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GREEN BOND ISSUANCE: AN EVENT STUDY TO ASSESS DEBT INSTRUMENTS'IMPACT ON ECM

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Abstract in italiano

Ll presente elaborato tratta il fenomeno delle cosiddette obbligazioni verdi, dall'inglese "green bond", ovvero obbligazioni legate a progetti con un impatto positivo nei confronti dell'ambiente. Il tema è stato scelto poiché seppur in fortissima crescita, si tratta di uno strumento finanziario relativamente nuovo nel contesto dei mercati azionari. La ricerca presentata può quindi essere divisa concettualmente in due parti, ovvero una prima parte dedicata alla presentazione del fenomeno in tutti i suoi aspetti con un constante riferimento alla storia degli studi e una seconda parte invece sperimentale che ha avuto come obiettivo quello di misurare l'impatto delle obbligazioni verdi sul mercato azionario. Nel primo capitolo viene presentata un'introduzione al fenomeno dei green bonds nel contesto sociale, economico e legislativo. Per quanto riguarda il contesto sociale, vengono spiegate le implicazioni etiche che hanno portato all'emissione delle obbligazioni a impatto sociale (Social Impact Bond - SIB) e quali sono le caratteristiche che le distinguono dai bond tradizionali. All'interno di questa macro categoria vengono poi individuate le obbligazioni verdi, delle quali viene descritta la loro storia sui mercati finanziari dagli esordi, passando per il mercato attuale e prospettando la loro evoluzione nel tempo. Il capitolo si chiude con uno sguardo alle certificazioni internazionali delle obbligazioni verdi, in maniera tale da avere un'idea anche sul loro inquadramento a livello istituzionale. Nel secondo capitolo viene spiegata la metodologia adottata nella ricerca sul campo. La spiegazione del metodo utilizzato è anticipata da una breve descrizione dei principali metodi di indagine che sono stati adottati nel corso della storia degli studi per spiegare come un particolare evento possa influenzare i mercati azionari. Questo capitolo è immediatamente seguito e connesso al terzo capitolo, consistente nella presentazione dei campioni analizzati. I campioni sono dettagliatamente analizzati poi nel quarto capitolo, in cui si è cercato di dimostrare il legame positivo che intercorre tra l'emissione delle obbligazioni verdi e il rendiconto al rialzo sulle azioni delle società che le emettono. I risultati ottenuti vengono poi confermati nel quinto capitolo, tramite l'utilizzo di test incrociati e il modello di regressione. Infine il sesto capitolo chiude il quadro della ricerca cercando di spiegare le motivazioni alla base dell'impatto positivo delle obbligazioni verdi sul mercato, prendendo in rassegna una serie di casi concreti a livello mondiale. In particolar modo, per questo capitolo conclusivo sono stati analizzati tre fattori, ovvero il rapporto che intercorre tra la divulgazione sociale aziendale e l'emissione delle obbligazioni verdi e la presenza di figure azionarie specializzate solo nell'economia verde. Nel settimo capitolo ed ultimo capitolo di ricerca vengono presentate tutte le tematiche di applicazione della tesi e che potrebbero essere analzzate sulla base di questo studio. Le conclusioni invece riassumono l'operato della tesi e confermano il raggiungimento delle risposte alle domande di ricerca.

Abstract in english

L his thesis deals with the phenomenon of the so-called "green bonds", which are bonds issued explicitly for the development of environmental projects. Green bonds are a relatively new financial tool in the context of equity markets and they have a high growth rate. The research presented can, therefore, be divided conceptually into two parts. A first part dedicated to the presentation of the phenomenon in all its aspects with a constant reference to the history of the studies. A second experimental part which has the objective to measure the impact of green bonds on the nowadays stock market. In the first chapter, green-bonds are presented in their social, economic and legislative context. Regarding the social context, an introduction to the Social Impact Bonds (SIB) is provided, describing which are the characteristics differing them from traditional bonds. Within this macro category, the green bonds are then identified. Thus it is presented green bonds' history on financial markets from the beginning, passing through the current market and prospecting their evolution over time. The chapter is further enriched with a look at international certifications, in such a way as to have an idea also of the institutional classification of green bonds. The second chapter explains the methodology adopted for the market research. In this chapter, it is also provided with a brief description of previous research methods, theorised along the history of the studies to explain how a particular event can influence the stock markets. This chapter is immediately followed and connected to the third chapter, consisting of the presentation of the analysed samples. Samples that are examined in detail in the fourth chapter, in which it is demonstrated the positive relationship between the issuance of green bonds by certain companies and the general price increase of their shares. Results obtained are then confirmed in the fifth chapter, through the use of cross-tests and the regression model. Finally, the sixth chapter closes the research framework explaining the motivations behind the positive impact of green bonds on the market, reviewing a series of worldwide samples. In particular, for this final chapter three factors have been considered, namely the relationship between Corporate Social Disclosure (CSD) and the issuance of green bonds and the appearance of specific shareholders investing just in the green economy. The seventh chapter highlights all the possible contexts in which the research study could be applied and in which directions possible future research could be done. The last chapter is the concluding chapter in which is summarised the facts discovered and the answer to the research questions.

Executive summary

This document aims at introducing the reader to Green Bonds, a relatively recent phenomenon which is attracting investors' interest for the benefits it brings both concerning financial returns and tax exemption and last but not least for the contributions they give in the environmental preservation.

To better understand the quantitative impact this security may have on issuers, this document presents a further in-depth analysis of the correlation between Green Bonds' issuance announcement and share returns of the issuers in the stocks' market.

The first chapter presents the general concept of Social Impact Bond ("SIB"), defined as "an instrument which pays investors economic returns which in turn are generated by non-profit or social organisations whose scope is to contribute to a social issue".

SIBs should produce by definition a socially desirable outcome by raising funds from financial investors and reimbursing them with the proceeds are granted by the public administration, following the reach of their objectives.

With the same purpose to make use of finance to generate a positive impact on a social issue, but with an entirely different contract structure, Green Bonds have been launched on the markets in 2007/2008.

These securities have the same financial structure of other corporate bonds (principal, maturity, coupon, yield, credit quality and they are traded in regulated markets) but they differ in the purpose of their issuance. Indeed, a bond to be considered "Green" must bring a positive impact on the environment, through financing either renewable energy sources or energy efficiency measures.

Therefore they can be used to finance projects in all the industries and the world's markets, in general where an improvement in energy efficiency can be obtained.

Their success has started in 2013, when some economies, such as the United States and the United Kingdom, recovered from the Global Financial Crisis and investors' appetite in financial markets raised to the pre-crisis levels.

Over a three years period, from 2013 to 2016, the market value of Green Bonds passed by €10bn to €80bn showing the incredible attractiveness of this instrument (see the graph below to a have a further geographical reference).

Due to this incredible success, it has been necessary to define standards to better describe the use of proceeds and other characteristics of Green Bonds; thus Climate Bonds Standards were introduced as part of an initiative aiming at contrasting global warming.

According to official estimates of the Climate Bond Initiative, 2017 full year total Green Bonds issuance totalled \$130bn, an increase of c. 63% compared to the \$80bn previous year issuance. This growth is mostly due to emerging markets, especially China, where the transition from a carbon economy to cleaner energy sources is taking place.

Moody's identify the most significant opportunities from China since 2016 the issuance from China represented 70% of the total emerging market issuances.

As aforementioned the second part of this document aims at developing a statistical analysis to demonstrate a relationship between the announcement of the issuance of a



Fig 0.1 Green Bond issuance by region (Climate Bonds Initiative/Green Bonds initiative 2016, Jan 2017)

Green Bond and the market price of the issuer company's shares.

In other words, are shareholders valuing the issuance of these securities positively? In order to answer this question in a reliable way, in chapter two event study methodologies are introduced as the basis of the analysis developed.

The approached used is the Fama, Fisher, Jensen and Roll (1969), which is still broadly recognised as one of the most effective methodologies.

Chapter 2 guides the reader through a general application of this methodology, with a detailed description of the single steps used in the case:

- Selection of a restricted dataset of the shares, on which the effect of the event is assessed, and a temporary window called "*event window*"
- Definition of an "estimation window"
- Calculation of the abnormal returns
- Evaluation of the CAR, as the sum of each abnormal return of each day in the *event window*
- Measurement of the statistical significance

These steps are described herein from a theoretical rather than a practical perspective since the aim is to introduce the reader to the general theories underlying the model. The reason hap this gives i partische auster finnen to Pho de loud akiember abno constitution prosenting 6 hencedifferentateohollesegiestruhielntsaonbehædshætedprigeeofothe itompanies issuing them could Aane bgethesen sistehodolly sites, that for a state of the Market Model as the Interesting is non-son the though position estimates the palan explained in this abaptic through a series This reakthown as by issual open dem, reform this try tand geographiad the general return of Firstly, the enackges athat the period and executive genty be the size in a large the size of the size triennstoon 2018 t2@177,avkbtlptingofiothepresentfeddoivenesserketthedexalysis since the recent birth Fotheyshandescriptio(grafpth above ullative admonsted over of a calculat Bornals d almost e), gives a Secondiglimona of other biowd of it the field to fit the field to fit the second to fit the field to fit the fit of the tions; Finallybet as spredensed or desvalping nup firthe contaitistical beached of adjustates and atoget if the The resignificanchiofwakicgmulative abound in returning and the sample dissertions that according is. weath The Uchaptions not high talavayes empacion ten the shows the firm and a pital acce the Naturalsdistespeos chosed by isito dreiddanga negyessifarti, havderstdoet plain advensed at idirdat ween impacthensforckscial versus and the thorse falled & Giricest i Variable and the affrict i Hardy there is is volt on the eds of argumebond is green influences the issuer's stocks returns in the market). FinallByggeredingngetheraphiSallowdelsureforethere is amplde, the the advertised substantional which percenetagiaions seccoritidation elemeterin textos tratea bear and, thad statistica Farsthan first norderlying ses, this issume to more mature financial markets, and specifically for Europe, this concerned will address a contraction of the terms the data to it with the address of the astriance which of a details and be the manised on the stand, a detail of the second stand stand of the second stand stand of the second stand stand

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for Green Bond and conventional bonds are significantly different each other. Finally, the t-tests show that the effect is different considering different time periods around the event date, and it is substantially different from zero just for (-1;2) and (-2;+2) time limits. The results of the t-tests made necessary the estimation of a regression model to understand which are the real factor that influences the stock's price in the days around the event. The parameters considered as independent variables to perform the regression model are related both to the issuer characteristics and to the bond ones, while the dependent variable is the CAR value only for the two significant time periods. The main point of attention is related to the dummy variable "Green", which indicates if the bond has or not the Green label. To perform the regression model, R is used, and RStudio is the platform that allows the computation of the data. The first regression model considered is a simple OLS linear model. It indicates a low significant impact for the Green variable and for just one period. To check the validity of the results obtained, the Autocorrelation and the Breusch Pagan tests are computed, the last one showed the presence of heteroscedasticity which biased the previous model. To solve it, it was decided to choose another model, the Weighted Least square model. This model, in fact, weights the impact of the residuals making constant the variance of the error term. The same previous tests are re-performed, and in this case, no problem was found. The analysis on the WLS model demonstrates a significantly positive impact of the green variable. This result means that the markets positively receive the Green Bond emission. The last analysis performed was an ANOVA analysis which stated that there is not any significant adjustment given by a model which consider the combined effect of the variables.

After the analysis, the research study drives the reader in the sixth chapter. This chapter, based on the previous one's results, explains the possible reasons behind the positive reaction of the market at the announcement of a green bond emission. Three possible explanations are founded out. The first one is related to the CSR and the disclosure of information. The market reacts positively to the disclosure of information and moreover tends to give a premium for the social/ecological investment. At the same time, the process that brings a bond to receive the green label is a lengthy and expensive assessment. This furnishes to the market the guarantee that the Green Bond effectively has a green project as the underlying project. The second reason is linked to the attractiveness of the Green Bond and the Green trend that is also affecting the financial world. In fact, it is demonstrated that a green bond instrument is attractive on the financial market also for the no traditional investor due its green nature. The conscious ecological investors bring more capital to the financial market but they drive the entire stack on the green investment, and green bonds are this kind of investment. Moreover, to enhance the ecological transformation and to reduce the carbon emission, the governments grant lower taxes for green investments and it increases the appetibility of the Green Bonds all for the traditional investors, which are also interested for the lower intrinsic risk compared to a standard bond. The last reason is related to the lower cost of funding. It is demonstrated that the green bonds provide lower yield respect to a comparable standard bond. This is explained by the massive asymmetry between offer and demand. The demand is exceptionally high for green bonds for the foregoing reasons, but at the same time, the offer is sharply limited. The shortage in supply is justified by the long and expensive assessment process which check the greenness of the underlying project and then provide the green label to the bond. This gap between offer and demand allows the issuer to furnish a green bond with a low yield on the primary market, but it is still convenient for an institutional investor who could resell them on the secondary market. In fact, also on the secondary market, the demand for a green bond is extraordinarily high, and it is demonstrated that the market price of green bonds strongly increases in the first 28 days of trading.

Summarizing, the high disclosure of information, the high quality of the assessment, and the attractiveness of the green bond as a green investment increase the demand on the investors' side. Thus the issuer company could furnish a green bond with a yield lower compared to the standard bond's average, receiving fund at a lower cost.

The last chapter of the Thesis is focused on the potential future development. Firstly, it is suggested to continuously update this research to take into account the longterm effect of a green bond emission. Following it is recommended to consider the green bond under a portfolio optimisation strategy point of view to understand how to capture the value at the issuance. The last point of interest is the greenwashing phenomena, which could be a huge threat to the green bond market and it must be fight fixing an unique green certification.

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1. Introduction

1.1 Social impact bond: a recent development

There are some social problems that governments all over the world have consistently find difficult to address, such as children in care, homelessness, youth unemployment or long-term health issues. Traditional models have failed to deliver the innovation and focus upon results needed to make inroads with these issues. Social Impact Bonds (SIBs) bring together the public, private and voluntary sectors to solve these challenges by having a clear and relentless focus on delivering the outcomes we want to see.

A Social Impact Bond (henceforth, SIB) has the peculiar characteristics that it is a pay-for-performance contract, which involves more parties and that pays investors economic returns which in turn are generated by non-profit or social organisations. Basically, the mechanism implies that governments or private entities pay for the results of projects which guarantee a socially desirable outcome and allow public bodies to save money in the long term. That is mean that if a project involving the people in the detention centres over to our society has a positive outcome, then the public administration will spend less money in managing criminality and prisons. Investors (private individuals, institutional investors and so on) initially funded through a SIB a non-profit organisation that presents a project with the right characteristics to be included in this sample.



