (STL_2);

Group 3: Debt to market value of total assets ratios: 3.1) Total leverage: total debt to market value of total assets ratio (TL_3), 3.2) Long-term leverage: long-term debt to market value of total assets ratio (LTL_3), 3.3) Short-term leverage: short-term debt to market value of total assets ratio (STL_3).

Debt ratios, based on total, long-term or short-term debt over total assets, are considered as more appropriate definitions for financial leverage than the definition of total liabilities to total assets. The reason behind is that debt ratios act as more accurate indicators whether a company could be in a default risk in the near future (Rajan and Zingales, 1995). To be more specific, line items included in total liabilities, such as accounts payable, tend to be used for transaction purposes. As a result, any leverage ratio, based on total liabilities, would be exaggerated (Rajan and Zingales, 1995). Thus, aiming to reflect the capital structure and financing decisions of the renewable energy companies more precisely, we calculated the alternative measures of leverage including total, long-term and short-term debt in the ratio numerator. For the purpose of our empirical analysis, we constructed these ratios using book value of debt as a reasonable approximation of its true value (Koller, Goedhart and Wessels, 2010). Moreover, Graham and Harvey (2001) point out that usually, companies do not rebalance their positions in response to financial market fluctuations.

In Group 1, we included debt ratios over book value of total assets. Book value of assets is a proxy of assets in place, while market values reflect firm's growth opportunities (Barclay, Morellec and Smith, 2006). However, the latter could not be collateralized and for

this reason we consider book values as a more precise indicator of company's capital structure. Furthermore, Myers (1977) emphasizes that managers tend to consider book leverage when borrowing decisions are concerned since debt is more reliably supported by assets already in place than by future growth opportunities. On the other hand, part of the assets could be financed by specific nondebt liabilities, which could impose bias upon our inferences. Therefore, in order to overcome any possible drawbacks, in Group 2 we included leverage measures with book value of total capital[2] in the denominator. According to Rajan and Zingales (1995), the total debt to total capital ratio reflects the effects of past financing decisions to the greatest extent. Furthermore, considering that book values are assumed to be backward looking, whilst market values-forward looking, the leverage definitions in Group 3 are constructed as debt over market value of total assets (Barclay et al. 2006). However, as previously stated, due to data availability limitations we were forced to calculate the market measures of leverage excluding two years and eight companies, ending up with a sample 59 renewable energy firms over the period 2007-2013.

Overall, considering several reliable definitions of leverage enables us to account for the influence of the capital structure determinants in a broader setting. Furthermore, the vast set of leverage measures allows verifying the consistency of the most significant factors.

3.4. Definitions of Capital Structure Determinants

The independent variables in our empirical model are divided into the following major groups: firm-specific, industry-specific, tax-related and macroeconomic capital structure determinants. As detailed explanation regarding the expected influence of each determinant on company's leverage was already provided in the "Literature Review, 2.5.1.Theoretical Predictions", here we focus only on the implemented factors and how we measure them. Table 1 presents the definitions of the included determinants in every group, as well as a summary of the factors' predicted effect on leverage provided by the trade-off and pecking order theories.

[2] Total capital is calculated as the sum of total debt and total equity.

Table 1. Capital Structure Determinants

Determinants	*Definition*	Considered Theories-Predicted effect on leverage		
		Static Trade-off Theory	**Dynamic Trade-off Theory**	**Pecking Order Theory**
Firm-specific determinants				
Profitability	Operating Profit to Assets	**+**	**-**	**-**
Size	Log of Assets	**+**	**+**	**-**
Growth	Change in Log Assets	**-**	**-**	**+**
	CAPEX to Assets	**-**	**-**	**+**
	Market-to-book Assets	**-**	**-**	**+**
Nature of Assets	Tangibility	**+**	**+**	**-**
	SG&A Expenses to Revenues	**-**	**-**	**+**
Policy and Decision Factor	Dividends to Assets	**+**	**+**	**-**
Industry-specific determinants				
Industry Conditions	Median Industry Leverage	**+**	**+**	**?**
	Listed Firms Dummy	**?**	**?**	**?**
Tax-related determinants				
Potential Debt Tax Shield	Effective Tax Rate	**+**	**+**	**?**
Nondebt Tax Shield	Depreciation to Assets	**-**	**-**	**?**
Macroeconomic determinants				
Legal Traditions	Common Law Dummy	**?**	**?**	**?**

The firm specific variables are divided into five measure subgroups: Profitability, Size, Nature of Assets, Growth, and Policy and Decision Factor. Profitability is measured as operating profit before depreciation and amortization divided by total assets. After that, we estimated Size through the natural logarithm of assets, as suggested by Frank and Goyal (2009). In our empirical model, we included three different Growth factors**:** 1) Change in natural logarithm of assets; 2*)* CAPEX divided by assets*;* 3) Market-to-book assets. The two factors that represent the Nature of Assets in our empirical model are: 1) Tangibility, which is calculated as fixed assets to total assets ratio, and 2) SG&A Expenses to Revenues. Finally, the Policy and Decision Factor, measured as dividends divided by total assets, provides an overview of the financial management strategy of a particular company.

We examined Industry Median Leverage as the major industry-specific determinant. To be more precise, we calculated the industry median level for every definition of leverage

on annual base. In addition to that, in order to test whether there is a differentiation between the capital structure decisions in public and private companies, we incorporated a dummy variable (Listed Firm Dummy). This variable takes the value of 1 for listed firms and the value of 0 for the non-listed ones. Regarding tax-related variables, we included the following two factors: 1) Potential Debt Tax Shield; 2) Nondebt Tax Shield. The proxy for the first factor is Effective Tax Rate, measured as taxes paid divided by earnings before interest, taxes, depreciation and amortization (Taxes Paid/EBITDA). The indicator for Nondebt Tax Shield is calculated by dividing depreciation expenses to assets. Regarding the macroeconomic variables, the fact the studied companies are geographically spread restricts the consistent investigation of factors such as expected inflation and GDP growth. However, we implemented a macroeconomic determinant that reflects the different legal systems in the country of origin of the examined renewable energy companies. Thus, in order to capture the effect of the legal tradition on capital structure decisions, we incorporated a dummy variable (Common Law Dummy). Logically, this factor takes the value of 1 when the company originates from a common law country, and the value of 0 for a civil law country of origin.

To clarify, in the models with book value definitions of leverage, book value of assets is used when required in the calculation of the variables. Similarly, when the market definition of leverage is concerned, we incorporated market value of assets in the relevant determinant measures.

3.5. Model Specification

As explained in the "3.1.Data Collection Method", we study 67 renewable energy companies for the period 2005-2013, forming an unbalanced data panel[3]. Most of the previous studies in the area have employed a pooled model (Cortez and Susanto, 2012; Alzomaia, 2014). Even though this model provides a simplistic way of dealing with the complex panel data structure, it is associated with several drawbacks: loss of information in the cross-section and time-series dimensions, no time-specificity and assumption of no heterogeneity[4], etc. (Brooks, 2008). Thus, in order to benefit from the wide spectra of panel data advantages, we utilize the following cross-sectional random effects panel data model[5]:

[3] Unbalanced panel: some cross-sectional units, compared to others, have less observations at different times (Brooks, 2008).
[4] This suggests that there is no dependence between the observations for the same variable in different periods.
[5] Discussion about model specification tests is presented in the next section: "3.6.Validity and Reliability".

$$L_{it} = \alpha + \sum_k \beta_k X_{k,it} + \epsilon_i + \upsilon_{it}\,, \qquad \text{Eq. (1)}$$

where L_{it} is the leverage measure of company i in year t, α is the common (global) intercept, X_{it} is a $1 \times k$ vector of leverage determinants (firm-specific, industry-specific, tax-related and macroeconomic determinants), ϵ_i is a measure of the "random deviation of each entity's intercept term from the 'global' intercept" (Brooks, 2008, p.498) and υ_{it} is the error term.

The empirical analysis is organised as follows. First, through Eq. (1) we investigate the influence of the studied factors on the nine different leverage definitions, described in "3.2.Definitions of Leverage", for our full sample. Considering the fact that the global financial crisis from 2008 is included in the observed period 2005-2013, we check whether the crisis had any effect on the capital structure decisions in the global renewable energy sector. Thus, we examine three periods: pre-crisis (2005-2007), crisis (2008-2010) and post-crisis (2011-2013). In the period breakdown we focus on only one definition of leverage, namely Total leverage (TL_1)[6], since a complete analysis of the factors' influence on all alternative definitions of leverage is beyond the scope of our thesis.

3.6. Validity and Reliability

The first step in our empirical analysis was to check for potential multicollinearity problem amongst the set of determinants incorporated in Eq. (1). Multicollinearity is present when there is correlation of |0.80|, or above, between any pair of the explanatory variables (Lewis-Beck, 1993). After examining the correlation matrices (See Appendices 2 and 3), we concluded that couple-wise correlations are within the interval [-0.40, 0.38] and therefore, there is no need of re-specifying any of the determinants or Eq. (1).