Pay for Success Financing Tool

Fig 1.1 Stakeholders'cycle

Finally, if the social outcomes are achieved, the governments or private entities initially involved in the transaction pay the investors for an amount equal to the initial investments plus interest in taking the risk.

Examining more in details the differences between a traditional bond and a SIB, it is possible to see how the latter presents some limitations that make them a less attractive instrument for an investors perspective:

- They are private contracts
- They lack standardisation
- They have limited accessibility
- They also have limited liquidity compared to a traditional bond
- They lack transparency
- They lack consistent market data

What emerges is that social impact bond are less attractive instruments and one could ask why they have to be promoted. The ultimate attractiveness of these instruments is that they can replace more and more the individual tax mechanism in the definition of the public goods financing. If SIB will replace traditional ways to finance public goods and social projects the gain will be as much for the Governments as for the private individuals which can benefit from a more reliable and efficient social system.

1.2 Introduction to green bonds

Over the last decades, global warming has become an issue of increasing importance, pushing governments all over the world to find a solution leveraging on engineering solutions and scientists. Green Bonds might be thought of as a form of SIB, aligning the interest of investor in green project to the desire to enter in the Fixed Income market. There is no universal definition of a "Green Bond", from a financial perspective they are equal to traditional bonds, with a coupon, a maturity and a YTM, but they benefit from higher visibility in terms of social impact since the use of their proceeds is relevant to climate or environmental purposes. In other words, this kind of security aims at financing investments in renewable energy, energy efficiency, climate-friendly projects, delivering a practical solution to global warming ultimately. It should be noted that from a legal perspective, a "Use of Proceeds" Green Bond is a traditional senior debt obligation of the issuer that pays a coupon but it is distinguished by the specificity of the use of proceeds (focused on environmentally friendly projects).

It is possible distinguish four main types of green bonds:

- Use of Proceeds Bond traditional debt security the proceeds of which are earmarked for use in advancing certain eligible investments
- Revenue Bond non-recourse to the issuer; the credit exposure is to pledged cash flows of the revenue stream. Proceeds are ring-fenced or tacked by the issuer and tied to the issuer's investments in the project
- Project Bond for single or multiple projects, where the investor has direct exposure to the project
- Asset-Backed Bond collateralized by one or more specific projects

1.3 Development of the green bonds market

The Green Bonds have started to be developed in 2007/2008, when supranational entities, such as the European Investment Bank and the World Bank, began to issue these securities with proceeds would have been used to fund climate or environmentally friendly projects. Since that time the market has started to change, and issuers have begun to engage in this type of transaction with a size of \$1bn rather than the average initial amount of c. \$10m. Furthermore, Green Bonds have started to be issued by corporates as well, rather than only Supranational or Government entities. The following graphs show the historical evolution of the market size.



The green bond market 2012-2016

It can be noted that Green Bonds market size has rapidly grown in time, with a total volume almost doubling between 2015 and 2016. Another interesting phenomenon is that Commercial banks and Corporate are the two issuers categories which have grown fastest. From a geographical perspective, as we can see in the following table, the latest years have seen Asian counties to issue more bonds of this category.



Green bond Issuance by region

Finally, it is important to see which are the use of proceeds of the Green bonds, to understand in which fields these instruments have reached the highest results. The following graph shows that energy is the main industry, according to the recent shift to renewable energy and energy efficiency in power plants.



Fig 1.3 Green Bond issuance by region (Climate Bonds Initiative/Green Bonds initiative 2016, Jan 2017)

At the same time Building energy management has seen rapid growth in attractiveness, representing one of the main fields of improvement to be aligned to the international treaties to save energy (i.e. Kyoto Protocol). Transportation follows immediately since energy optimisation in this industry is another issue to be faced and a field where many governments are investing money. The fact that the use of proceeds is more and more spread across the different sectors is an index that the "Green Transition" is taking place in different form and industries.

1.4 A key point: strandards definitions and their evolutions

Since the market has grown, it has become more and more important to be able to enhance disclosure and transparency of this security. In particular, due to the importance of the use of proceeds, investor ask for more detailed and disclosed information on the green effort. To this purpose, in January 2014, The Green Bonds Principles have been defined by a co-authored paper by BAML and Citi. These principles were not intended to be a strict definition, but rather to be viewed as a good practice to follow voluntary and designed to provide some guidance for the issuers in relation to:

- Use of proceeds: what can distinguish a Green Bond from another bond category is the use of the proceeds are collected when the security is issued. Under the Green Bonds Principles, the categories of projects potentially eligible are:
 - Renewable energy
 - Energy efficiency
 - Sustainable waste management and land use
 - Clean water and water treatment
 - Biodiversity conservation
 - Clean transportation
- **Project evaluation/selection:** this is one of the main points to be improved and undoubtedly the one which has been interested in the research. A framework describing the project has to be fulfilled, and issuers of green bonds may (or may not) decide to post the framework on their website. There is

even the possibility to obtain a second party opinion or certification, but there are no strict requirements to respect. Some issuers have engaged outside parties, such as Vigeo (an ESG rating agency) or DNV or CICERO, to write an opinion about the issuer's "framework".

- Tracking the proceeds: the issuers have adopted various practices to track the use of proceeds and monitor the effectiveness of the project. The Principles suggest (and do not make mandatory) the issuer disclose the process of assessing and tracking the proceeds. For added assurance, the issuer can have the tracked proceeds verified by an independent third party such as the issuer's auditors. "Attestation" or "verification" usually will require issuer to enter into an engagement letter with the auditors according to which the issuer and auditors will agree on the scope of the work, the work product (attestation letter or other), and how that information can be used or shared with third parties.
- **Reporting:** issuers can increase the transparency by publishing periodic reports which disclose their progress in using the proceeds. One may ask if the lack of a general and universal taxonomy represents an obstacle to the Green Bonds market growth. The answer is not and the numbers confirm this hypothesis: the investors demand remains robust in most of the regions of the world. The two countries where the introduction of some general principles contributed more in the market growth are China and India, where the introduction of guidelines in 2016 contributed to the most significant increase ever in the global Green Bonds market.



Fig 1.5 Green bond issuance by time (Moody's investor service/ Green sector global, Nov 2017)

1.5 2016, A year of fundamental achievements

In 2016 a new version of the Climate Bonds Standard (Version 2.1) has been published, and the reason is the continuously growing underlying market. The main additions in this version were the expansion of the range of debt instruments that can now be certified under the Standard (such as Yieldcos and Sukuk) as well as a Programmatic Certification option that will streamline the verification process for regular issuers with large portfolios of eligible assets. The Programmatic certification aims at facilitating the process of recognition of the available projects. In 2016 new Sector Criteria (Transport, Geothermal and Water) were finalised. It has been issuance guidelines became more common in this year, with India, Brazil and Morocco following the Chinese lead of 2015.

1.6 Latest developments and future trends

According to the official estimates, the 2017 full year total Green Bonds issuance totaled \$130bn, an increase of c. 63% compared to the \$80bn previous year issuance. The main rating agencies see a vast potential for Green Bonds relative to emerging markets: the number of issuances in these countries is increasing and the 2018 full year will see further growth, underpinned by ambitious climate and sustainable policy agendas and multilateral support for market development. Another area that will see an additional development is the Ile-de-France, where many French companies (Credit Agricole firstly) and Sub-sovereign entities are engaged in an increasing number of this transactions. Finally, rating agencies see many possibilities of growth, since climate and environmentally friendly policies are undertaken all over the world.

Many countries continue to enhance or develop sustainability policies in line with their commitments under the United Nations Framework Convention on Climate Change's 21st Session of the Conference of Parties (COP 21) in December 2015 or continue to refine them to make them more globally applicable. The European High-Level Expert Group (HLEG) on Sustainable Finance is seeking to create a green bond taxonomy appropriate to the European Union to help harmonise standards and accelerate the market in the EU. In China, the China Securities Regulatory Commission (CSRC) released new guidelines on the issuance of green bonds in March 2017 that added to other standards issued by the People's Bank of China and the National Development and Reform Commission. Taken together, these standards have spurred green bond issuance in China. The

Green Finance Committee (GFC) of the China Society for Finance and Banking and the European Investment Bank (EIB) are working together on enhancing the consistency of green finance definitions and standards between China and the EU. In India, the Securities and Exchange Board of India (SEBI) released green bond guidelines in May, and India has now issued \$5.4 billion of green bonds2 with a robust pipeline expected to follow, according to the Climate Bonds Initiative.

There are many different opinions on the future trends and developments of the Green Bonds market, but it is believed that the most exciting opportunities are in the emerging markets. Specifically, Moody's identify the greatest opportunities from China, since 2016 the issuance from China represented 70% of the total emerging market issuances.

1.7 Ultimate benefits in issuing green bonds

By issuing green bonds, corporates not only acquire a new source of capital, but they also invest in the environmental standard of their business. This can have a direct financial benefit by reducing operational costs--for example, reducing energy bills through energy-efficiency measures. It also demonstrates improvement when making environmental disclosure requirements. Some of these environmental disclosures are optional, such as those pioneered by the Global Reporting Initiative. Despite the fact that these bonds face some additional transaction costs (issuers must track, monitor and report on the use of proceeds) they can bring many advantages to the issuers. Indeed, by issuing this security, it is possible to offset this initial cost with the following benefits:

- Highlights the issuers' green assets/business, with benefits from the Governments incentives and higher visibility in the Corporate Social Responsibility matters
- Positive marketing story, with an impact on the shares of the companies issuing Green instead of non-Green bonds
- Diversify the investor base (as they can now attract ESG/RI specialist investors)
- Joins up internal teams to do the investor roadshow (environmental team with Investor relations and other business)

Finally, the increasing size of the market and the positive expectations on this security makes the Green Bonds attractive and innovative instruments. This paper aims at in-

troducing the literature regarding the phenomena and explaining a possible correlation between the issuance of Green Bonds a positive result in the market of the company issuing them.

1.8 Green bonds in Italy

In Italy, Borsa Italiana is the entity which takes care of defining standards to promote the definition and the spread of the Green Bonds. It has been observed that the definition of the use of proceeds has increasing importance in defining the investors' decisions. Borsa Italiana has provided in the last year a list of the Green and/or Social Bonds currently traded in the MOT and Extra MOT markets. The identification is made through the initial certification of a third party independent entity and the annual renewing of the information package relevant to their use of proceeds. In 2017 Enel S.p.A. has launched on the ExtraMOT PRO the biggest Green Bond at a corporate level in Europe, with a nominal value of €1.25bn and a coupon of 1%. Since 13th March 2017, a new segment dedicated to Green and Social Bond has been launched on MOT and ExtraMOT.

1.9 Green bonds certifications

Green Bonds have become very popular in recent years. The reason is perhaps to be found in the new green policies, which promote the destination of investments through projects helping lower global carbon emissions. Nevertheless, it is still difficult to see a commonly accepted definition of what a green bond is. This is especially true when dealing with certifications. In other terms, how can we be sure that these bonds are really "green"?

According to Ehlers and Packer (2016: 1, 2017: 89), there is still not a precise idea of what could be meant as "environmentally beneficial" investments. More and more often, however, certificates are issued indicating the "green" attitude of these bonds. Nowadays there are in fact many forms of certifications, which differ one another in their degree of granularity, their post monitoring impact and the use of more or less technical tools. At any rate, the key common point beyond these certifications is that of proving that those

bonds are expressly made for green projects. Before mentioning all different types of certification, we should first specify that each certificate follows a set of guidelines. Guidelines differ depending on the geographical area, but we still can identify two main criteria. For the European Union guidelines are defined by the ICMA Green Bond Principles (henceforth, GBP). These principles were outlined by some private financial institutions under the guidance of International Capital Markets Association (ICMA). Basically speaking, these consist of four principal points:

- 1) A green bond should promote an environmentally sustainable project.
- 2) The project to be financed should be reviewed under a specific process.
- 3) Green bonds should be tracked and verified.
- 4) There must be an annual reporting specifying the use of these bonds.

GBP also recommend to opt for external verification, choosing among one of the three criteria:

- 1) Second party review, namely a consultation within the private sector.
- 2) Third-party verification of the entire process to make it public.
- 3) Thirst party certification by experts in green economy.

For the Asian market, guidelines are provided by the Green Bond Endorsed Project Catalogue (CBEPC), created by China's Green Bond Finance Committee. As far as known, both systems are still not harmonised one another. Regarding the different types of known certifications, these could be divided into three main groups. The first group is composed of the certification issued by the Climate Bonds Initiative (henceforth, CBI). In the second group are enlisted a series of certifications issued by stock indices. The third group is instead dedicated to those certifications issued with the assistance of external reviewers, which are usually rating agencies, industries working with environmental solutions, and academic institutions (ICMA 2015, 2016; VV. AA 2016: 5; Ehlers, Packer 2016: 3, 2017: 92-94) (*Fig 1.6*).

Characteristics of	different green	bond identification	and certification schemes
	0		

Moody's Green Bond Assessments	Standard & Poor's Green Evaluations
Voc	
res	Yes
	Yes
Yes	
Yes	Yes
Yes	Yes
	Yes Yes Yes Yes

¹ Bank of America Merrill Lynch, Barclays MSCI, Standard & Poor's and Solactive.

1.9.1 External Reviewers Certifications

This certification was introduced by the BCI. This organisation has launched a specific standard helping issuer to obtain the certification. This consists in a third party verification of the CBS standards before the CBI issues the certificate. The reason for this dual control lies in the fact that bonds included in the CBI database and labelled as "green", but this does not mean they follow low carbon values (Ehlers, Packer 2017: 93). The certification process has two phases; the pre-issuance and the post-issuance phase (*Fig 1.7*). In the pre-issuance period, the issuer sends to the CBS Secretariat three documents: a form with all information about the nature of the bond, a report by a third party reviewer, and the Certification Application & Agreement legal document. When the documentation is accepted and reviewed by CBI, the third party reviewer must confirm that the bond conforms with the post-issuance requirements, producing another report. This report is thus sent to CBS Secretariat, if this is accepted, then the bond obtains a permanent certification (*www.climatebonds.net*).

1. Pre-Issuance Certification

Issuer prepares for Certification	Verifier undertakes readiness assessment	Issuer submits updated Info Form & verifier report to CBI	Standards Board confirms Pre-Issuance Certification
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2. Post-Issuance Certification



Fig 1.7 Climate Bonds Certification Phases (www.climatebonds.net)

1.9.2 Green Bond Indices Certifications

These certifications are issued by international indices. These indices label bonds as green and guide investors towards a portfolio of green bonds in order to diversify the risk. Green labels for the western countries could be assigned by the Bank of America Merrill Lynch, Barclays MSCI, Standards & Poor's and Solactive. Every index uses its methodology. In China labels are instead decided by the Shanghai Stock Exchange, the China Securities Index Co, the Shenzhen Securities Information Co and the International Institute of Green Finance (Ehlers, Packer 2016: 4, 2017: 93-94).

1.9.3 External Reviewers Certifications

Sometimes certifications are issued following the Green Bond Principles and thanks to the use of "second opinions" parties. These are independent institutions usually working on environmental projects acting as external reviewers. This allows a more balanced, objective, and "greenness" evaluation of the bond. (Ehlers, Packer 2016: 4). Apart from some international consulting companies such as, Deloitte, EY, KPMG, Oekom, Sustainalytics, and Vigeo, the most known reviewers are:

- *CICERO Second Opinions:* this certification is issued by CICERO, a climate research institute based in Oslo, Norway. This reviewer evaluates bonds upon request both in the selection of the project and in the investment. In each certification, it is indicated the level of "green" attitude of the bond and the project, based on scale up to three "shades of green". The more the bond support a long-term low carbon project, the more the grade rise (Cicero 2016, Ehlers, Packer 2016:4, 2017: 94).
- Moody's Green Bond Assessments: The Green Bond Assessments (GBAs) estimate the possibility that those bonds are effectively meant for a green project. The green label is assigned considering five key areas with different weights. For instance, 40% of the decision is based on the final use of proceeds, 15% on the quality of the organization (qualified personnel, estimation in the sector, etc.), 15% on the mangement of proceeds (general accounting, cash balances, etc.), 10% on the disclosure on use of proceeds, i.e. project's results and impact, and 20% on the reporting of the results. Together with these criteria, the choice is also based upon macroeconomic and financial market factors (Moody's Investors Service 2016; Ehlers, Packer 2016:5, tab. 2, 2017: 93-95, tab.2).

- Standard & Poor's Green Evaluations: the certification was introduced in 2017 and evaluations assign a score between 0 and 100 to evaluate a technical environmental impact. Regarding factors contributing to the issue of this certificate, a weighted of 60% is given to the environmental impact of the bond, 19% for its governance in terms of selection of project and its management, 6% for the preventive measures in order to prevent the use of that bond for other purposes and a 15% for the transparency of the whole procedure (Standard & Poor's 2017; Ehlers, Packer 2017: 95-96, tab.2).
- *The Carbon Trust Green Bond Certification:* this certification is issued by the Carbon Trust, a company of independent experts whose mission is to accelerate the transition to a suitable, low carbon economy. The company can provide an impact assessment and a report through a review of the sustainability of the project, of green impact of the bond and, the ability to track the green elements of the entire process (*www.carbontrust.com*).

2. Methodology

2.1 A brief introduction to event study methodologies

In this chapter, we will discuss all the *event study* methodologies that were developed across the year to analyse the impact of a particular event on the stock's value and how these kinds of event could generate an abnormal return (AR) on the shares' trading value.

The first analysis of *event studies* was provided by James Dolley (1933), but the more recent methodologies are based on the studies of Fama, Fisher, Jensen and Roll (1969). Their analysis combines the evaluation of potential abnormal return following a specific event but structured methodology concerning the use of statistical tests to verify the hypothesis of the presence of AR.

Following these studies, an important contribution was provided by Brown and Warner (1980-1985). In their two papers, Brown and Warner show the main *event study* tools. In particular, in the first one they worked on a data sample on a monthly basis (1980), in the second one, instead, their analysis was done on a sample based on daily data (1985).

2.2 Event study methodologies

An *event study* is always associated with the hypothesis that an event could influence the value of a target company, combined with the assumption that the effect of the event is immediately discounted on the stock's price. In particular, this impact is shown by an abnormal return of the shares' price (positive or negative).

In a complex context composed of firm's choices and market factors, it is largely necessary also to understand the magnitude of what we call *unrelated factors* which could undermine

the final output of study. So it is fundamental to be careful on the right decision of the benchmark or a model to evaluate the average return in order to get a successful *event study*.

The *event study* methodologies are based on the efficient market hypothesis and on the fact that price of a share should reflect the actual value of the future cash flows of the company. According on these hypothesis, the success on *event study* increase in the situations in which:

- It is difficult that the market may have anticipated the event's information;
- The event's informations is well defined;
- The announcement date of the event is event recognisable;
- It is possible to keep separate the event effect and the unrelated factors effects.

Nowadays, the Fama, Fisher, Jensen and Roll (1969) is still the approach used in the *event study*. Even now, indeed, the analysis is based on the valuation of the average and cumulative average of the abnormal returns in the days following the event considered. The main difference has been done to this methodology is the use of *intra-day* share's prices instead of using the monthly data.

In general, the application of this methodology could be synthesised in just five points:

- I. The first step is the selection of a restricted dataset of the shares, on which the effect of the event is examine, and a temporary window called *"event window"* during which the event is studied. Generally, the *"event window"* starts just few days before the event, to consider the possibility that the market has already anticipated the effect of event, and last until few days after the event in the case the market has not discounted the event in just one trading day.
- II. The second step is constituted by the definition of another short window, called *"estimation window"*. This time period comes before the *event window* and it is fundamental to estimate the normal returns. In particular, it allows understanding the correlation between the market reference and the stock, considering the market model.
- III. In the third step, the calculation of the abnormal returns is done as the difference between the share's effective return and the share's expected return. This is due to clean the stock performance from the market one.
- IV. This following step gives the opportunity to evaluate the CAR (cumulative abnormal return) as the sum of each abnormal return of each day in the *event window*.

V. The last step considers the statistical significance of the results above. In this phase, the results are check through statistical tests. If the tests show that there isn't any statistical importance, this means that the event doesn't change the stock's value significantly or it could mean that the change in value is not explain by the event. On the other hand, if the tests have shown a significance, this means that this kind of event influences the stock market and so it has an economic relevance.

In the following paragraph, each steps above will be explored.

2.2.1 "Event window" and sample selection

This first phase plays a crucial role in the success of an *event study*. Firstly, it is essential to check the validity of the efficient market hypothesis listed above. As we know, the share's value is always influenced by the information in circulation, so an underlying fundamental assumption is that the information related to the event are not disclosed before the event has happened. In fact, if this information circulates before the event, the effect on the share will be diluted in a progressive way, making impossible to recognise a clear impact of the event analysed.

A second consideration is related to the share's value turbulence due also to continuous portfolio rebalancing. This means that an abnormal return to being considered economical significant must be strong enough to be recognised among the market noise.

A last important observation is relative to the possibility to isolate the event, which we are analysing, from other factors or events. This is important because if these "unrelated" risks are not isolated, the analysis will address the abnormal returns to the event considered and not to the "unrelated" ones, biasing all the study. For this reason, it is so crucial to fix a good *event window* which is uncontaminated by "unrelated event".

After having chosen the event of the study, the next step is the sample selection on the basis of what it's written above. Another consideration about the sample selection is the importance of firm's characteristics. In fact, firms with different features could react in a completely different way to the same event. In particular, the reference is to the difference in terms of size and industry.

The following phase regards the definition of the *event window* on which the effect of the event is studied. Usually, the *event window* starts just a few days before the effective event, and it ends the day after or few days after the event to catch all the abnormal return

related to the reference event. Generally, a good practice is to fix a restricted *event window* to absorb the effect of the event and at the same time avoiding the market noise to dirt the performance.

Obviously, the choice of the *event window* size is also related to the kind of event considered. It is also important to consider the moment in which the event information is disclosed, in fact, if the information is diffused when the market is closed, it is important to choose as event day, the following day.

According to the size of the *event window* is possible also to classify the methodology in two different group:

- Short Horizon Event Study Methodology (SHES)
- Long Horizon Event Study Methodology (LHES)

The first class is characterised by shorter time horizon that is not above one. Indeed the LHES refers to an *event study* with an *event window* that lasts more than one year. According to Fama (1991), the SHES must be used more frequently because it is easier to isolate the effect of the event and increase the efficiency of the analysis. It is crucial to evidence that the robustness of a SHES is enough only if the abnormal return performance is concentrated in the *event window*.

2.2.2 Definition of the estimation window, the choice of the model and methods to evaluate the normal return

The next topic to be considered is the *estimation window*, a time window early before the *event window* during which the performance of the firm's stocks is compared to the market performance. Defining a right time frame is important to have a good analysis. In fact, fixing a large time span may bring to have "structural break", instead choosing for a too limited period could cause to get not significant estimations.

According to Binder (1998), it is a good procedure to choose a time frame of 200-300 days for *event study* based on intra-day data and 5-7 years for *event study* using monthly data.

In the next figure (Fig 2.1), how the event study time line is structured.



Fig 2.1 Event Study time line

As already discussed, to understand if a specific event generates a significant effect on the shares' value is fundamental to compare the stock's return during the event period with the same stock normal return.

To perform this analysis, the Abnormal Return is defined and it is evaluated as follow:

$$AR = R_{i,t} - R_{est,i,t} = R_{i,t} - E[R_{i,t}|X_t]$$

where:

AR is the abnormal return

 R_{it} is the effective ex-post return of the stock during the event period

 R_{extit} is the estimated normal return in the event period

 X_t is the conditional set of information for the normal model

As mentioned, it is not possible to get concrete data on the normal return, so it is fundamental to estimate the normal data in the event period. There are several methodologies to get the *expected return* of a share.

It is possible to identify two different categories of these approaches:

- Statistical models
- Economic models

The first category groups all the methodologies that are based on the statistical hypothesis about the stocks' return but not on economic theory. In these models, the habit is to assume that the share's returns are multivariate and normal and moreover these are independent and identically distributed over the time.

On the opposite side, the second group is composed of all the models concerning the investors' behaviour.

The need of a right choice for the *normal return* estimation approach makes it necessary to explain all the different methods. This gives the possibility to choose the best practice according to the data availability

2.2.2.1 Constant-Mean Return Model

This model implies that the average return of a stock is constant, so independent of the time and it is different for any share.

To perform this model, it is assumed that the *normal return* is equal to the average return of the stock evaluated during the time period before the event, what is defined as *Estimation Window*.

 μ_{I} is defined as the average return of the stock *i*, so the model is represented as:

$$R_{i,t} = \mu_i + \varepsilon_{i,t}$$

considering that: $E[\varepsilon_{i,t}]=0$ and $Var[\varepsilon_{i,t}]=\sigma_i^2$ $R_{i,t}$ is the return of the share *i* in the period *t* $\varepsilon_{i,t}$ is the error term σ_i^2 corresponds to the value (*i*,*i*) of a variance/covariance matrix

Brown and Warner (1980,1985) stated that this method is really simple, but at the same time, it could provide similar output respect to more complex models. The main difference between constant-mean return model and other more complex model is related to the output in the presence of "clustering". In this specific situation, this model provides lower quality results respect many others models.

2.2.2.2 Market Model OLS and Market Adjusted Model

This is the most common methods used to estimate the *normal return* of the stock. This method assumed a dependence between the return of stock and the general return of the market.

The main hypothesis is a linear relationship between the stock and the market portfolio represented by a market index.

This means:

$$R_{i,t} = \alpha_i + \beta_i R_{mkt} + \varepsilon_{i,t}$$

considering that: $E[\varepsilon_{i,t}]=0$ and $Var[\varepsilon_{i,t}]=\sigma_i^2$ $R_{i,t}$ is the return of the share *i* in the period *t* R_{mkt} is the market index return in the period *t* $\varepsilon_{i,t}$ is the error term σ_i^2 corresponds to the value (*i*,*i*) of a variance/covariance matrix α_I, β_i are the parameters of the market model as a proxy of the *normal return*

Generally, to evaluate alpha and beta, the estimation window considers the daily data from -300 to -60 or from -200 to -15 depending on event analysed.

One of the main problems with this approach is the data availability, so in many cases, the *market adjusted model* has used a sort of "restricted" version of the *market model*. In the *market adjusted model*, the expected return of the stock is substitute with the index return that is not considered constant over time.

According to this assumption, the α_I is equal to 0 and β_I is taken as equal to 1, so this approach does not require an *estimation period*. Due to several potential bias and distortions, this methodology is rarely used.

2.2.2.3 Multi-Factor Model

An alternative method is a Multi-Factor model which allows reducing the variance of the AR_{i,t} explaining in a better the variation of the *normal return*. The *market model* is a particular *multi-factor model*, but in general, there are more complex models which also explain the industrial composition of the market index.

In many cases, the real benefit of a complex multi-factor model is limited, in fact, it is obtained is just a short reduction of the variance of the AR_{it}.

Salinger (1992) gives a greater predictive ability to this approach, but at the same time, Brown and Weistein (1985) and Armitage (1995) have a completely opposite idea about that.

2.2.2.4 Dummy Variables Methods

Binder (1998) sustains to extend the *estimation window* until it also includes *event* window and so to introduce a dummy variable D_t which has 0 value for the observation of the *estimation window* and 1 for the observation of the *event window*. So the equation to be estimated will be:

$R_{i,t} = \alpha + \beta R_{mkt} + \gamma_t D_t + \varepsilon_{i,t}$

The coefficient of the dummy variables, γ_t , represent the abnormal performance of the stock *i* in the day *t*. The main advantage is to consider multiple events jointly. For example:

$$R_{i,t} = \alpha + \beta R_{mkt} + \gamma_{1,t} D_{1,t} + \gamma_{2,t} D_{2,t} + \varepsilon_{i,t}$$

where the two dummy variables $D_{i,t}$ and $D_{2,t}$ take into account two different events. Moreover, this model gives the opportunity to consider the variation of the beta market during the *event window*.

$$R_{i,t} = \alpha + \beta R_{mkt} + \gamma_{1,t} D_{1,t} + \beta_{2,i} (D_{2,t} R_{mkt}) + \varepsilon_{i,t}$$

where β_{2i} describes the change of the beta market during the *event window*.