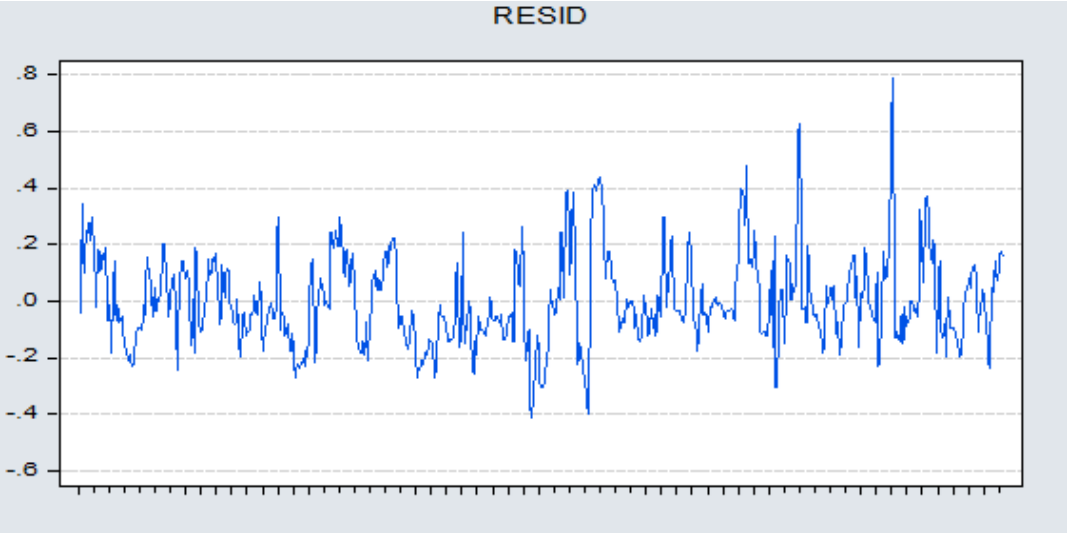
Next, to establish whether there are other relevant problems that could affect the consistency of our model and its results, we ran a simple pooled regression without any corrections or effects (See Appendix 4). By plotting its residuals (See Figure 1 below), we identified that they were systematically either above or below zero, which would imply heterogeneity. Furthermore, the variance of the errors across the sample was not constant, suggesting heteroscedasticity[7]. The presence of the latter, as Brooks (2008) explains, would still result in unbiased coefficient estimates. However, their standard errors could be wrong,

[6] Total debt to book value of total assets ratio

[7] Heteroscedasticity is present when the second OLS assumption of error terms having a constant variance is violated Brooks (2008).

consequently leading to false inferences. Thus, in order to control for heteroscedasticity and any potential cross-sectional correlation problems, from there on we used White Robust Standard Errors: White cross-section (EViews 8 User's Guide II, 2013).

Figure 1. Pooled Regression's Residual Plot



Source: created by the authors using EViews 8.1

After having identified the presence of heterogeneity through the use of a graphical method, we continued by formally testing for it. This was achieved through estimating Eq. (1) with dummy variables for cross-section units[8] (fixed effects specification) and then running a Redundant Fixed Effects-Likelihood Ratio test. If its null hypothesis, stating that the dummy variables are jointly zero, is rejected, there would be a sign of significant heterogeneity. The following table contains the results of the Redundant Fixed Effects - Likelihood Ratio test:

Table 2. Redundant Fixed Effects-Likelihood Ratio Results

Redundant Fixed Effects Tests			
Equation: LEV			
Test cross-section fixed effects			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	3.26	(297,228)	0.00
Cross-section Chi-square	888.73	297	0.00

Source: created by the authors using EViews 8.1. Formatted in Microsoft Excel.

[8] Due to EViews 8.1 specifications, we were able to review dummy variables for cross-section units only.

As it could be seen from the *p*-values, cross-section dummies are highly significant, implying that heterogeneity should be accounted for in the cross-section dimension.

The final matter covered in this section concerns the choice of panel data model specification. Brooks (2008) summarizes that in general the random effects model provides more efficient estimation in comparison to the fixed effects approach. On the other hand, the author continues by arguing that the random effects model has a very strict assumption of ϵ_i and υ_{it} not being correlated with any of the explanatory variables. The Correlated Random Effects - Hausman Test in EViews 8.1 tests whether this assumption holds. Unfortunately, two-way random effects (or a mix between random and fixed effects) for unbalanced panel data are not supported by the software. Thus, we ran the Hausman test for cross-section random effects only. Brooks (2008) sums up that if the *p*-value for the test is above 1 per cent, the null hypothesis that the random effects model is well-specified cannot be rejected. In our case, the Hausman test results[9] indicate that the random effects model is well-specified and thus, we could use it in order to control for heterogeneity in the cross-section dimension.

3.7. Limitations

The main limitation in our research method concerns data availability. To be more specific, we were forced to exclude R&D Expenses to Revenues ratio as a firm-specific determinant since a significant number of companies do not report their R&D expenses separately. In addition to that, as previously stated, we faced data limitation problems regarding the market value estimations, resulting in the exclusion of eight companies and two years. Thus, the number of observations in the market value regressions fell from 536 to 412.

3.8. Chapter Summary

The chapter outlined the process of data collection, data analysis and construction of our empirical model. To start with, we built our sample of 67 renewable energy companies, part of the RENIXX ® Index, by using financial data from Thomson Reuters Eikon and Datastream for the period 2005-2013. Overall, the majority of the examined companies originate from Germany and the United States. Furthermore, 60 per cent of all studied firms operate in common law countries. In order to obtain a better picture of the relationship

[9] Hausman test *p*-values are included as a subsection in the relevant regression results tables.

between capital structure and its determinants, we introduced nine alternative definitions of leverage, which is the dependable variable in our empirical model. They are classified in three major groups: Debt to book value of total assets ratios, Debt to book value of total capital ratios, and Debt to market value of total assets ratios. After that, we presented the measures of our model's independent variables, divided into firm-specific, industry-specific, tax-related and macroeconomic capital structure determinants. Regarding the empirical analysis, we implemented a cross-sectional random effects panel data model. Generally, the main focus of our empirical research is to test the influence of the capital structure determinants on all alternative definitions of leverage in our full sample. Additionally, in order to check whether the global financial crisis had any effect on the financing decisions in the studied sector, we divided our sample into three sub-periods, namely pre-crisis (2005-2007), crisis (2008-2010) and post-crisis (2011-2013). The results of the period breakdown could also serve as a robustness check of the consistency of our findings regarding the capital structure determinants in our full sample.

4. Results and Discussion

4.1. Descriptive Statistics

Table 3 presents the descriptive statistics for the dependent and independent variables. As previously mentioned in the Methodology section, we study three different leverage groups. However, since the same pattern in their descriptive statistics is observed, we focus the following analysis on leverage definition Group 1 (Total debt to book value of assets; Long-term debt to book value of assets; Short-term debt to book value of assets). According to Table 3, mean total debt ratio is 22.2 per cent and its median is 16.4 per cent; mean long-term debt ratio is 13.9 per cent and its median is 6.8 per cent, and mean short-term ratio is 8.3 per cent and its median is 3.5 per cent. From these results, we can conclude that the studied companies from the global renewable energy sector rely on equity as a main source of financing. Furthermore, long-term debt is preferred, being approximately twice as much as short-term debt.

Other informative results from Table 3 are concerned with firm-specific and tax-related determinants. For clarity and simplicity, in Table 3 all determinants, except for market-to-book assets, are based on book value of assets. The motivation behind this decision lies in the fact that the descriptive statistics of the factors, calculated with market value of assets (See Appendix 5), do not appear significantly different from those presented in Table 3. Moving on to the analysis, mean Profitability is -1.2 per cent and its median is 4.9 per cent, signalling that on average the studied renewable energy companies experience negative operating income before taxes. Regarding Growth determinants, Change in Log Assets, with mean of 2.3 per cent, and CAPEX to Assets ratio, with mean of 7.5 per cent, are based on book value of assets and present the average historical expansion in the sector. On the other hand, Market-to-book Assets ratio, with mean of 152.9 per cent, incorporates market value of assets, and is indicative of the high market expectations about the future prospects of the global renewable energy industry (Frank and Goyal, 2009).

Table 3. Descriptive Statistics

		Observations	Mean	Median	Maximum	Minimum	Standard Deviation	Jarque-Bera	JB *P*-value
Debt Ratios	***Definition***								
Total Leverage	Total Debt to Book Value of Assets	603	0.22	0.16	1.10	0.00	0.21	72.89	0.00
	Total Debt to Book Value of Total Capital	603	0.27	0.25	7.24	-22.22	1.00	4718722.00	0.00
	Total Debt to Market Value of Assets	413	0.21	0.13	0.84	0.00	0.21	52.67	0.00
Long-term Leverage	Long-term Debt to Book Value of Assets	603	0.14	0.07	0.65	0.00	0.17	140.41	0.00
	Long-term Debt to Book Value of Total Capital	603	0.19	0.10	0.98	-0.08	0.22	115.07	0.00
	Long-term Debt to Market Value of Assets	413	0.15	0.07	0.75	0.00	0.18	99.28	0.00
Short-term Leverage	Short-term Debt to Book Value of Assets	603	0.08	0.03	1.02	0.00	0.13	4808.30	0.00
	Short-term Debt to Book Value of Total Capital	603	0.08	0.05	7.24	-22.22	0.97	5647686.00	0.00
	Short-term Debt to Market Value of Assets	413	0.07	0.02	0.57	0.00	0.10	791.34	0.00
Firm-specific determinants									
Profitability	Operating Profit to Assets	603	-0.01	0.05	1.48	-6.14	0.38	365045.9	0.00
Size	Log of Assets	603	12.61	12.64	16.69	5.28	1.99	17.04951	0.00
Growth	Change in Log Assets	536	0.02	0.01	0.77	-0.10	0.07	40271.84	0.00
	CAPEX to Assets	603	0.08	0.05	0.83	-0.47	0.11	3822.892	0.00
	Market-to-book Assets	413	1.53	1.10	15.51	-19.49	1.85	47458.01	0.00
Nature of Assets	Tangibility	603	0.29	0.23	0.99	0.00	0.24	62.06685	0.00
	SG&A Expenses to Revenues	603	0.68	0.14	33.73	0.00	2.37	189587.2	0.00
Policy and Decision factor	Dividends to Assets	603	0.00	0.00	0.26	0.00	0.02	461858.7	0.00
Industry-specific determinants									
Industry Conditions	Median Industry Leverage	603	0.17	0.15	0.30	0.09	0.07	69.00	0.00
	Listed Firms Dummy	603	0.89	1.00	1.00	0.00	0.32	1003.42	0.00
Tax-related determinants									
Potential Debt Tax Shield	Effective Tax Rate	603	0.10	0.05	5.16	-9.65	0.63	277804.90	0.00
Nondebt Tax Shield	Depreciation to Assets	603	0.03	0.03	0.73	-0.01	0.06	126706.10	0.00
Macroeconomic determinants									
Legal traditions	Common Law Dummy	603	0.60	1.00	1.00	0.00	0.49	101.12	0.00

Concerning the Nature of Assets determinants, the mean score for Tangibility is 29.0 per cent and its median is 22.7 per cent. It is interesting to note that neither of the leverage definitions have a mean higher than the average tangibility (Total debt to book value of total capital's mean of 26.7 per cent is close, but still below 29). Due to the riskiness and long-term orientation of the renewable energy sector, the ratio of fixed assets to total assets could be seen as a ceiling, restraining the maximum leverage level that a company could have. If that is considered true, then the question why the firms in our sample under-utilize debt financing becomes relevant. However, earlier we concluded that the studied companies have on average negative operating income before taxes. Therefore, any tax-shields provided from higher debt levels would add no value, while the bankruptcy and distress costs would increase. The other determinant in the Nature of Assets group is SG&A Expenses to Revenues. From its mean of 67.7 per cent it can be concluded that the SG&A expenses offset a large portion of the revenues of the analyzed companies. According to the "*Global Trends in Renewable Energy Investment 2014"* report, the high costs, which explicitly characterize the renewable energy sector, are one of the reasons for the weak investment activity in the industry during the period 2009 - 2014 (Frankfurt School of Finance & Management, 2014).