2.2.2.5 Generalized Least Squares Methods

The OLS method assumes that the variance of the abnormal return estimated during the *estimation window* stays constant also during the *event window*. Moreover, it hypothesises the complete absence of correlation between the performance of the different stocks. Generally, these hypotheses do not hold, in fact, the stocks' return is often correlated, and the variance of the abnormal return could increase during the *event window*. To solve this issue, Collins and Dent (1984) suggest using a complete statistical approach, the *Generalized least squares method*. According to this approach, the variance of the abnormal return by a parameter sensible both to the variance of the stock and the covariance with the other shares. To implement it, it is necessary to estimate a variance/covariance matrix and then divide each abnormal return for its variance and N-1 covariance with other shares.

Moreover, Collins and Dent (1984) produce a method that allows correcting the variance of the stocks including it in the variation of the *event window*. This requires multiplying the variance for a factor ω_t obtained from the ratio between the cross-section variance of the abnormal returns during the *event window* and the variance of the abnormal return during the estimation window estimated through Generalized Least Squares. If the ratio is equal to 1, there is not any difference between the variances of the *estimation window* and of the *event window* instead if it is higher (lower) than 1, there is an increment (reduction) of the variance of the ratio.

2.2.2.6 Maximum Likelihood Estimation Methods

Due to the difficult nature of the *event data* definition, Ball and Torus (1988) suggested using a maximum likelihood estimation method which defines the *event date* as an aleatory variable.

Moreover, a maximum likelihood estimation methodology could be useful to solve a common problem related to the *event study*. Indeed, the volatility of the shares price increases during the *event window* and this could push the common tests to reject the null hypothesis (AR=0) even if it is true. This problem was solved by Boehmer, Musumeci and Poulsen (1991). Starting from a maximum likelihood estimation, they implement a new test called "standardised cross-sectional test". This test has the strong advantage to consider the variance of the share price both during the *estimation window* and during the *event window*.

2.2.3 Cumulative abnormal returns and car tests

After choosing the model to evaluate the normal returns and use them to evaluate the AR of each day in the *event window*, the next step is to compute the Cumulated Abnormal Returns (CAR). The CAR is defined as follow:

$$CAR(-t_1; + +t_2) = \sum_{i=-t_1}^{t_2} AR_i$$

where

 $(-t_1; +t_2)$ is dimension of the *event window* considered, it could vary to make more robust the analysis.

AR, are the Abnormal returns

The CAR gives a preliminary overview on the effect of the event, but it must be tested through a t-test:

$$t = \frac{\beta_1 - \beta_{1,0}}{SE(\beta_1)}$$

where

 $\begin{aligned} H_{0}: \beta_{I} = 0 \\ \text{The SE}(\beta_{I}) \text{ is the standard deviation} \\ \beta_{I} \text{ is the average of the CAR for the time period considered} \\ \beta_{I,0} \text{ is the average to be tested, in the analysis is considered equal to zero} \end{aligned}$

This test allows clarifying if the cumulated abnormal returns are statistically different from zero.

The next important test that must be important if there are different samples to be considered if the average of this samples is jointly different. This will be useful in the following analysis to discover if Green Bond and Standard Bond bring to a different reaction on the market.

The test is the following one:

$$t = \frac{\beta_1 - \beta_2}{SE} * \sqrt{\frac{N_1 * N_2}{N_1 + N_2}}$$

where

 $H_0: \beta_1 = \beta_2$

The SE is the average standard deviation of the samples.

 N_1 and N_2 are the dimensions of the samples 1 and sample 2.

The importance will be discover a difference in our sample to justify the next steps as the regression model.

2.2.4 Regression model

2.2.4.1 OLS Model

The final analysis will be conducted through a regression model. The regression model is fundamental to understand which could be the significant variable for the description of the dependent variable and the impact of each of them on the CAR value. The impact of the variable is represented by the β value, which is the parameter that explains how a change of the dependent variable influence the final value of the dependent variable. The linear model could be summarised by the following formula:

$$Y = X\beta + \varepsilon$$

The general assumption of this model are two:

- The distribution of the errors terms is multivariate normal with average zero, constant variance → Homoscedasticity
- The errors terms are not correlated \rightarrow No Autocorrelation

The assumption must be tested through specific statistical tests.

The linear model set the Ordinary Least Squares (OLS) regression to estimate the parameters, minimizing the sum of the squared error terms.

$$\varepsilon'\varepsilon = (y - X\beta)'(y - X\beta)$$

which allows to get:

$$\hat{\beta} = (X'X)^{-1}X'y$$

The OLS parameter is BLUE(best, linear, unbiased, estimator) of β .

2.2.4.2 Weighted Least Squares model

In the presence of heteroscedasticity, the OLS model is biased because the variance of the error term is not constant. The Weighted Least Squares (WLS) Model is the model aimed to solve this issue.

In the presence of heteroscedasticity and assuming no-autocorrelation, the variance-covariance matrix assumes this form:

$$\sigma^2 \Omega = \begin{bmatrix} \sigma_1^2 & 0 \dots & 0 \\ 0 & \sigma_2^2 \dots & 0 \\ 0 & 0 \dots & \sigma_n^2 \end{bmatrix}$$

If the matrix is estimated, the previous relationship is real but with the addition of a constant term:

$$\sigma^{2}\widehat{\Omega} = k \begin{bmatrix} \sigma_{1}^{2} & 0 \dots & 0 \\ 0 & \sigma_{2}^{2} \dots & 0 \\ 0 & 0 \dots & \sigma_{n}^{2} \end{bmatrix}$$

The solution, as previously said, is given by the WLS model. Chosen $W=diag(w_1, w_{2,2}, ..., w_n)$, the vector composed by the diagonal value of the weight matrix, the weighted least square estimator has this new formula:

$$\hat{\beta}_{WLS} = (X'WX)^{-1}X'Wy$$

These are the main theoretical patterns the thesis is based on. Instead of chapter 5, the implementation and the computation of the tests and regression models are shown in step by step description, in order to give the possibility to the reader to emulate the research results.

3. Description of the sample

This paragraph aims at describing details of the two main samples which represents the starting point of our analysis:

- (1) A sample composed of corporate Green Bonds
- (II) A benchmark sample of corporate bonds which cannot be classified as "Green" according to the principles explained in paragraph.

The first sample includes 405 securities, while the second 714, namely corporate bond¹, whose issuance has been announced in the period from January 1st, 2013 to December 31st, 2017. The main difference is that the first one has been obtained by setting the "Green use of proceeds" criteria in the SRCH function of Bloomberg, while the second one obtained by setting no filter for corporate bonds search and excluding the Green ones. The timeframe of issuance has been decided by looking at the historical evolution of this market and investors' attention to Green securities. By looking at graphs in paragraph (*Fig 3.1-3.6*), it is possible to see that Green Bonds market value and investments have started to increase and become significant since 2013.

For instance, by comparing the issuance both for green and non-green bonds one can observe as the issuance of green bonds started much slowly during 2013, reaching significant percentages in 2015 and 2017. That is mean that - considering the whole historical period – the Green bonds sample is more uniformly distributed among the yeas, but still most of the securities which include having been issued in the last three years. On the contrary, most of the bonds in the non-Green sample have been announced in 2017, registering a general low issuance of bonds until the 2016 year (*Fig 3.1-3.2*). In the following chapters, we will see as the reason for this considerable growth in green bonds issuance on the world market could be due to new green political and government trends.

^{1.} Our analysis has excluded government bonds in order to assess the impact on share prices of companies.

In fact, CSR disclosure regulations, the tax exemption of this type of bonds and the support of public banks, have securely stimulated the green bonds issuance. From a general point of view, there is an increase in both green and non-green bonds issuances in 2017 due to the recovery in the equity markets².



Regarding the industries of reference, where the issuers operate, we can observe a wide sectors distribution. On the one hand, non-green bonds are uniformly issued in all sectors with a slightly high percentage - about 34%- in the financial sector. The other sectors are instead uniformly distributed ranging from 13% and 5%; only the utilities sector is underrepresented. The financial sector is the most attested also in the green bonds market, constituting 45% of all industries. Green bonds are also well represented in the consumer/cyclical sector with a 30%, while surprisingly this type of bonds are still less popular among the utilities (11%), the industrial and energy (5%) sectors.



Fig 3.3 Green Bond sample's issuer by sector



2. www.theguardian.com/business/2017/dec/29/global-markets-end-on-record-high-after-adding-9tn-in-2017;www.money. cnn.com/2017/12/29/investing/stocks-2017-wall-street;www.borsaitaliana.it/borsaitaliana/statistiche/mercati/mtainternational/2017/mtainternational201712_pdf.
As seen, most of the business exposure of these two samples refer to the financial services industry. The percentage increases when dealing with green bonds. This is because this sector is waking up in recent years because of climate changes. The reason for this waking must be found in the impact of natural disasters caused by weather fluctuations, which always more often crush both financial and human capitals. Natural disasters caused by climate change may, in fact, have a strong negative indirect impact on financial returns. For instance, when economic infrastructures dealing with primary goods are temporarily blocked by extreme events or long lasting and sensitive climate changes in various countries deeply modify inner economies, especially with regard to the third and second industrial sectors. All these negative effects have resulted in an increase of efforts with regard to climate risks and thus has influenced decisions in the financial market. The common sense that revolves around this problem is based on the simple fact that it is much easier, in terms of costs and market timing, to prevent than to treat climate changes. Indeed, if climate changes were conceived a few years ago as a problem to solve, now the financial sector has found in this an incredible business opportunity. These have resulted in more investments specifically issued for low carbon projects or other types of investments aimed at supporting measures, tools and services to react to climatic oscillations (Miller, Swan 2016). Probably, the most famous of these investments toward a new green economy is that made during the 2015 Paris Agreement, when the participating countries decided to devolve \$100 billion a year by 2020 to pro-climate initiatives (Bodansky 2016). This decision was immediately followed by 450 CEOs from 65 countries through financial actions supporting Science-based Emissions Targets³. Thus the greatest part of green bonds in the financial sector is issued to operate a full transition from fossil to non-fossil fuels in order to convert the planet to a low carbon economy. This phenomenon also explains why the second investment sector is that of the consumer/cyclical industries since both sectors are interconnected when dealing with the green economy. In the following years, significant investments will be devoted to the energy efficiency of industrial buildings and transports. As a matter of fact, for consumer cyclicals, it is meant industries in the field of automotive, entertainment, housing and retail. Green bonds in this sector are issued especially with regard to technologies implementing renewable energies, such as the wind and solar ones. Aeolic systems and photovoltaic in fact represent innovative and cost-competitive sources of energy. Bloomberg New Energy Finance⁴ has estimated that by 2040 more than 64% of the source of energy will be provided by wind and solar powers. This will be possible by cost-related factors, considering that the solar energy is already cheaper than coal in many European countries and that the future of transports will be electricity, possibly from clean sources. Green bonds issuance for the other minor attested sectors (utilities, industrial, energy) is therefore related to companies engaged in

newsroom.unfccc.int/lpaa/business/lpaa-focus-on-business-global-business-community-comes-to-paris-with-solutions-for-ta king-on-the-climate-challenge-across-the-board/.

producing and delivering utility services, such as clean electric power and natural gas. Regarding our samples, another interesting statistic is provided by the breakdown per country of risk. As shown in graphs below (*Fig 3.5-3.6*), the major part of non-green issued bonds generally comes from the United States (48%). However, when those bonds are green, this percentage is reduced to 35%, while the majority of green bonds is issued by other countries (37%), namely neither from America nor Europe nor China (both 14%). Furthermore, if we compare percentages between non-green and green bonds, we might observe three facts:

- 1) The Unites States could be still considered the market that invests more than all, but probably this is the country where the conversion to the green economy is still slowed down by various political reasons.
- 2) The Chinese market has an opposite position compared to the Unites Stated. In fact, if this is the country that emits less non-green bonds in the world with a meagre 7%, this percentage is duplicated when bonds are green. This probably suggests a shift in the local economy.
- A similar observation as the case of China, could be stated for the other countries, which probably include developing economies, such as the Asian and African markets.



Percentages from our samples confirm new worldwide trends in green economy indeed. Nowadays, China and India are in fact the leading countries in terms of clean energy investments. According to the above mentioned Bloomberg statistics, those countries by 2040 will represent the 28% and 11% of all investment in clean power generation (wind, solar, nuclear) respectively. It has been estimated that just the 18% of new planned coal power plants will be used by 2040, although coal's production in China will reach a peak in 2026.

4. The applied methodology

The purpose of the analysis described in this chapter of the paper is to establish if there is a correlation between the returns on the shares of companies and the announcement of the issuance of a Green Bond.

The underlying assumption to be verified is that if Social Impact Bonds in the form of Green Bonds are issued, they represent a sort of way through which the company can communicate a strong drive to environmental safety and climate change awareness and ultimately a strong Corporate Social Responsibility.

Markets react positively to companies involved in the Green and Environmental Economy; thus the assumption is that they should react positively also to the issuance of a Green Bond.

The analysis has been performed by collecting a sample of input data to analyse, namely the historical share prices of the company which issued green bonds in relation to the announcement date of the issuance.

These events have been studied with a model described in the next paragraph which allowed to establish if the correlation is present or not.

Finally in order to understand if the analysis has a statistical significance or not a statistical test has been run and the results described.

4.1 How to get the dataset

The first step in drafting the model was data collection, and the source of all the input data is Bloomberg.

There are two main input samples which have been used in the model: the first one is the

Green Bonds sample, containing a random sample of bonds the use of proceeds of which respects the Green Bonds Principles, and the second one is the Non-Green Bonds sample. The two samples were collected and analysed in two different excel files and had been obtained performing the same calculations, and the only difference was the way through which the two initial lists of bonds have been obtained by setting different criteria on the SRCH page of Bloomberg.

The Green Bonds list has been obtained from a Bloomberg data download, setting the following search criteria in the SEARCH page of the server (the page which allows finding different securities by setting filters on the Bloomberg's Global securities sample):

- Bonds: Active (which allows selecting all the active bonds currently listed in the Global markets)
- Use of Proceeds: Green (which allows restricting the selection only to the Bonds with the abovementioned use of proceeds)

After having applied these two filters, 906 securities have been found from the server and downloaded to an excel file by applying the following columns findings:

- Issuer name (the name of the company issuing the bond)
- Company corporate ticker (identifying ticker of the issuer)
- ISIN (the ultimate identification of the bond, unique for each security)
- Currency (as default option the currency of the stock exchange's country in which the bond is listed)
- Coupon value
- Coupon type (fixed or floating, as established in the Bond Prospectus)
- Yield to maturity at the last trading date before the download date (namely, 8th of December 2017)
- Issue date of the Bond
- Maturity date
- Maturity type (Callable before maturity or not callable)
- Country of risk (the country of the company issuing the bond or the country in which it runs its operations)
- Amount issued (in local currency)
- Moody's initial rating at the issuance
- Moody's current rating
- S&P's initial rating at the issuance
- S&P's current rating

At the purpose of the analysis, the following columns have been added manually by ap-

plying formulas to the initial sample download from Bloomberg:

- Ticker share (ticker of the share related to the company issuing the bond, obtained by applying the formula:
 =BDP("company ISIN"&" ISIN", "BOND_TO_EQY_TICKER")&" Equity"
- Bond Bloomberg ticker (useful to identify the announcement date, obtained by applying the formula =*BDP("company ISIN"&" Corp", "ID_CUSIP")&" Corp"*
- Announcement date (the date of the announcement of the issuance of the bond, obtained by applying the formula:

=BDP("Bond Bloomberg ticker", "ANNOUNCE_DT")

The ultimate purpose of adding these three items is shown in the following paragraphs of this chapter, but for a general preliminary understanding the reader could think about them in the following way:

• Ticker share: it is not possible to obtain it from a direct download from Bloomberg, but using the abovementioned formula on the company ISIN this item is easily obtained.

The ticker of the listed shares related to the companies issuing the bonds are fundamental to obtain the historical share price and analyse of the market reacts to certain events relevant to the company (in this case the announcement of the issuance of a bond).

- Bond Bloomberg ticker: an important identification number for the security, from which it was possible to obtain other parameters.
- Announcement date: the most important temporal reference for the analysis, it allows knowing in which date the issuance of the bond was announced to the markets.

The following step in preparing the data sample was to find the share price of the companies issuing the bonds and the price of the reference index (Market index of the country in which the company is listed), from 200 days prior to the announcement date to 7 days after the announcement date.

In order to have the corresponding share prices the following 2 columns have been transposed from the Bloomberg download worksheet into another worksheet:

- Ticker share
- Announcement date

Then, having ticker of the relevant shares and announcement date of the bonds issuance ordered in row 1 and 2, numbers from -200 to + 7, as reference dates for the shares prices,

have been put in the first column of the worksheet.

Finally, by applying the formula $=BDP("Ticker share", PX_LAST, "Announcement date + column A", "Announcement date + column A", "days=c") it has been possible to have in columns share prices from 200 days prior to the announcement date up to 7 days after the announcement date.$

It is essential to say that by applying the formula with the setting "days=c", only the trading days are considered and not all the days.

At this stage of the analysis a further filter has been applied to the initial securities sample: all the securities with an unknown announcement date have been excluded since otherwise, it would not have been possible to calculate a correct share price for them: from this further selection a final sample of 406 Green Bonds have been obtained, and the model consider this sample in its analysis.

It was necessary at this point to perform the same analysis of the share prices also for the relevant market indexes, necessary to perform the calculation of the "Market Model" parameters (explained in the next chapter).

Market indexes has been found by applying the formula =*BDP("Ticker share*", "*REL_IN-DEX*")ど" *Index*" to the ticker of the shares under analysis.

After having found the index names, the formula =BDP("Ticker share", PX_LAST, "Announcement date + column A", "Announcement date + column A", "days=c") was used to calculated the values of these indexes for the same days of the share prices.

As a final result, a worksheet containing share prices and relevant market indexes values for a time period of 207 days was obtained.

The same procedure has been applied to the non-Green bonds sample, a benchmark sample which includes bonds with the same characteristics but with use of proceeds that is not under the "green" category.

In order to obtain this sample the download from Bloomberg has been done setting the following parameters in the SRCH page of the server:

- Bonds: Active (which allows to select all the active bonds currently listed in the Global markets)
- Use of Proceeds: Exclude Green (which allows to exclude from the selection all the Bonds with the abovementioned use of proceeds)
- Issuance date: higher than 01/01/2012 (since the Green Bonds phenomena is relatively recent and for a better comparison of the two samples all the bonds prior to 2012 have been excluded)

By setting these filters a sample of 246,937 bonds has been obtained and since the number was too high for being compared, and further criteria would have been made the resultant

sample too much different from the Green Bonds one the decision has been to simply take the first [714] bonds from the 246,937 list and apply the other steps of the procedure only to these [714] bonds.

The bonds so obtained are completely comparable to the Green Bonds sample and the fact that they are the first of a random download from the server.

4.2 How to evaluate the cumulative abnormal returns

The following steps have been applied to both the data samples in the same manner to have a model which allows comparing the Cumulative Abnormal Returns ("**CAR**") reported by the shares of the companies which have issued the bonds under analysis. The ultimate scope of the model is to see if there is a correlation between the announcement of the issuance of a bond and the share price performance of the issuer.

The comments to the results are explained in the next point of this chapter, while here the explanations are limited the calculations which allowed us to reach the results.

Starting from the excel with the samples described in the paragraph 1.1.2. An analysis was performed on the simple returns reported by the shares of the companies issuing the bonds.

In order to do that, a simple return in the form $R = \frac{Pt}{Pt - 1} - 1$ (where *R* is the return, P_t and P_{t-1} the price of the stock in time period *t* and in the time period *t*-1 namely, in this case, two consecutive days) has been calculated for the historical share prices from 200 days prior to the bond's issuance announcement date and 7 days after the issuance announcement date.

The same formula has also been applied to the relevant market indexes to obtain the returns even for these indexes.

At this stage of the calculations, the step was to draft the share prices' and market indexes' expected returns according to the model.

The model chosen for the analysis is the "Market Model", one of the most common models used. It builds on the actual returns of a reference market and the correlation of the company's share with the reference market. The equation below describes the model:

$$ARi, t = Ri, t - (\alpha i + \beta i Rm, t)$$

The subscripts "*i*" refers to the share while the subscript "*t*" refer to the days.

Where $AR_{i,t}$ is the abnormal return on a distinct day within the *event window* (in this case we used an *event window* of 207 days, from 200 days prior to 7 days after the announcement date) and represents the difference between the actual stock return ($R_{i,t}$, the return calculated on the Bloomberg share prices data) on that day and the normal return, which is predicted based on two inputs.

The typical relationship between the firm's share and its reference index (expressed by the α and β parameters), and the actual reference market's return ($R_{m,t}$, the return calculated on the Bloomberg market indexes data).

The two parameters α and β are calculated on excel as follow:

- α : =INTERCEPT("share prices returns series"; "market indexes values returns series"), where the returns series, in this case, have been calculated within the time window -200/-7.
- β: =SLOPE("share prices returns series"; "market indexes values returns series"), where the returns series, in this case, have been calculated within the time window-200/-7.

Thus, after having calculated these 2 parameters on excel within the time window of 183 days, the next step was to calculate the model expected return for a time horizon from -7 days to + 7 days after the announcement date of the bond issuance. By applying the formula:

$$(\alpha i + \beta i Rm, t)$$

With $R_{m,t}$ moving from -7 to +7 days after the issuance date, it was possible to obtain the model expected return.

Finally by applying the difference between the actual returns and the model expected returns it was possible to have the abnormal returns ("AR") for a period going from -15 days to +7 days the announcement date.

The last step has been to calculate the CAR by applying the following formula:

$$CAR(t1,t2) = \sum_{t=t1}^{t2} ARi, t$$

The analysis envisages to calculate the CAR for a period that goes from -7 to +7 days to the announcement date.

4.3 How to test the significance of the CAR(s)

To better assess the significance of the model a statistical test has been applied to verify its statistical significance and thus its validity.

To this purpose, the test chosen was the T-test, a statistical parametric test which aims to verify if the average value of a distribution is significantly different from a reference value. In financial econometrics, this test has the formal definition:

$$t = \frac{\beta 1 - \beta 1, 0}{SE(\beta 1)}$$

Where β_1 is the estimator (in this case the actual return), $\beta_{1,0}$ is the hypothesis value (in this case the model-expected return), while SE(β_1) is the standard error of the regression. To assess the statistical significance of the model the T-test has been applied in two cases:

• Applying as the numerator of the formula the abnormal return while the denominator was obtained with the formula =*ERR.STD.YX("share prices returns series"; "market indexes values returns series").*

The returns series have been considered from the day -7 to day -200 (before the announcement date)

The T-stat variable t has been calculated instead with abnormal returns ranging from -7 to +7 to the announcement date of the issuance.

• Applying as the numerator of the formula the cumulated abnormal return while the denominator was obtained with the formula = $RAD.Q((t+7)^*$ standard error of the regression at the power of 2").

The returns series have been considered from the day -7 to day -200 (before the announcement date)

The T-stat variable t has been calculated instead with abnormal returns ranging from -7 to +7 to the announcement date of the issuance.

4.4 How to develop the regression model

In order to understand how each variable previously described could impact on the CAR magnitude and if the contribution is positive or negative, what is necessary is to run a regression model.

The first thing to do that is to adapt the dataset for the statistical tool used, RStudio. So first step was to create an excel sheet in which the column was the variables and each row represents every single data.

The dataset, in particular, was composed as follow:

- First Column: CAR [-1;+2]
- Second Column: CAR [-2; +2]
- Third Column: Maturity Type
- Fourth Column: Issued Amount
- Fifth Column: Yield to Maturity
- Sixth Column: Size
- Seventh: Growth
- Eighth: Market to Book
- Ninth : Profitability
- Tenth: Green Dummy Variable

This layout permits to create a clear database, simple to be imported in RStudio.

After that, it is required to transform the dataset from *.xlsx file* to a *.csv file* to do that it is merely necessary to change the file format in the FILE menu.

The next steps are entirely and directly performed on RStudio.

The first one is to import the dataset which is possible through the function *file.choose()*. This function allows to open an external file and to import it into RStudio.

The next phase is to adapt the file format to the one read by RStudio and to save the dataset on the "work environment" of the tool. To compute this step is necessary to choose the function *read.csv2()*. In this way, RStudio recognizes the dataset and make possible all the following analysis.

Once a time the dataset is installed, what is fundamental to create the regression model is the variables definition. To do that, just rename the variable of the dataset selecting them through the formula "*nameofdataset snameofcolumn*". For example, if the objective is to save the amount issued variable what is required is:

> AmountIssued<- dataset\$AmountIssued

It is necessary to repeat these steps for each single variables, in this way the software recognises the value of the different variable and classify them according to their nature, in terms of Numerical or Factorial. After that, it is finally possible to create the linear regression model. To do that, it is just required to recall the function lm() pre-installed in the basic package of the software. The structure of this function is quite easy, as it is possible to notice:

> model1<-lm(dependent_variables ~ 1+ variable1+ variables2 +....; data=dataset)

The linear model will be developed according to the Implement->Test-> Modify logic. To provide the best possible model to describe the relations between variables.



Fig 4.1 Regression Model development cycle

This lm() function makes possible the creation of the linear model and the basis of the creation of this model several test and analyses are possible.

First of all, what is attractive to be considered are the characteristics of the model, in particular, it refers to the statistical significance of the independent variables and R-squared which is a proxy about the goodness of the model.

To recall of this information, it is required to digit the *summary()* function; also this formula is already pre-installed in the basic software package. According to the example:

> summary(model1)

In this way, the software will provide the mean value, the standard error, the t-value and the p-value for all the variables and the intercept of the model. Moreover, there will be shown a small scheme which highlights the significance of each dependent variable and its detailed level of significance.

The next possible use of the software is to run a preliminary statistical analysis as "Descriptive Statistic", and for example, it is possible to see the histogram of the variables through the *hist* function.

The main secondary step, for a complete analysis, regards the tests of the hypothesis related to the heteroscedasticity and Autocorrelation. Starting from the Autocorrelation, to check the presence of this issue, the *dwtest()*, one of the functions of the *lmtest* package must be compute.

> dwtest(model1)

The test furnishes the parameter to check the values in the table *(attachment 1)* to suggest the presence of Autocorrelation. For what concerns the heteroscedasticity, the suggested test is the Breusch-Pagan test.

To perform the test is necessary to use the *bptest()* function installed in the package *lm-test()* as follow:

> bptest(model1)

According to the results will be possible to understand the presence or not of the heteroscedasticity. In the next chapter, it will be shown the presence of heteroscedasticity. To solve them, it is necessary to perform a WLS model, which is an ordinary least square model weighted by the residuals of the OLS distribution.

Once the heteroscedasticity problem is solved, the next steps are related to the analysis of the relations. It is possible to perform a model regression model to consider interdependencies between variables as follow:

> model2<-lm(y~x1+x2+...+xn+x1:x2+x1:x3+...+x1:xn)

The model that considers all the possible interdependences could be better or not respect to the traditional model. To understand that, it is important to compute an ANOVA analysis which compares two models:

> anova(model1,model2)

Through this function, the report will be a short list of data as the degree of freedom, residuals and the significance level of the two models. If the second model implemented is better concerning the significance description of the dependent variable, the RStudio software shows a symbol to indicate also the increased accuracy of the second model compared to the first one.

5. Analysis of results

In this chapter, the attention is focused on the analysis of the results of every model adapted and previously described. The analysis will follow a consecutive series according to the sequence of models introduced in the complete thesis framework. Firstly, it is considered the results got from the *event study* approach. Following these outcomes, there will be the introduction of the linear regression model, its relative tests and the analysis of each variable chosen to describe the Cumulative Abnormal Return dependent variable better. The last step will be the analysis of the of each coefficient obtained and the relative magnitude and significance focusing in particular on the Green dummy variable, which is the principal object of our entire thesis.

5.1 Event study results

The event study methodology, as previously shown, is based on a series of consecutive steps. The main results that are important to be displayed are related to the evaluation of the market models, to the estimation of the abnormal return and then the calculation of the Cumulative Abnormal Returns (CAR) and Cumulative Average Abnormal Returns (CAAR).

5.1.1 Market model results

The market models created for each stock related to each bond issued gives the following results.