The last factor requiring attention is Effective Tax Rate, part of the tax-related determinants. Its mean and median are 9.9 per cent and 5.1 per cent, respectively. At first sight, these results seem considerably low, especially when compared to the corporate tax rates in most of the countries of origin of the studied companies (See Appendix 1). Alipour et al. (2015) find out that companies face declining effective corporate tax rate the higher their long-term debt is. It could be inferred that due to low profitability, the analyzed renewable energy companies do not need to employ huge amount of long-term debt in order to greatly reduce their tax burden. Another possible explanation could be found in the fact that twelve companies from our sample (18 per cent) are registered in tax heavens, such as the Cayman Islands and Bermuda, where the tax rate is 0 per cent, and thus, bringing down the mean value for the Effective Tax Rate.

Table 3 also reports the Jarque-Bera test statistic and its related *p*-values. The Jarque-Bera test is informative for the distributional properties of the data and considers its skewness[10] and kurtosis[11]. The null hypothesis of the test is of normality and is not rejected if

[10] The skewness measures the extent to which a distribution is not symmetric about its mean value (Brooks, 2008)
[11] The kurtosis measures how fat the tails of the distribution are (Brooks, 2008)

the *p*-values are bigger than 0.01. As it can be seen from Table 3, that is not the case with our data. However, since we consider our dataset to be sufficiently large, the consequences of normality violation are insignificant (Brooks, 2008).

4.2. Regression Results

4.2.1. Full Sample

The results obtained from estimating Eq. (1) for the three leverage groups are summarised in Table 4. This table reveals that the models for total leverage and long-term leverage have considerably higher explanatory power (*R*-squared) compared to the short-term leverage ones, signalling that short-term financing decisions are influenced by a wider range of factors. Furthermore, all regression tests have an F-statistic *p*-value of 0.00, and therefore rejecting the null hypothesis that all slope coefficients are equal to zero. After pointing out the main characteristics of the regression model under its different leverage specifications, the subsequent analysis covers the results for each determinant group.

Firm-specific determinants

The results in Table 4 indicate that Profitability has a negative relationship with all leverage definitions, except for STL_3. It is interesting to note that the determinant is significant throughout the whole Group 1. Concerning Group 2, Profitability is significant only regarding total leverage and long-term leverage. In Group 3, Profitability does not appear to be a relevant capital structure determinant. Overall, these results indicate that more profitable firms would have lower leverage levels, which is consistent with the dynamic trade-off and pecking order theories.

With respect to Firm Size, Table 4 shows a positive and significant at the 1 percent level association with total leverage and long-term leverage from all three groups. Concerning short-term leverage, its relationship with Size is positive and significant in Group 1, positive and not significant in Group 2, and negative and irrelevant in Group 3. Our findings suggest that the bigger a renewable energy company is, the larger its long-term and total debt are, which is in line with the trade-off theory.

Growth is studied with the help of three different determinants. The first one is Change in Log Assets, which was implemented in Group 1 and Group 2 only. Interestingly,

the same pattern in the coefficient signs is observed between these two groups: Change in Log Assets has a negative relationship with total leverage and short-term leverage, and a positive one with long-term leverage. In relevance terms, the determinant is significant for the two short-term leverage specifications and LTL_1 and TL_2. Another Growth determinant is CAPEX to Assets. According to our findings, the latter has an overall negative and insignificant relation with leverage. The last determinant, discussed in this section, is Market-to-book Assets. Since it is based on market value of total assets, it is utilized only in Group 3. The Market-to-book Assets variable appears to be significantly negative in all leverage equations from Group 3. Even though that all three Growth determinants are measured differently, they share the same pattern, more precisely being that firms with higher past growth and expected future expansion have less leverage. These results are consistent with the trade-off theory.

The next set of determinants considers Nature of Assets. Its first representative is Tangibility. The results presented in Table 4 indicate that Tangibility has a positive and significant at the 1 per cent level relation with total leverage and long-term leverage from all three groups. Regarding short-term leverage, the discussed determinant is not relevant and has a positive sign for STL_1 and STL_3, and a negative for STL_2. Tangibility has the highest average coefficient value in absolute terms amongst all significant coefficients, which is informative for the strong economical significance of the factor. The above stated results indicate that firms with more fixed assets tend to employ more long-term than short-term debt. These results are in line with the predictions of the trade-off theory.

Moving on to SG&A Expenses to Revenues, also part of the Nature of Assets group, Table 4 shows an overall negative and highly significant association with leverage. The intuition behind these results implies that companies with higher SG&A expenses would have lower available cash flows, and therefore lower leverage. These findings are in line with the trade-off theory.

The last firm-specific determinant is the Policy and Decision factor, measured by the ratio Dividends to Assets. The results, as shown in Table 4, reveal that the latter has a negative relationship with all studied leverage specifications, meaning that high dividend paying firms have lower leverage. Concerning its relevance, Dividends to Assets appears statistically and economically significant in the relation with total leverage and short-term leverage from Group 2 and Group 3. Overall, these results are supported by the pecking order theory.

Table 4. Regression Analysis: Full Sample

		Group 1			Group 2			Group 3		
	Period:	*2005 - 2013*			*2005 - 2013*			*2007 - 2013*		
	Leverage Denominator:	*Book Value of Total Assets*			*Book Value of Total Capital*			*Market Value of Total Assets*		
	Leverage definition:	**Total Leverage TL_1**	**Long-term Leverage LTL_1**	**Short-term Leverage STL_1**	**Total Leverage TL_2**	**Long-term Leverage LTL_2**	**Short-term Leverage STL_2**	**Total Leverage TL_3**	**Long-term Leverage LTL_3**	**Short-term Leverage STL_3**
Firm-specific determinants	***Measure***									
Profitability	Operating Profit to Assets	-0.085***	-0.040**	-0.038*	-0.113**	-0.043*	-0.078	-0.004	-0.001	0.000
		0.025	0.020	0.021	0.050	0.023	0.048	0.047	0.036	0.014
Size	Log of Assets	0.029***	0.021***	0.007***	0.029**	0.031***	0.002	0.017***	0.020***	-0.001
		0.003	0.003	0.002	0.014	0.005	0.007	0.004	0.004	0.003
Growth	Change in Log Assets	-0.050	0.082*	-0.104***	-0.194**	0.085	-0.179**	-	-	-
		0.059	0.049	0.035	0.087	0.075	0.081	-	-	-
	CAPEX to Assets	-0.141	-0.108	-0.024	-0.228	-0.131	-0.132	-0.008	-0.072	0.067
		0.098	0.079	0.048	0.144	0.096	0.097	0.104	0.073	0.047
	Market-to-book Assets	-	-	-	-	-	-	-0.011***	-0.004***	-0.006*
		-	-	-	-	-	-	0.004	0.001	0.003
Nature of Assets	Tangibility	0.399***	0.389***	0.018	0.389***	0.429***	-0.075	0.425***	0.417***	0.023
		0.041	0.025	0.023	0.070	0.028	0.048	0.031	0.018	0.015
	SG&A Expenses to Revenues	-0.007***	-0.002***	-0.005***	-0.012***	-0.003***	-0.008***	-0.012*	-0.004	-0.008***
		0.002	0.001	0.001	0.002	0.001	0.001	0.006	0.004	0.002
Policy and Decision factor	Dividends to Assets	-0.251	-0.081	-0.185	-0.535*	-0.220	-0.632*	-0.404**	-0.039	-0.308*
		0.166	0.127	0.120	0.298	0.161	0.374	0.160	0.056	0.158
Industry-specific determinants										
Industry Conditions	Median Industry Leverage	0.376***	0.170**	0.216***	0.662***	0.316***	0.398***	0.480***	0.192***	0.284***
		0.069	0.067	0.038	0.149	0.108	0.044	0.099	0.053	0.072
	Listed Firms dummy	-0.196***	-0.078***	-0.118***	-0.206***	-0.101***	-0.072	-	-	-
		0.027	0.007	0.021	0.065	0.012	0.050	-	-	-
Tax-related determinants										
Potential Debt Tax Shield	Effective Tax Rate	-0.017*	-0.011	-0.005	-0.021	-0.012	0.002	-0.007	-0.013	0.004
		0.009	0.013	0.007	0.017	0.018	0.009	0.009	0.011	0.006
Nondebt Tax Shield	Depreciation to Assets	-0.010	-0.106	0.082	0.267***	-0.190	0.522**	0.078	-0.007	0.035
		0.056	0.088	0.089	0.074	0.133	0.203	0.069	0.047	0.087
Macroeconomic determinants										
Legal traditions	Common Law Dummy	-0.010	-0.043***	0.029***	0.007	-0.058***	0.066	-0.017***	-0.029**	0.011*
		0.010	0.012	0.008	0.042	0.019	0.042	0.006	0.012	0.007
	Number of observations	536	536	536	536	536	536	412	412	412
	Number of firms	67	67	67	67	67	67	59	59	59
	R-squared	0.380	0.403	0.118	0.228	0.354	0.102	0.479	0.518	0.120
	Adjusted R-squared	0.366	0.389	0.098	0.210	0.339	0.082	0.465	0.505	0.096
	Correlated Random Effects - Hausman Test	0.634	0.041	0.012	0.459	0.021	0.408	0.077	0.046	0.016

This table summarizes the results from estimating our random effects panel regression Eq. (1). The determinants are the same as those defined in **Table 1.** All results are reported in three decimal places. Two results are reported for each determinant: on top, coefficient value; below, heteroscedasticity and serial correlation robust standard errors.

***, **, and * Significance levels at the 1, 5, and 10 per cent levels, respectively

Industry-specific determinants

The first factor from the industry-specific group of determinants is Median Industry Leverage, which is positively and significantly related to all studied leverage groups. These results are in line with the postulates of the trade-off theory. The second variable from this group is Listed Firms Dummy, which was incorporated in the equations for Group 1 and Group 2 only. According to our results, the dummy always appear to have a negative and highly significant, except for STL_2, association with leverage. What can be inferred from these findings is that listed renewable energy companies tend to have lower leverage in comparison to the private ones, signalling that equity markets provide an efficient alternative to debt financing. Judging by the overall coefficient size of both industry-specific determinants, it can be concluded that they are not only statistically but also economically significant.

Tax-related determinants

Table 4 highlights that Potential Debt Tax Shield, measured through Effective Tax Rate, have an overall insignificant relationship with leverage. Coefficient sign wise, the determinant is negative in all total and long-term leverage equations, while STL_1 is negative, and STL_2 and STL_3 are positive. Regarding Nondebt Tax Shield, calculated by the ratio of Depreciation to Assets, we arrive at mixed results. The only identifiable trend lays in the positive coefficient sign in all three short-term leverage equations, and the negative one in all long-term debt ratios. In general, this factor is insignificant. The results for both tax-related determinants are neither supported by the trade-off theory nor the pecking order one.

Macroeconomic determinants

The last group of determinants considers the Legal Traditions and is based on a Common Law Dummy. In all three leverage groups, Legal Traditions appear to have a negative and significant association with long-term leverage, and a positive and significant, except for STL_2, relation with short-term leverage. In the long-term debt ratio equations, TL_3 has a negative coefficient and is significant at the 1 per cent level, while TL_2 and TL_1 are insignificant. A discussion about these findings is presented in “4.3.Discussion”.

4.2.2. Period Breakdown

Table 5 illustrates the regression results from estimating Eq. (1) for the three periods, namely, 2005-2007 (pre-crisis), 2008-2010 (crisis), and 2011-2013 (post-crisis). In this case, as explained in the Methodology, we focus only on one leverage definition: Total debt to book value of total assets, and any comparison with Table 4 results is based on it. Table 5 provides interesting results in regards to the explanatory power (*R*-squared) of the model for three periods. The model does "best" (with *R*-squared of 0.483) when applied to the pre-crisis period. However, the explanatory power of the model is substantially lower for the crisis (*R*-squared of 0.256) and post-crisis (*R*-squared of 0.304) periods, hinting that a broader range of factors should be considered. In addition, the F-statistic *p*-value for all three subsamples is 0.00 again. Finally, due to software specifications, the pre-crisis period has 134 observations, while the other two: 201 observations.

Firm-specific determinants

The results displayed in Table 5 reveal that there is a negative relationship between Profitability and total leverage in all three periods. In terms of relevance, Profitability appears significant only in the pre-crisis period. The next firm-specific determinant is Size, defined as Log of Assets. The latter, according to the figures in Table 5, is positively associated with total leverage and significant at the 1 per cent level in the crisis and post-crisis periods. With respect to Growth, the coefficient of Change in Log Assets is not relevant and has a negative relation with leverage pre-crisis and positive during and post-crisis. Regarding CAPEX to Assets, the results from Table 5 indicate that it has a negative relationship with leverage, which is significant only in the pre-crisis period. The next set of determinants considers the Nature of Assets. Tangibility, again, appears to be statistically and economically significant and positively correlated with leverage in all three periods. Concerning SG&A Expenses to Revenues, it has a negative relationship with leverage, while only insignificant in the post-crisis subsample. The last determinant from the firm-specific group is Dividends to Assets, which is again both statistically and economically significant, and negatively associated with leverage for all periods. Overall, only Change in Log Assets differentiates from our findings for the firm-specific determinants in the full sample.

Table 5. Regression Analysis: Period Breakdown

	Period:	*2005 - 2007 (Pre-Crisis)*	*2008 - 2010 (Crisis)*	*2011 - 2013 (Post-Crisis)*
	Leverage Denominator:	*Book Value of Total Assets*	*Book Value of Total Assets*	*Book Value of Total Assets*
	Leverage definition:	**Total Leverage**	**Total Leverage**	**Total Leverage**
Firm-specific determinants	***Measure***			
Profitability	Operating Profit to Assets	-0.017***	-0.019	-0.027
		0.005	0.048	0.037
Size	Log of Assets	0.003	0.028***	0.021***
		0.004	0.001	0.003
Growth	Change in Log Assets	-0.043	0.152	0.586
		0.043	0.170	0.507
	CAPEX to Assets	-0.277***	-0.062	-0.034
		0.081	0.127	0.052
	Market-to-book Assets	-	-	-
		-	-	-
Nature of Assets	Tangibility	0.701***	0.276***	0.417***
		0.064	0.054	0.013
	SG&A Expenses to Revenues	-0.009***	-0.006***	-0.003
		0.001	0.001	0.004
Policy and Decision factor	Dividends to Assets	-0.346**	-0.223*	-1.554***
		0.139	0.120	0.588
Industry-specific determinants				
Industry Conditions	Median Industry Leverage	-2.108***	-0.176	0.778***
		0.239	0.196	0.068
	Listed Firms dummy	-0.189***	0.008	-0.051*
		0.022	0.051	0.027
Tax-related determinants				
Potential Debt Tax Shield	Effective Tax Rate	-0.011*	-0.012	-0.021
		0.006	0.009	0.034
Nondebt Tax Shield	Depreciation to Assets	-1.063***	0.413	-0.101**
		0.121	0.536	0.045
Macroeconomic determinants				
Legal traditions	Common Law Dummy	-0.056***	-0.023*	-0.031**
		0.000	0.013	0.012
	Number of observations	134	201	201
	Number of firms	67	67	67
	R-squared	0.483	0.256	0.304
	Adjusted R-squared	0.432	0.209	0.259
	Correlated Random Effects - Hausman Test	0.101	0.919	0.106

This table summarizes the results from estimating our random effects panel regression Eq. (1). However, the sample is divided into three different subperiods. The determinants are the same as those defined in **Table 1**. All results are reported in three decimal places. Two results are reported for each determinant: on top, coefficient value; below, heteroscedasticity and serial correlation robust standard errors.

***, **, and * Significance levels at the 1, 5, and 10 per cent levels, respectively

Industry-specific determinants

The industry-specific determinants show mixed findings. The results from Table 5 indicate that Median Industry Leverage is significant only in the pre- and post-crisis subsamples. Furthermore, we conclude that while the variable has a negative relationship with leverage pre- and during the crisis, the coefficient becomes positive in the post-crisis period. The next determinant of this group is Listed Firms Dummy. In terms of significance, the latter follows the same pattern as the Median Industry Leverage. However, the coefficient has a negative association with leverage pre- and post-crisis, and a positive one during the crisis. To conclude, we fail to identify resemblance between the results for the full sample and the three periods and overall, there is no support by either of the discussed theories.

Tax-related determinants

The first determinant from this group is Effective Tax Rate, which shows an overall negative and insignificant relation with leverage. However, this is in line with the full sample results. That is not that case with the Depreciation to Assets factor. Its coefficient is negative and significant in the pre- and post-crisis periods. On the contrary, during the crisis Depreciation to Assets has a positive and irrelevant relationship with leverage. Overall, the coefficient of Depreciation to Assets is consistent with the predictions of the trade-off theory, which is not the case in the full sample results.

Macroeconomic determinants

As discussed before, the only representative from this group is the Common Law Dummy. The results from Table 5 show that the latter has a negative and significant association with leverage, which does not contradict the findings from the full sample estimation.

4.3. Discussion

4.3.1. Analysis of the Regression Results

This study set out with the aim of assessing the importance of various factors which influence capital structure decisions in the global renewable energy sector. In the process of achieving this goal, we also indentified certain trends related to the capital structure itself, which are briefly commented in the rest of this paragraph. The descriptive statistics reveal a

very interesting finding in terms of the choice of financing alternatives. In all three leverage definition groups, long-term debt is preferred to short-term debt, with the former being around two thirds of total debt. However, the average total leverage is not higher than 27 per cent, implying that equity is the prevailing source of funds for the studied renewable energy companies. These findings are in line with Sonntag-O'Brien and Usher (2004) research in which they emphasize that renewable energy technologies are associated with long timeframes and high uncertainty, leaving most short-term investors out of play. Further support could be obtained from EY (2014) report, in which it is stated that prior 2014 the renewable energy green bond market was not well suited to provide debt funding. The authors explain that the key reasons for this were the unproven technology and the sector being relatively young with investors lacking understanding of its business risk.