(attachments 2-3)

The previous table shows both the alfa and the beta, which allows reflecting the stock performance during a "standard" period. Each model reports the standard deviation and the R-squared which could be considered goodness indicators. The market model could lead to some simplistic results, and in some cases, it does not fit well with the real stock trend, and this could depend on the choice of the market index, that, as mentioned, was chosen automatically by the Bloomberg Platform as the best-fitted market index for every single stock. Nevertheless, the market model was the only feasible model that was possible to performed according to the dimension and heterogeneity of our dataset. In fact, it was not possible to create a more detailed model as Fama-French three model factor because it requires the estimation of two parameters for each, starting from the creation of a portfolio composed by five hundred equity indexes for every single stock, which means created more the one thousand customised portfolios. Considering the importance of the Fama French model and its parameters related to growth and size of the bond issuer, it was decided to introduce these values for the estimation of the regression model which will be described in the section 5.2.

In general, according to the results and the literature followed as trail for the market model definition, it is possible to conclude that the outcomes obtained are good enough to help in the evaluation of the abnormal returns.

5.1.2 Abnormal returns, cumulative abnormal returns and cumulative average abnormal return

The second part of the analysis is focused on the outcome of the *event study* itself, in particular, the results and the tests on the abnormal returns, cumulative abnormal returns and cumulative average abnormal returns are highlighted considering the assumptions the model is based on.

The abnormal return, as already stated, is evaluated as the difference between the real daily performance of the stock considered during the *event window* and the expected return obtained through the market model developed as shown in the paragraph 4.2. This methodology is applied both on the green bond sample and on the standard bond

sample. This choice was obviously driven by the necessity to compare the two samples considering that the main aim of the thesis is to understand and highlighted the different potential behaviour of the stock market in the reaction of green bond issuance.

5.1.2.1 Test on cumulative abnormal return and cumulative average abnormal return

First, what is necessary is to demonstrate if the Cumulative Abnormal Return and the Cumulative Average Abnormal Return are significantly different from zero or not. This starting test is fundamental for two main reasons:

- to understand if the issuance of a bond could generate an abnormal return on the stock market
- to have a preliminary consideration on the effect or not of the green label of a bond

In fact, according to the research's objective is not sufficient to demonstrate that a bond issuance could perform an unexpected divergent return on the market but at the same time, it is necessary to find out if the green bond label could give a different effect from the standard green bond.

After this test analysis, it is possible to face four different scenarios which can lead to different considerations and implication for the further development of the research.

These possible scenarios are correlated on the significance difference from zero of the green bond and standard bond issuance. In particular, it is possible to face these situations:

- 1. *Green Bond and Standard Bond CAR and CAAR are not significantly different from zero.* This is a risky situation, which brings to conclusion of the entire research. Indeed, it has no sense to try to understand how different factors could influence the CAR for a green and standard bond if the CAAR and CAR are not significantly different from zero
- 11. *Standard Bond CAR and CAAR is significantly different from zero, Green Bond not.* This situation is not expected according to the literature reviewed. If this condition occurs, it is necessary to consider the entire dataset and to try to understand if any other extraordinary event has happened during the estimation window that could analyse the wrong estimation of normal return.

- III. Green Bond CAR and CAAR is significantly different from zero, Standard not. This situation is the most interesting to be studied; in fact, it gives a preliminary condition to speculate on a significant effect of the green label on the market. The following analysis required will be a regression model to understand whatever effect impact on the CAR value and if effectively, the green bond label has a significant effect, its magnitude and its sign.
- IV. Green Bond and Standard Bond CAR and CAAR are significantly different from zero. This scenario is interesting to be analysed as the previous one. In this context, it is highly probable that the study will conduct to find out that there is not any particular value-added effect of the green label. Also under this circumstance, it is necessary to compute a regression model to identify if the green label has or not an effect.

The test, as presented in chapter 4.3, is a *t-student* test. The test, by definition, has the aim to verify a pre-fixed hypothesis. In particular, two kind of test are conducted to certificate two different kind of hypothesis:

- I. The CAAR and CAR are different from zero
- 11. The CAAR and CAR of two samples are different each other

Firstly, the first type of test was performed considering the two samples separated, to confirm that the bond issuance has a significant effect on the stock market.

This test is a two-tier *t-student* test in which the hypotheses are the following:

 $H_0: \mu_i[-t_1; +t_2] = 0$ $H_a: \mu_i[-t_1; +t_2] \neq 0$

where:

 μ is the CAAR and i is the index which identifies the sample $[-t_1; +t_2]$ is the period constituted by two limits which could be equal or different

The results obtained are summarized in the next table.

CAR	Media Campionaria	Dev.std campionaria	Statistica
(-2+2)	-0,003241855	0,062608192	-1,3729038
(-5;+5)	-0,003720793	0,075883544	-1,3000667
(-7;+7)	-0,005815779	0,084259849	-1,8300581
(-3,+3)	-0,004936063	0,101290743	-1,2920775
(-1;+1)	-0,001834119	0,039095074	-1,2438932
(-4;+4)	-0,003095578	0,089563076	-0,9164114
(-1;2)	-0,00316169	0,060607541	-1,3831532
(-1;3)	-0,005665027	0,099535967	-1,509036
(-2;1)	-0,001914284	0,041828329	-1,2134265
(-2;3)	-0,005745192	0,100647581	-1,5134876
(-3;1)	-0,001105155	0,043203771	-0,6782332
(-3;2)	-0,002432726	0,063509532	-1,0156216
(-1;0)	-0,000847325	0,027962956	-0,8034239
(-2;0)	-0,00092749	0,031889749	-0,7711448
(-3;0)	-0,000118361	0,033971619	-0,0923783

 Tab 5.1
 Standard Bond t-test on CAAR

CAR	Media campionaria	Dev.standard	Statistica
(-2+2)	0,003013229	0,034749186	1,72557983
(-5;+5)	-0,000741353	0,046897473	-0,3145742
(-7;+7)	-0,000568615	0,056100309	-0,2016974
(-3,+3)	0,001551929	0,037644018	0,82039584
(-1;+1)	-5,42926E-06	0,026850127	-0,0040239
(-4;+4)	-6,66457E-06	0,044240027	-0,0029978
(-1;2)	0,002662768	0,033304619	1,79102274
(-1;3)	0,002021191	0,036608488	1,09868503
(-2;1)	0,000345032	0,028459845	0,24125386
(-2;3)	0,002371652	0,038116952	1,23817051
(-3;1)	-0,000474692	0,030667459	-0,3080217
(-3;2)	0,002193505	0,035059388	1,24503608
(-1;0)	0,000249865	0,022956625	0,21659337
(-2;0)	0,000600326	0,02468317	0,48398732
(-3;0)	-0,000219397	0,027866361	-0,1566745

 Tab 5.2
 Green Bond t-test on CAAR

The test is performed considering two different significance level of 5% and 10%. As it is shown, the test is performed on the more different time window. It was chosen to consider both symmetric and asymmetric time period, and it was decided to fix -7 days (7 days before the event) as a lower limit and +7 days(7 days after the announcement date) as an upper limit. Fixed the maximum and minimum boundaries, every possible time window was considered, and for each of them, the test is computed under different significance level.

This choice is made for two main reason:

- · Importance to check robustness of the model and results
- Understand if there is any common border which make the results from significant to insignificant different from zero

The test points out that the analysis falls into the third scenario (III). Indeed no CAAR for each time window of the standard bond sample appears significantly different from zero. Instead, the CAAR for the Green Bond sample is significantly different from zero in two specific periods of time.

According to this previous analysis, it is possible to notice that the significant CAARs both for the [-1;+2] and [-2;+2] time periods are positive, so it gives a preliminary signal of the positive effect of the Green Bond issuance, which will be deeply analysed through the regression model in the section 5.2. The second consideration is related to the difference, in terms of the effect on the market, between the Green Bond and Standard Bond. It is easy to recognise that in analysed sample, there is no significant effect of the Standard Bond which means that the announcement event of a Standard Bond issuance does not get any extraordinary behaviour from investors.

To confirm this second point, it is computed the second type test. This test is a *t-student* test between two independent samples.

The hypothesis in this conditions are the following:

$$H_0: \ \mu_{SB}[-t_1; +t_2] = \ \mu_{GB}[-t_1; +t_2]$$
$$H_a: \ \mu_{SB}[-t_1; +t_2] \neq \ \mu_{GB}[-t_1; +t_2]$$

where:

 μ_{SB} [-t₁; +t₂] represents the CAAR for Standard Bond during a selected period μ_{GB} [-t₁; +t₂] represents the CAAR for Green Bond during a selected period The results obtained are shown in table below:

CAR	Dev std Pooled	Statistica
(-2+2)	0,054250965	-1,835067659
(-5;+5)	0,066909152	-0,708721515
(-7;+7)	0,07534283	-1,108432268
(-3,+3)	0,08411767	-1,227579006
(-1;+1)	0,0351805	-0,827302599
(-4;+4)	0,076406355	-0,643432095
(-1;2)	0,052440629	-1,767722192
(-1;3)	0,082598923	-1,481032982
(-2;1)	0,037566846	-0,957190995
(-2;3)	0,083699287	-1,54344753
(-3;1)	0,039154975	-0,256270754
(-3;2)	0,054988255	-1,339009938
(-1;0)	0,026270459	-0,664723031
(-2;0)	0,029498396	-0,824326419
(-3;0)	0,031908151	0,050396667

Tab 5.3 Jointly t-test on CAAR

The test is performed considering the same level of significance of 5% and 10%. This test confirmed the previous suspicion. As it represents, for the both [-1;+2] and [-2;+2] time windows, there is a statistically proved difference between the two samples, which means that the Green Bond issuance caused a market reaction and it is not same for the Standard Bond. Moreover, this result brings to the necessity to analyse the effect of the Green label on the CAR value. This will be a central point for the regression model development and the rest of this research study.

According to both tests, it is possible to conclude that the Green Bond issuance requires further description. The results obtained show a significant effect of the announcement on the market. The significance of the test is confirmed for more than one-time window which gives more robustness of the results got. In particular, it is important to notice that the significant effect is found for small time windows around the event date ([-1;+2] and [-2;+2]) which enhances the probability that no other events occur to alter the *event study* analysis. Moreover, it is clear that for a larger time window, the effect is absorbed and so it is not detected through the study.

The next step required to conclude the analysis of the result is the focus on the regression model. The regression model will explain which are the fundamental factor to better describe the CAR and it will give a definitive answer on the importance or not of the Green Bond label for bond issuance.

5.2 Regression model

The regression model is the final step of the quantitative analysis for this research study. The regression model aims to analyse and describe which are the main important variables that could represent the variation in the value of the CAR. This section will be articulated according to the logical step followed to implement, test and modify the model according to the logical loop scheme, described in chapter 4.4.

So according to this scheme, the first model to be analysed will be the preliminary model, which is characterised by all the variables described in the chapter 4.4.

This model is defined as "preliminary" model due to the several statistic issues that affect it. The next step will be the description of the statistical tests on this model. These tests verify the correctness of the assumption described in the chapter 2 and check the accuracy respect to statistical features as Autocorrelation, Heteroscedasticity, etc.

The last step will be the definition and description of the results of the "corrected" model followed by a brief description of the significance of some variables will be explored.

5.2.1 The ols linear regression model

The OLS model is the first regression model of the research study. It has as the dependent variable, the CAR value, and, as independent, all the variables described in the chapter 4.4. The CAR value depends on the *event window* chosen for the analysis. In particular, it has been decided to select just the event periods that are confirmed as significant in the CAR tests. According to this choice, only two event periods were selected ([-2; +2] and [-2; +1]) which means to consider just two independent regression models. These models are linear models with both linear, logarithmic and dummy variables. As it is known, the main target of this study research is to identify a significant relation between the Green dummy variable, which describes if the bond is green or not and the impact on the CAR value.

The Ordinary Least Square model has the following formula:

$\begin{aligned} CAR(-t_{1;} + t_{2}) \\ &= \alpha + \beta_{1} YTM + \beta_{2i} MatType_{i} + \beta_{3} \ln(AmountIssued) \\ &+ \beta_{4} Profitabilty + \beta_{5} \ln(Size) + \beta_{6} Growth + \beta_{7} MtB + \beta_{8i} Green \end{aligned}$

where the Variable MatType and Green are factorial variables and the Amount Issued and Size variables are log-transformed to represent better the changes in the amount of the value of bond and revenues of the firm considered.

According to this model, two results, related to the two different time periods are obtained.

Variables	Estimate	Std.Error	t value	Pr(> t)	Signif. Codes
Intercept	0,0120100	0,01242	0,966	0,3341	
YTM	-0,0000200	0,00007	-0,270	0,7870	
MatTypeCALLABLE	0,0019600	0,00280	0,701	0,4835	
MatTypeCONV/CALL/PERP	-0,0568500	0,03196	-1,799	0,0756	
MatTypeCONV/PUT	-0,0350700	0,03194	-1,098	0,2726	
MatTypeCONVERTIBLE	0,0201200	0,00999	2,013	0,0444	*
MatTypeEXTENDIBLE	0,0427900	0,03198	1,338	0,1813	
MatTypePERP/CALL	0,0033260	0,00403	0,826	0,4088	
MatTYpePUTABLE	0,0169700	0,02260	0,751	0,4527	
MatTYpeSINKABLE	-0,0179000	0,02320	-0,772	0,4406	
Amount Issued	-0,0012060	0,00066	-1,823	0,0686	
Profitability	0,0109700	0,00694	1,581	0,1142	
Size	0,0000793	0,00058	1,370	0,1710	
Growth	0,0204100	0,00476	4,287	0,00002	***
MtB	0,0752700	0,04943	1,523	0,1281	
Green	0,0056200	0,00328	1,711	0,0874	

The following table shows the output referred to the model with the period (-1;+2):

 Tab 5.4
 CAR(-1;+2) OLS Regression Model

According to this preliminary model, just a few variables are considered significant to describe the CAR output. In particular:

- Growth variable is the main significant value and it is supported by a significant code approximately equal to zero, which stands for a real significance between the dependent and independent variable.
- Maturity Type is composed by 8 different characteristics but just two of them are proved significant by the regression output. These are the CONVERTIBLE and the CONVERTIBLE/CALLABLE/PERPETUAL Maturity types. The first one presents a significant code equal to 0,01 instead of the second one equal

to 0,1. The remaining scenario are not significant.

- Another significant value, supported by a significant code equal to 0,1, is the Bond amount issued.
- The more interesting result, instead, is the confirmation of the significance of the green dummy variable. This is sustained by a significant code of the 0,1.

An interesting outlook on the green variable is the positive result of the mean value which supports the hypothesis that a green bond emission gives a positive impact on the firm's share which was first shown by the CAAR tests.