Moving on to the main purpose of this paper, the following discussion centres on the capital structure determinants. The focus is on the overall trends outlined from the analysis of the full sample and period breakdown results. Nevertheless, a few individual findings deserve attention and are therefore discussed separately. Beginning with Profitability, our results indicate an overall negative and significant relationship with leverage. This outcome is consistent with the results of Myers and Majluf (1984), Kester (1986), Titman and Wessels (1988) and Fama and French (2002). Moreover, the recent researches of Hennessy and Whited (2005), Titman and Tsyplakov (2007), Strebulaev (2007) and Kayhan and Titman (2007) also support the fact that profitable companies maintain lower debt ratios.

Consistent with the empirical findings of Warner (1977), Titman and Wessels (1988), Rajan and Zingales (1995) and De Jong et al. (2008), our results show a positive and significant association between Firm Size and leverage. An explanation of this finding could be that larger firms are more stable and have lower probability of default, and therefore, can sustain more debt. Observing the results from the period breakdown, it is interesting to note that in the pre-crisis subsample Firm Size is not a relevant factor. However, during and post-crisis the latter becomes significant at the 1 per cent level. A possible explanation of this might be that since the crisis created a very turbulent market environment, bond holders and other types of lenders felt more secure investing their money into big companies, which enjoy the perks of lower volatility and decreased information asymmetry (Ogden et al. 2003).

Regarding firm growth, as previously explained, we use three different determinants. The overall results indicate a negative relationship of all three growth factors and leverage.

However, only Market-to-book Assets appear to be significant. The intuition behind these findings is that firms of fast growth are normally expected to accumulate enough internal funds in order to sustain their expansion without having to rely on external financing. These results are in agreement with those of Rajan and Zingales, (1995), Frank and Goyal (2009), Flannery and Rangan (2006) and Hovakimian (2006).

Moving forward to the next firm-specific determinant, our findings indicate a positive and significant at the 1 per cent level association between Tangibility and total and long-term leverages. However, our results imply that Tangibility is insignificant for all three short-term leverage definitions suggesting that the studied renewable energy companies match the maturity of their assets with their debt. These findings are in line with Harris and Raviv (1991), Rajan and Zingales, (1995), Köksal and Orman (2014) and Amidu (2007). Considering the period breakdown, we arrive at a surprising result regarding the absolute coefficient value of the Tangibility variable. It fell from 0.701 pre-crisis to 0.276 during the crisis, marking a drop of 60.6 per cent. These results are rather puzzling and in clear contradiction with the findings of Harrison and Widjaja (2014). In their study, the two authors observe that the coefficient of tangibility undergoes a significant increase of 40 per cent during the crisis, raising the influence of this determinant in leverage decisions due to its capacity to diminish adverse selection problems.

The subsequent discussion in this paragraph is dedicated to the two determinants with the most consistent results amongst all twelve regressions that we ran. The first one is SG&A Expenses to Revenues, which according to our results, has a negative and highly significant relationship with leverage. The logic behind this finding is that companies with higher expenses would have lower available cash flows, which on the other hand, would not be able to support the costs of higher debt levels. These results are in accord with Long and Malitz (1985) and Frank and Goyal (2009). The second robust coefficient is Dividends to Assets. It has a negative and overall significant[12] association with leverage. The intuition here is the same as the one for SG&A Expenses to Revenues. It is interesting to mention that the determinant Dividends to Assets in the post-crisis sample is significant at the 1 per cent level and with the second highest coefficient value of 1.554 in absolute terms from all regression results. A possible explanation for this might be that the dividend paying renewable energy

[12] The coefficient of Dividends to Assets is significant in 4 out of 9 cases for the full period sample and 3 out 3 for the period breakdown. Since the results from the period breakdown appear quite robust, our overall judgment is that the determinant is significant.

companies from our sample increased their dividends after the crisis in order to attract long-term investors such as pension and insurance funds. By doing so, the equity of the studied firms increased leading to lower leverage levels. Finally, the results for the Dividends to Assets determinant are consistent with Myers (1984) and Frank and Goyal (2009).

The next group of determinants considers industry-specific conditions. Median Industry Leverage appears to be significant and positively associated with leverage, suggesting that the studied renewable energy companies follow target adjustment behaviour in their leverage decisions. Furthermore, it could be inferred that these firms employ less debt in comparison to the median industry level. Our results are in agreement with previous research of Schwartz and Aronson (1967) and Bradley et al. (1984). Of particular interest are the period breakdown findings. In the pre-crisis period, the coefficient of the Median Industry Leverage is significant and negative, having the highest of all absolute values of |-2.108|. It may be that before the crisis, some of the studied renewable energy companies were highly levered, being way above the industry median. In the crisis sample, this determinant looses relevance, but is still negatively related to leverage. A sign of change is then found in the post-crisis period, where Median Industry Leverage is highly significant again, but with positive coefficient of 0.778. A possible inference could be that in order to fight the adverse impact of the crisis, the studied renewable energy companies had to substantially reduce their debt levels, arriving at a lower than the industry level leverage ratio. The second and last factor from the industry-specific group is Listed Firms Dummy. The results indicate a significant and negative relationship with leverage, implying that listed companies have an efficient substitute of debt in the representation of equity. These findings are in line with Helwege and Liang (1996), but somewhat against those of Myers (1984).

Considering the tax-related determinants, our results suggest an overall negative relationship between Effective Tax Rate and leverage. However, the factor lacks statistical significance in 83.3 per cent of the cases. A probable reason for this could lie in the fact that 18 per cent of the companies in our sample are unaffected by corporate taxation. Our findings are in agreement with the empirical evidence from recent studies by Antoniou, Guney and Paudyal (2008) and Karadeniz et al. (2009). Concerning Depreciation to Assets, this study has been unable to demonstrate any prevailing significance and coefficient sign trends.

The final paragraph of this section considers the macroeconomic determinant, represented by the Common Law Dummy. Overall, the factor appears to be significantly and

negatively related to total and long-term leverage. These results indicate that the studied renewable energy companies operating under common law traditions tend to have lower total leverage, which is consistent with Fan et al. (2011). On the other hand, our findings for long- and short-term debt are in clear contradiction with Fan et al. (2011) and Baker and Martin (2011). It is difficult to explain these results, but they might be related to the fact that during the studied period the renewable energy companies were not yet established on the market and were associated with high business risks, altering the behaviour of different lenders.

4.3.2. Trade-off or Pecking Order?

The second question in this study seeks to determine which of the two theories, trade-off or pecking order, explains the findings of our study better. Table 6 summarizes the theoretical factor predictions alongside with our empirical results.

There are only two determinants from our study, which follow the factor predictions of the Pecking order theory, and they appear quite robust. The first one is Profitability, with eleven out of twelve coefficients being negative, and the second one is Dividends to Assets, which has a robust negative association with leverage in all observed regressions. However, the dynamic trade-off theory also predicts a negative relationship between profitability and leverage, as explained by Frank and Goyal (2008), which adds even more explanatory power to the trade-off framework.

Overall, we find that the dynamic trade-off theory describes the capital structure decisions in the studied renewable energy companies better. It is interesting to note that this trend is also present in the full sample and period breakdown results separately (See Appendices 6 and 7). To our knowledge, there are no previous studies examining the applicability of either of the discussed theories to the capital structure decisions in the renewable energy sector. Therefore, our result could be seen as a solid foundation prompting future research.

Table 6. Comparison of Theoretical Predictions with Data Results

Determinants	*Definition*	Static Trade-off Theory	Dynamic Trade-off Theory	Pecking Order Theory	Data
Firm-specific determinants					
Profitability	Operating Profit to Assets	**+**	**-**	**-**	-
Size	Log of Assets	**+**	**+**	**-**	+
Growth	Change in Log Assets	**-**	**-**	**+**	-
	CAPEX to Assets	**-**	**-**	**+**	-
	Market-to-book Assets	**-**	**-**	**+**	-
Nature of Assets	Tangibility	**+**	**+**	**-**	+
	SG&A Expenses to Revenues	**-**	**-**	**+**	-
Policy and Decision Factor	Dividends to Assets	**+**	**+**	**-**	-
Industry-specific determinants					
Industry Conditions	Median Industry Leverage	**+**	**+**	**?**	+
	Listed Firms Dummy	**?**	**?**	**?**	-
Tax-related determinants					
Potential Debt Tax Shields	Effective Tax Rate	**+**	**+**	**?**	-
Nondebt Tax Shield	Depreciation to Assets	**-**	**-**	**?**	+/-
Macroeconomic determinants					
Legal Traditions	Common Law Dummy	**?**	**?**	**?**	-

5.Conclusion

The present paper was designed to determine the factors that significantly influence capital structure decisions in the global renewable energy sector, where the topic has been under-researched. Our study was inspired by a combination of the raising importance of sustainability on a global scale and the high relevance of capital structure decisions for the survivability of companies in the context of the financial crisis 2008.

The study was based on a sample of 67 renewable energy companies for the period 2005-2013. Our data was analyzed using a panel data model, in which leverage was the dependent variable, controlled by a set of firm-specific, industry-specific, tax-related and macroeconomic independent variables. To add further depth to our research, and to confirm the robustness of our results, several definitions of leverage were implemented. A novelty of our paper comes from the fact that we incorporated a legal traditions variable that enabled us to investigate whether the legal origin has any impact on firm's financing decisions. In addition to examining the entire sample period, we divided our data into three sub-periods: 2005-2007 (pre-crisis), 2008-2010 (crisis), and 2011-2013 (post-crisis), with the aim to unearth if the financial crisis had any influence on the association between leverage and its determining factors. Finally, we performed a comparative test of the pecking order theory and the trade-off theory in order to find out which framework provided a better explanation of our results.

The evidence from this study suggests that the prevailing source of funds for the studied renewable energy companies is equity. Moreover, long-term debt is preferred to short-term debt, with the former being approximately two thirds of total debt. Interestingly, we find that on average the studied companies experience negative operating income before taxes. Therefore, employing additional debt would not add any further value in the form of tax shields, but would increase the financial distress and bankruptcy costs. On the whole, these results are in line with previous researches, stating that the renewable energy sector is long-term oriented and associated with high business risks.

Our regression analysis reveals that the determinants which are positively and significantly correlated with leverage are Size, Tangibility and Median Industry Leverage.

Considering Size, we conclude that large renewable energy firms are more stable and less likely to go bankrupt, thus being able to support higher debt levels. In general, our results for Tangibility confirm that the studied companies match the maturity of their assets with their debt. The findings of this research provide evidence that the examined renewable energy firms tend to adjust their leverage levels towards the industry median one. To continue, we find that the factors Profitability, Market-to-book Assets, SG&A Expenses to Revenues, Dividends to Assets, Listed Firms Dummy and Common Law Dummy are negatively and significantly associated with leverage. Overall, we conclude that more profitable firms with higher expected growth require less debt, since they can finance their operations with accumulated internal funds. It is relevant to mention that our results for Market-to-book Assets highlight the elevated market expectations about the future prospects of the global renewable energy sector. Moreover, our findings suggest that the studied companies are characterized by high SG&A and dividend expenses, which imply that they have less available funds to cover the additional costs of using more debt. In regards to the Listed Firms Dummy, we conclude that the publicly traded entities from our sample have lower leverage since their access to the equity capital markets provides them with an efficient substitute of debt. Another interesting finding to emerge from our research is that the renewable energy companies, originating from countries with common law traditions, tend to have lower total leverage. To our surprise, tax-related determinants turn out to be insignificant, with effective tax rate being negatively correlated to leverage. The fact that 18 per cent of the companies in our sample are unaffected by corporate taxation could partly attribute to this unexpected result. Regarding Depreciation to Assets we fail to identify any prevailing trend in the coefficient sign. Furthermore, we conclude that past growth, measured through Change in Log Assets and CAPEX to Assets, has no impact on capital structure decisions in the studied sector.

Concerning the period breakdown results, no major impact of the financial crisis 2008 on the capital structure determinants is recognized. The only significant factor that underwent a substantial change is Median Industry Leverage, which turned from negative in the pre- and the crisis periods to positive in the post-crisis one. Our implication here is that during the first two periods some of the studied renewable energy companies were over-levered. Thus, in order to fight the adverse impact of the crisis, these firms had to substantially reduce their debt levels, arriving at a lower than the industry level leverage in the post-crisis times. It is also worth mentioning that Firm Size became a highly significant factor during and post-

crisis, signalling that due to the turbulent market environment, investors preferred putting their money into larger renewable energy companies during these two periods.

Finally, the last research question of this paper consists of a comparative test of the factor predictions provided by the trade-off and pecking order theories, and our findings. The principal theoretical implication of our study is that the dynamic trade-off theory better describes the capital structure decisions in the studied renewable energy companies.

Our master thesis has thrown up several questions in need of further investigation. Thus, it is recommended that additional research be undertaken in the following areas. First of all, as the scope of our study was limited in terms of data availability, it would be valuable to conduct an empirical research including larger number of companies during an extended observed period, covering several economic cycles. Second, we recommend any future investigation to examine the effect of institutional ownership and ownership concentration on leverage decisions in the renewable energy sector. Moreover, further research might explore how government subsidies affect the borrowing preferences in the industry. Last, but not the least, examining the role of corporate governance in leverage decisions might be worthwhile as it can add value, resulting in a more precise analysis form both theoretical and practical perspectives. Generally, our recommendations for future research would develop further the insights provided by our study on the capital structure determinants in the global renewable energy sector.

References

Aamir, Z., Gulzar, S., Uzma, F. and Aslam Khan, S. (2013). Factors affecting the capital structure in energy sector of Pakistan. *International Journal of Academic Research*, 5(3), pp.503-510.

Adam, T. and Goyal, V. (2008). The investment opportunity set and its proxy variables. *Journal of Financial Research*, 31(1), pp.41-63.

Alipour, M., Mohammadi, M. and Derakhshan, H. (2015). Determinants of capital structure: an empirical study of firms in Iran. *International Journal of Law and Management*, 57(1), pp.53-83.

Alzomaia, T. (2014). Capital structure determinants of publicly listed companies in Saudi Arabia. *The International Journal of Business and Finance Research*, 8(2), pp.53-67.

Amidu, M. (2007). Determinants of capital structure of banks in Ghana: an empirical approach. *Baltic Journal of Management*, 2(1), pp.67-79.

Antoniou, A., Guney, Y. and Paudyal, K. (2008). The Determinants of Capital Structure: Capital Market-Oriented versus Bank-Oriented Institutions. *Journal of Financial and Quantitative Analysis*, 43(01), pp.59-92.

Baker, H. and Martin, G. (2011). *Capital Structure and Corporate Financing Decisions: Theory, Evidence and Practice*. 1st ed. ISBN: 978-1-118-02294-8: Hamilton.

Banerjee, A. and De, A. (2014). Determinants of Corporate Financial Performance Relating to Capital Structure Decisions in Indian Iron and Steel Industry: An Empirical Study. *Paradigm*, 18(1), pp.35-50.

Barclay, M., Morellec, E. and Smith, Jr., C. (2006). On the Debt Capacity of Growth Options. *Journal of Business*, 79(1), pp.37-59.

Bradley, M., Jarrell, G. and Kim, E. (1984). On the Existence of an Optimal Capital Structure: Theory and Evidence. *The Journal of Finance*, 39(3), pp.857-878.

Brooks, C. (2008). *Introductory econometrics for finance*. 2nd ed. Cambridge: Cambridge

University Press.

Brunnschweiler, C. (2010). Finance for renewable energy: an empirical analysis of developing and transition economies. *Environment and Development Economics*, 15(03), pp.241-274.

Castanias, R. (1983). Bankruptcy Risk and Optimal Capital Structure. *The Journal of Finance*, 38(5), pp.1617-1635.

Copeland, T., Weston, J. and Shastri, K. (2005). Financial theory and corporate policy. 4th ed. Boston, MA: Addison-Wesley.

Cortez, M. and Susanto, S. (2012). The determinants of corporate capital structure: evidence from Japanese manufacturing companies. *Journal of International Business Research*, 11 Special Issue (3), pp. 121-134.

DeAngelo, H. and Masulis, R. (1980). Optimal capital structure under corporate and personal taxation. *Journal of Financial Economics*, 8(1), pp.3-29.

De Jong, A., Kabir, R. and Nguyen, T. (2008). Capital structure around the world: The roles of firm- and country-specific determinants. *Journal of Banking & Finance*, 32(9), pp.1954-1969.

Ettenhuber, C. (2013). *Financing Corporate Growth in the Renewable Energy Industry*. Frankfurt: Peter Lang GmbH, Internationaler Verlag der Wissenschaften.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, *Official Journal of the European Union*, L 140, pp. 16-62.

EViews 8 User's Guide II. (2013). IHS Global Inc.

EY, (2014). *Renewable energy country attractiveness index*. Issue 40.

Fama, E. and French, K. (2002). Testing Trade-off and Pecking Order Predictions About Dividends and Debt. *The Review of Financial Studies*, 15(1), pp.1-33.

Fan, J., Titman, S. and Twite, G. (2011). An International Comparison of Capital Structure and Debt Maturity Choices. *Journal of Financial and Quantitative Analysis*, 47(01),

pp.23-56.

Flannery, M. and Rangan, K. (2006). Partial adjustment toward target capital structures. *Journal of Financial Economics*, 79(3), pp.469-506.

Frank, M. and Goyal, V. (2003). Testing the pecking order theory of capital structure. *Journal of Financial Economics*, 67(2), pp.217-248.

Frank, M. and Goyal, V. (2008). Trade-off and pecking order theories of debt. In: *Handbook of Empirical Corporate Finance*, 2nd ed. Amsterdam: Elsevier Science, pp.135-202.

Frank, M. and Goyal, V. (2009). Capital Structure Decisions: Which Factors Are Reliably Important?. *Financial Management*, 38(1), pp.1-37.

Frankfurt School of Finance & Management (2014). *Global Trends in Renewable Energy Investment 2014*. Frankfurt: FS-UNEP Collaborating Centre.

Graham, J. and Harvey, C. (2001). The theory and practice of corporate finance: evidence from the field. *Journal of Financial Economics*, 60(2-3), pp.187-243.

Gilson, S. (1997). Transactions Costs and Capital Structure Choice: Evidence from Financially Distressed Firms. *The Journal of Finance*, 52(1), pp.161-196.

Harris, M. and Raviv, A. (1991). The Theory of Capital Structure. *The Journal of Finance*, 46(1), pp.297-355.

Harrison, B. and Widjaja, T. (2014). The Determinants of Capital Structure: Comparison between Before and After Financial Crisis. *Economic Issues Journal Articles*, 19(2), pp.55-83.

Haugen, R. and Senbet, L. (1986). Corporate Finance and Taxes: A Review. *Financial Management*, 15(3), pp.5-21.

Hovakimian, A. (2006). Are Observed Capital Structures Determined by Equity Market Timing?. *Journal of Financial and Quantitative Analysis*, 41(01), pp.221-243.

Hovakimian, A., Opler, T. and Titman, S. (2001). The Debt-Equity Choice. *The Journal of Financial and Quantitative Analysis*, 36(1), pp.1-24.

Helwege, J. and Liang, N. (1996). Is there a pecking order? Evidence from a panel of IPO

firms. *Journal of Financial Economics*, 40(3), pp.429-458.

Hennessy, C. and Whited, T. (2005). Debt Dynamics. *Journal of Finance*, 60(3), pp.1129-1165.

Hull, R. (1999). Leverage Ratios, Industry Norms, and Stock Price Reaction: An Empirical Investigation of Stock-for-Debt Transactions. *Financial Management,* 28(2), pp.32-45.

International Energy Agency, (2014). *World Energy Outlook 2014*. Paris, p.4.

Jensen, M. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *American Economic Review*, 76(2), pp.323-329.

Jensen, M. and Meckling, W. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), pp.305-360.