A problem that arises from the output is the R-squared, which indicates how the model describes the dependent variable. This result is too low, and this means that the model does not represent the effective CAR. This could be explained by missing variables which could better fit on the model or some statistical issues that will be tested in the next paragraph.

Variables	Estimate	Std Error	t value	Pr(> t)	Signif. Codes
Intercept	0,0136000	0,01349	1,008	0,3135	
YTM	-0,0000415	0,00008	-0,516	0,6058	
MatTypeCALLABLE	0,0023380	0,00304	0,770	0,4415	
MatTypeCONV/CALL/PERP	-0,0785700	0,03471	-2,264	0,0238	*
MatTypeCONV/PUT	-0,0434200	0,03469	-1,252	0,2109	
MatTypeCONVERTIBLE	0,0277200	0,01085	2,554	0,0108	*
MatTypeEXTENDIBLE	0,0538700	0,03473	1,551	0,1212	
MatTypePERP/CALL	0,0038120	0,00437	0,872	0,3833	
MatTYpePUTABLE	0,0160300	0,02454	0,653	0,5137	
MatTYpeSINKABLE	-0,0273900	0,02519	-1,088	0,2771	
Amount Issued	-0,0014650	0,00072	-2,040	0,0416	*
Profitability	0,0121600	0,00753	1,614	0,1068	
Size	0,0011180	0,00063	1,780	0,0754	
Growth	0,0205500	0,00517	3,974	0,0001	***
MtB	0,0658200	0,05367	1,226	0,2204	
Green	0,0053130	0,00357	1,490	0,1366	

The second model referred to the period (-2;+2), and the table below shows the results obtained by the regression model:

 Tab 5.5
 CAR(-2;+2) OLS Regression Model

The output of this model reflects the one of the regression model (-1;+2) largely. In fact, the significant variables of the regression model are exactly the same, but there is a strong difference concerning the green dummy variable.

In the model (-2;+2) the green dummy does not arise as statistically significant from the output, and this provides complete opposite results from the previous one.

The reasons behind these contrast results could be many and different, but the most pro-

bable is related to the biased characteristics of the ordinary least square model. According to this suspect, it is important to perform some test to check the consistency of the two regression model and eventually to change them in order to solve a statistical problem found through the tests.

To enhance the necessity to test the presence or not of some issues as Autocorrelation or Heteroscedasticity, there is, also, in this case, a really low value of the R-squared.

At the end of this paragraph, it is clear to must test some statistical hypothesis. The hope related to these tests is to find out some problems in order to solve them and then check if the change in model characteristics could increase not only the significance of the number of predictors but also to enhance the value of the R-squared of both two models.

5.2.2 Tests on the regression model

The problems that could influence the regression output are mainly two:

- Heteroscedasticity
- Autocorrelation

Based on that, the next step is to perform statistical tests to clarify if there is the presence or not of these two issues to solve them.

5.2.2.1 Autocorrelation test

The first step in the analysis of the autocorrelation is graphical, and it is represented by the visualisation of the correlation diagram. The correlation Diagram is a matrix which shows which are the relations between each couple of variables. It is decided to provide a mixed-autocorrelation matrix, which shown though bubbles the magnitude of correlation and also indicates the exact value of the correlation parameter of each couple of variables.

AmountIssued					
-0.51	Growth				
-0.28	0.6	MtB			•
0.39	-0.52	-0.16	Profitability		
0.39	-0.14	-0.17	0.24	Size	
-0.02	0.04	-0.03	-0.14	-0.07	YTM

This is the autocorrelation matrix:

Fig 5.1 Autocorrelation Matrix

According to the matrix, there is the suspicion of some evident correlation, for example between growth and market to book ratio. Nevertheless, it is necessary to check the effective presence of the autocorrelation through a test. It is decided to choose the Durbin-Watson

This test has the aim to verify the autocorrelation between variables. The test is quite easy to be interpreted. The test's output stays in the range of 0 to 4 values. If there is not any correlation, the test will give back the value of 2, if there is a positive correlation the test will give a value between 0 and 2, instead if the correlation is negative the test will give back a value between 2 and 4.

To get a conclusion from the test, it is necessary to compare the Durbin-Watson statistic

with the correct lower and upper bounds, in the *attachment 1*. If D>DU, there is not any correlation, if D<DL, there is a positive correlation, if the DL<D<DU the test does not provide any significant conclusion. The significance level chosen for the test is 0,05. The first model to be check is the model (-1;+2), and the output is the following one:

DW-Statistic	DL	D _U	P-value
1,91113	1,70713	1,83057	0,07482

 Tab 5.6
 Durbin-Watson test for CAR(-1;+2) OLS Regression Model

So for the model (-1;+2), the DW-statistic is higher than the Du reference value, which means that there is not any kind of significant correlation between variables. So the autocorrelation problem for the model (-1;+2) does not arise, and so the model is not biased by this kind of issue.

Now it is necessary to test also the second model, the model (-2;+2). These are the results obtained:

DW-Statistic	DL	D _U	P-value
1,9519	1,70713	1,83057	0,2099

 Tab 5.7
 Durbin-Watson test for CAR(-2;+2) OLS Regression Model

Also in this case, the model results not affected by the autocorrelation problem. In fact, also for the model (-2;+2), the DW-Statistic is higher than the DL reference value which confirms the absence of correlation.

In the end, it is possible to conclude that autocorrelation does not impact on the models. It is not necessary to solve any problem regarding a correlation between variables.

5.2.2.2 Heteroscedasticity tests

The required next step is to check the presence or not of heteroscedasticity. The suggested test, in this case, is the Breusch-Pagan test. Also in this case, it is necessary to compute two independent test for each regression model.

The first model analysed is the model (-1;+2), and this is the output of the test:

BP-Statistic	P-Value
32,327	0,005809

Tab 5.8 Breusch-Pagan test for CAR(-1;+2) OLS Regression Model

It is clear from the P-value result that the model presents heteroscedasticity. If fact the p-value is extremely lower than significance level of 0,05 chosen for the test.

The second model analysed is the model (-2;+2), and in this case, the output is quite the same:

BP-Statistic	P-Value
17,733	0,124

Tab 5.9 Breusch-Pagan test for CAR(-2;+2) OLS Regression Model

So it is clear that the regression models are affected by the heteroscedasticity which could lead to biased output.

It is necessary to change the initial model to face this issue. The solution defined is to work on a General Least Square model (GLS).

5.2.3 The weighted least square model

The weighted least square model (WLS) is a regression model which better fits under a heteroscedasticity condition. It is described theoretically in the chapter It is described theoretically in the section 2.2.4.2. This model, in fact, could bring to switch from heteroscedasticity to a homoscedasticity condition and so, it is the most indicated to solve the issue arise.

The predictors are to solve the heteroscedasticity problem, but what is interesting is that the predictors remain unbiased. In fact, a WLS model in a situation of homoscedasticity is simply an OLS model.

So after the computation of the model the new-adjusted model, it is fundamental to re-perform the regression model to extract the value of the estimators. What is expected in this new situation is the change concerning the significance of the variables and magnitude.

The first model considers the model (-1;+2)WLS and the output obtained by the statistical tool is the following one:

Variables	Estimate	Std.Error	t value	Pr(> t)	Signif. Codes
Intercept	0,0476600	0,00922	5,167	0,0000004	***
YTM	-0,0000214	0,00005	-0,443	0,6577	
MatTypeCALLABLE	0,0038440	0,00187	2,060	0,0400	*
MatTypeCONVERTIBLE	0,0239600	0,00691	3,470	0,0001	***
MatTypeEXTENDIBLE	0,0333600	0,00225	14,816	<2e-16	* * *
MatTypePERP/CALL	0,0022710	0,00266	0,854	0,3934	
MatTYpePUTABLE	0,0248000	0,01890	1,312	0,1901	
MatTYpeSINKABLE	0,0004657	0,02148	0,022	0,0983	
Amount Issued	-0,0027640	0,00048	5,763	0,0000002	***
Profitability	0,0077970	0,00405	1,927	0,0546	
Size	0,0013630	0,00039	3,502	0,0005	***
Growth	0,0197700	0,00345	5,737	0,00000002	***
MtB	0,1702000	0,04150	4,101	0,000049	***
Green	0,0094530	0,00211	4,482	0,0000093	***

 Tab 5.10
 CAR(-1;+2) WLS Regression Model

The solution obtained is extremely positive for the future analysis of this research study. Almost all variables are shown as significance, even without the same significance level. The significance variables in particular are:

- *MatType:* almost all the factors are considered significant.
- *Amount Issued:* the value of the amount issued is significant but, it has a negative value so increasing the value of the emission decrease the cumulated abnormal returns.
- *Amount Issued:* there is an important relation in terms of Amount issued of the bond and the CAR value. The relation is related to the liquidity of the bond which increase the market appetite.
- *Profitability:* the profitability of the firm is significant and positive correlated with the CAR variable. This is expected and often really common for the market.
- *Size:* the size, calculated as logarithm of the revenues of a firm, is positive and significantly correlated to the CAR value. This could be explained by the fact

that a bigger company generally has a more stable cash flow to repay the debt and so it is positively recognized by the market.

- *Growth:* also the growth of a company is positive and significantly related to the CAR. This could be easily explained. A company whose is rapidly growing and has the access to the debt market obtains the possibility to growth more and so it easily increase its value.
- *MtB:* it is positive related to the CAR value.
- *Green:* it is confirmed as significant and positive, but now it is strongly supported by the significance. The reason behind the significance and the positive effect may be different and will be analysed in the next chapter. This result is really in part for the aims of the research study because it definitely confirms the hypothesis of green label effect on the stock market.

Another important aspect of the model (-1;+2)WLS is the increase in the value of the R-squared that reaches the 0,3779 value. This could be considered a great increase regarding the goodness of the model and it is possible to consider that the model is enough good to be used in several areas.

The second model is the model (-2;+2)WLS, and the new regression output is the following:

Variables	Estimate	Std.Error	t value	Pr(> t)	Signif. Codes
Intercept	0,0459900	0,00979	4,697	0,0000035	***
YTM	0,0000251	0,000058	0,428	0,6685	
MatTypeCALLABLE	0,0051540	0,00203	2,540	0,0114	*
MatTypeCONVERTIBLE	0,0230300	0,00572	4,024	0,0001	***
MatTypePERP/CALL	0,0066990	0,00310	2,163	0,0311	*
MatTYpePUTABLE	0,0234400	0,02035	1,152	0,2499	
MatTYpeSINKABLE	-0,0283400	0,02154	-1,316	0,1889	
Amount Issued	-0,0025700	0,00052	-4,915	0,00000124	***
Profitability	0,0160700	0,00486	3,309	0,0010	**
Size	0,0010220	0,00046	2,202	0,0282	*
Growth	0,0266500	0,00403	6,614	0,00000000	***
MtB	0,1459000	0,04619	3,158	0,001691	**
Green	0,0078650	0,00230	3,426	0,0000667	***

Tab 5.11CAR(-2;+2) WLS Regression Model

The new model presents the same characteristics of the model(-1;+2)WLS, and in fact, the significant variable is the same. The great advantage of this new model is the significance of the Green dummy variable which is the contrast with the OLS one. Moreover, it

confirms what is resulted from the model (-1;+2)WLS about the effect and significance of the green label.

This shortly introduced the next chapter in which 3 possible reasons about the impact of green bond on the stock market are provided. But it is necessary to check if effectively the Heteroscedasticity is removed in the new models.

5.2.3.1 Heteroscedasticity test on WLS Model

The aim of these test is the same as the previous one, so to understand if the new WLS models have or not heteroscedasticity in order to understand if the output may be biased.

It is chosen to follow the same tests. So it is computed the Breusch-Pagan test on the first model, the model (-1;+2) GLS and this is the output:

BP-Statistic	P-value
16,352	0,1524

 Tab 5.12
 Breusch-Pagan test for CAR(-1;+2) WLS Regression

So the p-value is higher than the significance value which means that the null hypothesis, the presence of homoscedasticity, is confirmed. This is a positive outcome that confirms the goodness of the model and supports the validity of the estimator obtained.

The test is also performed on the model (-2;+2)GLS, and the result is the following one:

BP-Statistic	P-Value
17,733	0,124

 Tab 5.13
 Breusch-Pagan test for CAR(-2;+2) WLS Regression Model

Also for the second model, the null hypothesis is confirmed.

5.2.3.2 Interdependence of Variable Green and others variables explained through ANOVA analysis

The last step of the analysis is to create an advanced model which takes into consideration the effect of the variable green jointly with the others regression independent variables on the CAR value. The model is then compared with actual WLS model to understand if the addition of the new-combined variables gives a significant improvement in the explanation of the CAR.

The advanced model is performed both for the (-2;+2) and (-1;+2) time periods. The result of the ANOVA are the following ones.

Model	RSS	Sum of Sq	F	Pr(>F)
CAR(-1;2) WLS	1,207			
CAR(-1;2) WLS Interdependence	1,1851	0,02189	1,6956	0,1342

Tab 5.14 Anova test between CAR(-1;+2) WLS and WLS Interdependence models

Model	RSS	Sum of Sq	F	Pr(>F)
CAR(-2;2) WLS	1,3629			
CAR(-2;2) WLS Interdependence	1,3456	0,017294	1,1618	0,3271

Tab 5.15 Anova test between CAR(-2;+2) WLS and WLS Interdependence models

The output of both the ANOVA pushes to exclude an extra-improvement through the advance model. In fact, no clearance on the impact of the combined variables is highlighted by the ANOVA. It is not significantly different to consider the WLS models or the Advanced ones.

After this analysis is possible to conclude that the Green Variable has a significant effect on the CAR value, but at the same time, the interdependence of the green dummy variable with other dependent variable does not increase the goodness of the model. So it is possible to go on to the second target of this research: Why the Green label has

an impact on the stock market.

In the next chapter, the attention will be focused discussing the 3 main possible reason, supported by the literature.