Karadeniz, E., Kandir, S.Y., Balcilar, M. and Onal, Y.B. (2009). Determinants of capital structure: evidence from Turkish lodging companies. *International Journal of Contemporary Hospitality Management*, 21(5), pp.594-609.

Kayhan, A. and Titman, S. (2007). Firms' Histories and Their Capital Structures. *Journal of Financial Economics*, 83, pp.1-32.

Kester, W. (1986). Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Corporations. *Financial Management,* 15(1), pp.5-16.

Koller, T., Goedhart, M. and Wessels, D. (2010). Valuation: Measuring and managing the value of companies. 5th ed. Hoboken, New Jersey: Wiley.

Kpmg.com, (2015). *Corporate tax rates table | KPMG | GLOBAL*. [online] Available at: http://www.kpmg.com/global/en/services/tax/tax-tools-and-resources/pages/corporate-tax-rates-table.aspx [Accessed 16 May 2015].

Kraus, A. and Litzenberger, R. (1973). A State-Preference Model of Optimal Financial Leverage. *The Journal of Finance,* 28(4), pp.911-922.

Köksal, B. and Orman, C. (2014). Determinants of capital structure: evidence from a major developing economy. *Small Bus Econ*, 44(2), pp.255-282.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1998). Law and Finance.

Journal of Political Economy, 106(6), pp.1113-1155.

La Porta, R., Lopez-De-Silanes, F., Shleifer, A. and Vishny, R. (1997). Legal Determinants of External Finance. *The Journal of Finance*, 52(3), pp.1131-1150.

Lewis-Beck, M. (1993). *Regression analysis*. London: Sage Publications.

Long, M. and Malitz, E. (1985). Investment Patterns and Financial Leverage. *National Bureau of Economic Research*, pp.325-352.

Marsh, P. (1982). The Choice Between Equity and Debt: An Empirical Study. *The Journal of Finance*, 37(1), pp.121-144.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, XLVIII(Number Three).

Modigliani, F. and Miller, M. (1963). Corporate Income Taxes and the Cost of Capital: A Correction. *The American Economic Review*, 53(3), pp.433-443.

Myers, S. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, 5, pp.147-175.

Myers, S. (1984). The Capital Structure Puzzle. *The Journal of Finance*, 39(3), pp.574-592.

Myers, S. and Majluf, N. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2), pp.187-221.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, XLVIII(Number Three).

Modigliani, F. and Miller, M. (1963). Corporate Income Taxes and the Cost of Capital: A Correction. *The American Economic Review*, 53(3), pp.433-443.

Nelson, D. and Pierpont, B. (2013). *The Challenge of Institutional Investment in Renewable Energy*. Climate Policy Initiative Report.

Ogden, J., Jen, F. and O'Connor, P. (2003). Advanced corporate finance. Upper Saddle River, N.J.: Prentice Hall.

Proença, P., Laureano, R. and Laureano, L. (2014). Determinants of Capital Structure and the 2008 Financial Crisis: Evidence from Portuguese SMEs. *Procedia - Social and Behavioral Sciences*, 150, pp.182-191.

Rajan, R. and Zingales, L. (1995). What Do We Know about Capital Structure? Some Evidence from International Data. *The Journal of Finance*, 50(5), pp.1421-1460.

Renewable-energy-industry.com, (2015). *Renewable Energy Industry - Stock Index RENIXX World, global alternative energy index*. [online] Available at: http://www.renewable-energy-industry.com/stocks/ [Accessed 19 Apr. 2015].

Renewables 2014 Global Status Report. (2014). [online] Paris, France: REN21 Renewable Energy Policy Network for the 21st century. Available at: http://www.ren21.net/REN21Activities/GlobalStatusReport.aspx [Accessed 19 Apr. 2015].

Schwartz, E. and Aronson, J. (1967). Some Surrogate Evidence in Support of the Concept of Optimal Financial Structure. *The Journal of Finance*, 22(1), pp.10-18.

Shyam-Sunder, L. and Myers, S. (1999). Testing static trade-off theory against pecking order models of capital structure. *Journal of Financial Economics*, (51 (1999), pp.219-244.

Sonntag-O'Brien, V. and Usher, E. (2004). Mobilising Finance For Renewable Energies. *International Conference for Renewable Energies, Bonn 2004*.

Strebulaev, I. (2007). Do Tests of Capital Structure Theory Mean What They Say?. *Journal of Finance*, 62(4), pp.1747-1787.

Stulz, R. (1990). Managerial discretion and optimal financing policies. *Journal of Financial Economics*, 26(1), pp.3-27.

Taggart, R. (1985). Secular Patterns in the Financing of U.S. Corporations. *National Bureau of Economic Research*, University of Chicago Press, New York, pp.13-80.

Titman, S. (1984). The effect of capital structure on a firm's liquidation decision. *Journal of Financial Economics*, 13(1), pp.137-151.

Titman, S. and Tsyplakov, S. (2007). A Dynamic Model of Optimal Capital Structure. *Review of Finance*, 11(3), pp.401-451.

Titman, S. and Wessels, R. (1988). The Determinants of Capital Structure Choice. *The Journal of Finance*, 43(1), pp.1-19.

United Nations Environment Programme, (2004). *Financial Risk Management Instruments for Renewable Energy Projects*. United Nations Publications. Oxford.

United Nations, (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change. Kyoto.

Warner, J. (1977). Bankruptcy Costs: Some Evidence. *The Journal of Finance*, 32(2), pp.337-347.

Appendix

Appendix 1. List of included companies with their corresponding country of incorporation, law tradition and tax rate

Company name	Country of incorporation	Legal tradition	Corporate Tax Rate (2013)
BDI-BIOENERGY INTERNAT.AG	Austria	Civil Law	25.00%
VERBUND AG INH. A	Austria	Civil Law	25.00%
XINJIANG GOLDW.SC.+T.H	China	Civil Law	25.00%
VESTAS WIND SYST. NAM.DK1	Denmark	Civil Law	25.00%
THEOLIA EO 0,10	France	Civil Law	33.33%
7C SOLARPARKEN AG O.N.	Germany	Civil Law	29.55%
AS ABWICKL.SOLAR.I.A.	Germany	Civil Law	29.55%
CAPITAL STAGE AG	Germany	Civil Law	29.55%
CROPENERGIES AG	Germany	Civil Law	29.55%
DALDRUP+SOEHNE AG	Germany	Civil Law	29.55%
ECOUNION AG	Germany	Civil Law	29.55%
ENERGIEKONTOR O.N.	Germany	Civil Law	29.55%
ENVITEC BIOGAS O.N.	Germany	Civil Law	29.55%
MANZ AG	Germany	Civil Law	29.55%
NORDEX SE O.N.	Germany	Civil Law	29.55%
PHOENIX SOLAR AG O.N.	Germany	Civil Law	29.55%
PNE WIND AG	Germany	Civil Law	29.55%
SFC ENERGY AG	Germany	Civil Law	29.55%
SOLAR-FABRIK AG O.N.	Germany	Civil Law	29.55%
SOLARWORLD AG O.N.	Germany	Civil Law	29.55%
SONNE + WIND BET.NA O.N.	Germany	Civil Law	29.55%
UMWELTBANK AG O.N.	Germany	Civil Law	29.55%
REC SILICON ASA NR 1	Norway	Civil Law	28.00%
GAMESA CORP.TEC.I.EO-,17	Spain	Civil Law	30.00%
SOLARIA ENERGIA Y M.EO-01	Spain	Civil Law	30.00%
ENERG.DIEN.HLD.NAM.SF-,10	Switzerland	Civil Law	18.01%
MEYER BUR.TECH.NAM.SF-,05	Switzerland	Civil Law	18.01%
DYESOL LTD.	Australia	Common Law	30.00%
ENERGY DEV. LTD	Australia	Common Law	30.00%
GEODYNAMICS LTD	Australia	Common Law	30.00%
INFIGEN ENERGY	Australia	Common Law	30.00%
CHINA SING.SOL.TECH.DL-01	Bermuda	Common Law	0.00%
HANERGY THI.F.P.G.HD-0025	Bermuda	Common Law	0.00%
UNIT.PHOTOVOLTA.GR.HD-,10	Bermuda	Common Law	0.00%
BALLARD PWR SYS (NEW)	Canada	Common Law	26.00%
CANADIAN SOLAR INC.	Canada	Common Law	26.00%
HYDROGENICS CORP.	Canada	Common Law	26.00%
INNERGEX RENEWABLE ENERG	Canada	Common Law	26.00%
RAM POWER CORP.	Canada	Common Law	26.00%

CHINA HIGH-SPEED DL-,01	Cayman Islands	Common Law	0.00%
GCL POLY ENERGY HLDGS LTD	Cayman Islands	Common Law	0.00%
HANWHA Q CELLS CO. ADR/5	Cayman Islands	Common Law	0.00%
JA SOLAR HLDGS ADR	Cayman Islands	Common Law	0.00%
SOLARGIGA ENERGY H. HD-01	Cayman Islands	Common Law	0.00%
TRINA SOLAR ADR/50 DL-01	Cayman Islands	Common Law	0.00%
YINGLI GREEN ADR/1 DL-,01	Cayman Islands	Common Law	0.00%
SUZLON ENERGY LTD GDR/4	India	Common Law	33.99%
SOLARTRON -FGN- BA 1	Thailand	Common Law	20.00%
ALKANE ENERGY PLC LS-,005	United Kingdom	Common Law	23.00%
PV CRYSTALOX SOLAR LS-052	United Kingdom	Common Law	23.00%
ADVANCED EN. INDS DL-,001	United States	Common Law	40.00%
AMER. SUPERCOND. DL-,01	United States	Common Law	40.00%
AMTECH SYS INC. DL-,01	United States	Common Law	40.00%
ASCENT SOLAR TEC.DL-,0001	United States	Common Law	40.00%
FIRST SOLAR INC. D -,001	United States	Common Law	40.00%
FUELCELL ENERGY DL-,0001	United States	Common Law	40.00%
GREEN PLAINS INC.	United States	Common Law	40.00%
GT ADVANCED TECHS DL-,01	United States	Common Law	40.00%
OCEAN POWER TECH. NEW	United States	Common Law	40.00%
ORMAT TECHNOLOG. DL-,001	United States	Common Law	40.00%
PLUG POWER INC.NEW DL-,01	United States	Common Law	40.00%
RGS ENERGY A DL-,0001	United States	Common Law	40.00%
SPIRE CORP. DL -,01	United States	Common Law	40.00%
SUNEDISON INC. DL -,01	United States	Common Law	40.00%
SUNPOWER CORP. DL -,01	United States	Common Law	40.00%
U.S. GEOTHERMAL I.DL-,001	United States	Common Law	40.00%
RENESOLA LTD ADR 2 O.N.	Virgin Islands	Common Law	0.00%

Source: information about tax rates is obtained from KPMG.com (2015), list of companies part of RENIXX ® (Renewable-energy-industry.com, 2015)

Appendix 2. Correlation matrix: book values

	AVLEV	COMLAW	COSTR	FSIZE	GR	INVR	MNGP	PBL	PROF	TANG	TAX	TS1
AVLEV	1.00											
COMLAW	-0.00											
COSTR	0.02	0.13										
FSIZE	0.14	- 0.04	-0.28									
GR	-0.33	0.08	-0.06	-0.05								
INVR	-0.13	0.16	0.09	0.13	0.04							
MNGP	-0.08	- 0.03	-0.06	0.09	-0.00	-0.00						
PBL	0.18	- 0.01	-0.13	0.28	-0.17	0.03	0.00					
PROF	-0.19	- 0.19	-0.36	0.36	0.16	0.02	0.15	-0.06				
TANG	0.17	0.09	-0.09	0.35	-0.10	0.29	0.09	0.14	0.19			
TAX	-0.01	- 0.05	-0.02	0.04	-0.07	-0.03	0.06	0.00	0.05	-0.01		
TS1	0.26	- 0.14	0.03	-0.04	-0.21	-0.03	-0.04	0.11	-0.11	0.10	-0.02	1.00

AVLEV- Median Industry Leverage; **COMLAW**- Common Law Dummy; **COSTR**- SG&A Expenses to Revenues; **FSIZE**- Log of Assets; **GR**- Change in Log Assets; **INVR**- CAPEX to Assets; **MNGP**- Dividends to Assets; **PBL**- Listed Firms dummy; **PROF**- Operating Profit to Assets; **TANG**- Tangibility; **TAX**- Effective Tax Rate; **TS1**- Depreciation to Assets

Appendix 3. Correlation matrix: market values

	TANG	PROF	FSIZE	TS1	COSTR	INVR	AVLEV	TAX	MNGP	COMLAW	MTB
TANG	1.00										
PROF	0.05										
FSIZE	0.07	0.29									
TS1	0.24	-0.09	-0.09								
COSTR	-0.04	-0.40	-0.29	0.04							
INVR	0.37	-0.28	-0.07	0.06	0.31						
AVLEV	0.21	-0.14	-0.02	0.26	0.08	-0.03					
TAX	0.03	0.03	0.00	-0.01	-0.02	-0.00	0.01				
MNGP	0.09	0.08	0.02	-0.01	-0.06	-0.02	-0.04	0.04			
COMLAW	0.09	-0.20	-0.07	-0.13	0.21	0.13	0.00	-0.05	-0.03		
MTB	-0.26	0.02	0.16	-0.12	0.05	-0.15	-0.22	-0.11	-0.03	0.01	1.00

TANG- Tangibility; **PROF**- Operating Profit to Assets; **FSIZE**- Log of Assets; **TS1**- Depreciation to Assets; **COSTR**- SG&A Expenses to Revenues; **INVR**- CAPEX to Assets; **AVLEV**- Median Industry Leverage; **TAX**- Effective Tax Rate; **MNGP**- Dividends to Assets; **COMLAW**- Common Law Dummy; **MTB**- Market-to-book Assets

Appendix 4. Pooled regression results

Dependent Variable: LEV
Method: Panel Least Squares
Date: 05/11/15 Time: 14:46
Sample (adjusted): 2006 2013
Periods included: 8
Cross-sections included: 298
Total panel (unbalanced) observations: 536

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0783	0.0572	-1.3679	0.1719
TANG	0.4353	0.0337	12.9191	0.0000
PROF	0.0073	0.0322	0.2275	0.8202
FSIZE	0.0191	0.0045	4.2050	0.0000
GR	0.0980	0.1173	0.8357	0.4037
TS1	0.1379	0.1335	1.0326	0.3023
COSTR	-0.0080	0.0032	-2.4871	0.0132
INVR	-0.0001	0.0821	-0.0017	0.9986
AVLEV	0.4358	0.1076	4.0500	0.0001
TAX	-0.0100	0.0113	-0.8865	0.3757
MNGP	-0.4089	0.4450	-0.9188	0.3586
COMLAW	-0.0273	0.0153	-1.7819	0.0753
PBL	-0.1382	0.0314	-4.3956	0.0000

R-squared	0.4068	Mean dependent var	0.2228
Adjusted R-squared	0.3932	S.D. dependent var	0.2103
S.E. of regression	0.1638	Akaike info criterion	-0.7561
Sum squared resid	14.0364	Schwarz criterion	-0.6522
Log likelihood	215.6340	Hannan-Quinn criter.	-0.7154
F-statistic	29.8890	Durbin-Watson stat	0.4970
Prob(F-statistic)	0.0000		

AVLEV- Median Industry Leverage; **COMLAW**- Common Law Dummy; **COSTR**- SG&A Expenses to Revenues; **FSIZE**- Log of Assets; **GR**- Change in Log Assets; **INVR**- CAPEX to Assets; **MNGP**- Dividends to Assets; **PBL**- Listed Firms dummy; **PROF**- Operating Profit to Assets; **TANG**- Tangibility; **TAX**- Effective Tax Rate; **TS1**- Depreciation to Assets

Source: created by the authors using EViews 8.1. Formatted in Microsoft Excel.

Appendix 5. Descriptive statistics: market value

		Observations	Mean	Median	Maximum	Minimum	Standard Deviation	Jarque-Bera	JB *P*-value
Debt Ratios	***Definition***								
Firm-specific determinants									
Profitability	Operating Profit to Assets	412	-0.02	0.04	1.24	-3.67	0.29	81519.50	0.00
Size	Log of Assets	412	13.30	13.31	17.12	7.78	1.84	4.13	0.13
Growth	Change in Log Assets		-	-	-	-	-	-	-
	CAPEX to Assets	412	0.07	0.03	0.87	-0.27	0.11	8061.11	0.00
	Market-to-book Assets	412	1.53	1.10	15.51	-19.49	1.85	47447.52	0.00
Nature of Assets	Tangibility	412	0.29	0.20	1.28	0.00	0.27	71.93	0.00
	SG&A Expenses to Revenues	412	0.60	0.14	16.34	0.00	1.76	29854.87	0.00
Policy and Decision factor	Dividends to Assets	412	0.00	0.00	0.31	0.00	0.02	1064282.00	0.00
Industry-specific determinants									
Industry Conditions	Median Industry Leverage	412	0.18	0.16	0.30	0.09	0.08	46.09	0.00
	Listed Firms dummy		-	-	-	-	-	-	-
Tax-related determinants									
Potential Debt Tax Shields	Effective Tax Rate	412	0.08	0.06	5.16	-9.65	0.70	157743.30	0.00
Nondebt Tax Shield	Depreciation to Assets	412	0.04	0.02	0.83	0.00	0.07	99609.40	0.00
Macroeconomic determinants									
Legal traditions	Common Law Dummy	412	0.56	1.00	1.00	0.00	0.50	68.73	0.00

Appendix 6. Comparison of theoretical predictions with data results: full sample

Determinants	*Definition*	Static Trade-off Theory	Dynamic Trade-off Theory	Pecking Order Theory	Data
Firm-specific determinants					
Profitability	Operating Profit to Assets	+	-	-	-
Size	Log of Assets	+	+	-	+
Growth	Change in Log Assets	-	-	+	-
	CAPEX to Assets	-	-	+	-
	Market-to-book Assets	-	-	+	-
Nature of Assets	Tangibility	+	+	-	+
	SG&A Expenses to Revenues	-	-	+	-
Policy and Decision Factor	Dividends to Assets	+	+	-	-
Industry-specific determinants					
Industry Conditions	Median Industry Leverage	+	+	?	+
	Listed Firms Dummy	?	?	?	-
Tax-related determinants					
Potential Debt Tax Shields	Effective Tax Rate	+	+	?	-
Nondebt Tax Shield	Depreciation to Assets	-	-	?	+
Macroeconomic determinants					
Legal Traditions	Common Law Dummy	?	?	?	-

Appendix 7. Comparison of theoretical predictions with data results: period breakdown

Determinants	*Definition*	Static Trade-off Theory	Dynamic Trade-off Theory	Pecking Order Theory	Data
Firm-specific determinants					
Profitability	Operating Profit to Assets	+	-	-	-
Size	Log of Assets	+	+	-	+
Growth	Change in Log Assets	-	-	+	+
	CAPEX to Assets	-	-	+	-
	Market-to-book Assets	-	-	+	-
Nature of Assets	Tangibility	+	+	-	+
	SG&A Expenses to Revenues	-	-	+	-
Policy and Decision Factor	Dividends to Assets	+	+	-	-
Industry-specific determinants					
Industry Conditions	Median Industry Leverage	+	+	?	-
	Listed Firms Dummy	?	?	?	-
Tax-related determinants					
Potential Debt Tax Shields	Effective Tax Rate	+	+	?	-
Nondebt Tax Shield	Depreciation to Assets	-	-	?	-
Macroeconomic determinants					
Legal Traditions	Common Law Dummy	?	?	?	-