6. Green bonds impact on the stock markets

As shown in the previous chapter, when companies decide to issue green bonds these are rewarded on the stock markets by seeing the price of their shares increasing. This phenomenon can be explained using two factors, namely the relationship with the Corporate Social Responsibility disclosure and the increasing presence of ESG/RI specialist investors

6.1 Corporate Social Responsibility (CSR)

Basically speaking, the CSR factor could be resumed in a short explanation. As a matter of fact, the more non-financial information⁵ About a company is transparent and spread, the more the risk investment is reduced. Consequently, when the risk investment is low, the reduced average cost of the capital increases the evaluation and -therefore - the price of the shares. The reason for this tendency could also be explained by the fact that investors and stakeholders tend to ask more frequently ESG performance in order to take more accurate decisions (Martin, Moser 2012: 1; Aggarwal 2013: 51; Caesaria, Basuki 2017: 1). KPMG (2011) has reported that 95% of the 250 largest companies worldwide has provided a CSR disclosure, with the European ones at the top of disclosure percentage. Over the last decade, many studies have been conducted to examine the relationship between CSR disclosure and the financial performance of companies. As correctly reported by some scholars (Orlitzky *et al.* 2003; Aggarwal 2013: tabs.1-4, De Klerk *et al.* 2015; Friede et al. 2015; Caesaria, Basuki 2017), those results are often contradictory. If past researches provided contrasting data about the relationship between CSR and share price/market value of equity (Aupperle *et al.* 1985; Griffin, Mahon 1997; Rowley, Berman

^{5.} For non-financial information about a company, it is meant here as all information related to the social and environmental impact, i.e. the Environmental, Social and Governance (ESG) performance.

2000; Patten 2002; Margolis, Walls 2003; Orlitzky *et al.* 2003; Hassel *et al.*, 2005; Murray *et al.* 2006; van Beurden, Gössling 2008; Hoepner, McMillan 2009; Barth, Clinch 2009; Schadewitz, Niskala 2010; De Klerk, De Villiers 2012; Revelli, Viviani 2015). Nowadays we can affirm that Global Reporting Initiative (GRI)⁶ are positively associated with share prices, that is mean that higher levels of CSR are associated with higher share prices (Rabah Gana, Dakhlaoui 2011:2; Aggarwal 2013: 57; De Klerk *et al.* 2015: 210). In particular research (Friede *et al.* 2015) that was based upon a comparison among 2000 individual studies between 1970 and 2015 has found out that roughly 90% of cases find a non-negative relationship between ESG and CSR disclosure (*Fig 6.1.*). This result is significant considering that the compared studies were all independent one another and scholars applied different methods of analysis.



Fig 6.1 CSR disclosure in (after Friede et al.2015)

This positive tendency was noticed in recent years in different financial markets, from European to the African and Asian market (*Fig 6.2*). In all markets, as shown below, it was observed that it was much more sensible the disclosure of CSR with the financial accounting information rather than just providing financial information. However, in order to understand this positive relationship, an in-depth insight to internal economies is here provided. This is because some scholars think that the ESG-CFP relation is influenced by human orientations (del Mar Miras-Rodríguez *et al.* 2015).



Fig 6.2 ESG–CFP relation in various regions based on the study of Friede et al.2015 (after Friede et al. 2015)

6.1.1 European and western markets

Concerning the US market, some scholars believe that the ESG-CFP relationship is significantly higher compared to other developed countries (Allouche, Laroche 2005; Dixon-Fowler et al. 2013). Following the above-mentioned research (Friede et al. 2015:223), apart from the US market, western markets have a smaller share of positive results. This result is event especially by comparing North America (42.7% positive) and Europe (26.1% positive). For the European market, the first study finding a positive correlation was carried out in Finland (Schadewith, Niskala 2010), but probably the most significant is the case of the UK market. In the UK CSR information is usually provided voluntarily, even though some studies suggest that impending regulations might have stimulated this spread⁷. For instance, 99% of companies have declared the CSR by 2008; this wish also mirrors investors' expectations (De Klerk et al. 2015: 209). Investors, in fact, tend to get informed on the environmental impact of the company before taking a decision (Solomon, Solomon 2006; De Villiers, Van Staden 2010). British investors, in particular, are interested in knowing the environmental impact of the company and they prefer to know this information during the investment decision-making (De Villiers, Van Staden, 2010), the same could be affirmed for all those UK institutional investors assisting privates for their investments (Solomon, Solomon 2006). The hypothesis at the base of some studies is whether understanding if the asymmetry of information considerations

^{7.} See for instance the Paris Agreement signed in December 2015, KPMG 2008, Choi et al. 2013, Miller, Swan 2016.

between managers and shareholders may influence UK managers to provide high levels of CSR disclosure. Fittingly, this hypothesis does not consider all those cases in which this disclosure is imposed by law. This asymmetry exists when the ownership is distinguished by the control between shareholders and managers. On the one hand, shareholders, in fact, need to know information about the risk of a certain company in order to control management affairs and policies. This the risk information is also useful to estimate future earnings and cash flows of shares. On the other hand, managers use CSR disclosure to communicate to shareholders information about the company's environmental performance (Healy, Palepu 2001; Al-Tuwaijri et al. 2004). The reason behind this choice must be found in two explanations; a higher CSR disclosure may attract more investors (Dhaliwal et al. 2011), and managers are usually incentivised with payments of shares or bonuses linked to earnings (De Klerk et al. 2015: 213). Another interesting data is the CSR disclosure level observed in environmentally sensitive industries. The association is evidentially positive as underlined by some studies (Deegan, Gordon 1996; Clarkson et al. 2011). In fact, environmentally sensitive industries are considered riskier due to their potential in developing environmental liabilities and the public concern about their activity (De Villiers et al. 2011). Thus the CSR disclosure is used by those companies to allow investors to evaluate risks' assessment. About this topic, the most recent study (De Klerk et al. 2015) has considered a sample of 89 UK companies, including banks and insurance companies, exanimated for the biennium 2007/2008 using KPMG data. The study was carried out before the new Companies' Act, so it was not influenced by current regulations. Three questions of CRS disclosure were kept in mind:

- 1) Is the GRI framework used for CSR disclosure or not?
- 2) Which level of compliance has the GRI guidelines?
- 3) Based on KPMG 2008 data collection, can we find a composite measure for the CSR disclosure practices?

Results of this study have demonstrated the above-mentioned theories. Thus higher levels of CSR disclosure by companies are associated with higher share prices, and in particular, this association is stronger if we are dealing with environmentally sensitive companies (*Fig 6.3.*). Furthermore, the CSR disclosure provides also value-relevant information to shareholders. That is mean when the CSR disclosure is provided combined with financial accounting details; market values are by far more explained than providing detailed financial accounting information.



Fig 6.3 CSR disclosure and share price in Western Markets

6.1.2 African markets

Regarding the African markets, three case studies are here presented. The first two were conducted during the 2011 year in Tunisia and Nigeria; then there is a third one for South Africa between 2012-2014 years. In the first case, 36 Tunisian companies were studied over the 2001-2005 period. The average CSR disclosure score of those companies was of 76%, considering that the Arab Institute of Business Managers established that the annual report of each company should include a section describing social and environmental data. The research has proved that the societal CSR disclosure significantly affected companies' cost of capital. Specifically, high level of disclosure is generally associated with a high cost of capitals. The highest CSR disclosure levels occurred in large companies and all those involved in non-financial sectors (Rabah Gana, Dakhlaoui 2011).

The second case - that of Nigeria - is interesting because we can have an idea of the CSR disclosure impact in developing economies. The study was based on 5 international quoted conglomerates. Those companies were randomly chosen from the database published in the Nigerian Stock Exchange Fact Books for 2001-2006. The study has shown that the size of the company and the internal economy of a country are crucial factors in the relationship between CSR disclosure and shares' value. The author, in fact, hypothesises that this relationship is positive just if applied to western economies. On the contrary, the relationship is negative in developing economies and for those small-medium companies that have to face internal factors (Oba 2011).

The third and last case study for African markets is that of South Africa. In this case, two distinguished researchers were conducted in 2012 and 2014. The first research was carri-

ed out by the same scholars who analysed the UK market (De Klerk, De Villiers 2012). Companies were chosen among the top 100 included in the KPMG 2008 dataset and the McGregor BFA database. These were analysed adopting an Ohlson model, which has indicated a strong relationship between those companies with a high CSR disclosure and high shares prices. Nevertheless, this result was partially defined by the second research by a graduate student (Marcia 2014), who analysed 82 local companies out of a list of 401 included in the Johannesburg Stock Exchange (JSE). The adopted method comprehended both International CSR disclosure standards and South African CSR measures. The study has found out that the CSR disclosure would be just a marginal factor in the increase of the market value of the equity and that, as the case of Nigeria, social, cultural and macroeconomic factors might play a more important role.



Fig 6.4 CSR disclosure and share price in African Markets

6.1.3 Asian markets

According to Friede *et al.* research (2015), Asia/Australia markets present a positive share of 33.3%. Based on KPMG (2011) dataset, about 50% of companies in the Asia Pacific has provided a CSR disclosure. In India, this phenomenon has been encouraged by the "National Voluntary Guidelines (NVG) on Social, Environmental and Economic Responsibilities of Business" issued in 2011 by the Ministry of Corporate Affairs (MCA) (Aggarwal 2013: 52). Just during 2012, the number of India companies declaring CSR information increased from 34 to about 80 (John 2012).

A similar legislative initiative was promoted in Indonesia, leading 86 local companies to report their CSR up to 2014. A recent study was conducted for the Indonesian Stock Exchange (BEI), 42 companies were analysed during years 2013-2014. This study discovered that economic, environmental, and social aspects - as part of CSR disclosure - of those companies have a positive impact on the market performance of those companies.
Thus a multifaceted CSR disclosure would positively strengthen companies 'reputation with the natural consequence of increasing their market value (Caesaria, Basuki 2017).

We cannot talk about Asian markets without mentioning China. A positive trend between CSR disclosure and ESG engagement improving was also observed in Chinese companies. A good example is provided by the State Grid Corporation of China – the largest public electric company in the world – that included CSR disclosure in the 2006 annual report. This decision led to a domino effect to other Chinese industries, in fact, if during 2006 just 32 reports including CSR were deposited, these were already 817 during 2011 (Yue 2012), reaching a peak of 1,705 in 2012 (Syntao 2013). All these reports enabled investors to evaluate ESG risk better and thus taking more accurate decisions (Li 2015).

Another case study is Thailand. Here the government and the Stock Exchange of Thailand since 2012 have constantly promoted the participation in sustainability assessment throughout annual awards and other types of incentives encouraging local companies to present CSR disclosures. Also for this country, a study measuring the CSR disclosure effect on companies was recently conducted. Differently, from the Indonesia case, the companies' sample was much greater. Indeed, 425 companies were taken into consideration and they were selected from the SETSMART database by the Stock Exchange of Thailand. In this study, the reference vintages were 2012-2014 years. The study has shown that almost the majority of those companies presented a CSR disclosure in their annual reports. However, for the first time, it was noticed that the CSR disclosure had generated a significant negative impact on companies' value. This data is remarkable if we consider that most of those companies belong to the resource industry, that is mean they are strictly connected to pollution problematics. According to the authors (Ratanacharoenchai et al. 2017), the CSR disclosure is sensitive information and this could provide positive or negative effects to the company, depending on the market sector in which this operates⁸. This study has also explained why previous studies were reporting negative data about the disclosure of CSR.



^{8.} To be honest, the authors affirmed also that the negative report of their study might have been due to the falling of oil price during the period of study.

6.2 ESG/RI Specialist investors

One of the positive elements characterising the issuance of green bonds is the fact that they attract environmentally-conscious investors who are just in sustainability projects. Green bonds are particularly attractive for some investors because they are tax-free and they contribute providing fiscal incentives to those companies that wish to invest in renewable energies. Investors that choose to invest in green bonds are specialists looking for a safe place for their investments. This is due to three important factors:

- 1) The World Bank has assigned an AAA rating to green bonds. A classification that offers a strong guarantee of investment (Trompeter 2017: 5-6).
- Governments tend to stimulate low-carbon investments by adopting some policy instruments. Those instruments have the benefit of increasing great amount of private capitals for every public dollar. With this regard, one of the countries that adopt more measures in this sense is Canada (*Fig 6.6.*) (Meadowcroft *et al.* 2012: 5).

Type of Mechanism	Policy Instruments
Regulatory Mechanisms	Feed-In Tariffs Renewable Fuel Standards Renewable Portfolio Standards/Green Certificates Best Available Technology Requirements
Tax-based Mechanisms	Capital Gains Tax Waivers R&D, Investment, and Production Tax Credits Accelerated Depreciation Carbon Tax
Carbon Market Mechanisms	Domestic Carbon Cap and Trade Project-based Carbon Credits National and Multilateral Carbon Funds
Equity Finance Mechanisms	Venture Capital, Infrastructure, and Investment Funds R&D and Project Grants
Debt Finance Mechanisms	Mezzanine/Subordinated and Senior Debt Funds Loan Softening/Guarantees Green Bonds Public/Public-Private Energy Service Company (ESCO) Funds

Fig 6.6 Government initiatives for Low-Carbon Investments in Canada (after Meadowcroft et al. 2012: tab.1)

3) Low-carbon investment opportunities are growing up fast worldwide and private investors are running parallel to institutional investors that up today constituted the 65% of investments (Meadowcroft *et al.* 2012: 14). It was calculated that investments in this field - including among the others green bonds - have grown from \$22 billion to 175-200 billion in the period between 2002-2010. Trend statistics predict that this sector will reach \$400-500 billion per year until 2020, reaching a pick of \$2.2 trillion just for the field of renewable energies (Glemarc 2011:2).

According to Hubbard (2008), the number of investors who invested in Socially Responsible Investments (SRI) has increased so much that this led to the creation of various sustainability indices, such as Dow Jones Sustainability Index, Johannesburg Stock Exchange (JSE) SRI Index, Domini Social Index (DSI), etc. Furthermore, the green market has grown so fast that already during 2014 this was oversubscribed; namely, investors demand was much higher than the availability of shares (Boulle 2014). Evidently, the issuance of a green bond is a strong signal on global markets and this attracts peculiar investors increasing the demand on the shares and consequently raising the prices. Indeed, shareholders can be distinguished into three categories: traditional investors supporting mutual or pension funds, hedge fund investors, and CSR investors (Dimson et al. 2015) The CSR investors aim to improve companies'social and environmental issuance. It is important to remind that this kind of investors are not neutral since they decide to invest their funds exclusively in carbon-free projects (Barnea et al. 2005: 334). The positive effect of investors' activism in increasing shares value might be evident or behind the scenes. As a matter of fact, even if investments reach companies through private channels the increase of shares value could be measured before the market is aware of this (Becht et al. 2009; Doidge et al. 2015). In other cases, the impact of green investors is not perceived in the future since this is mirrored through high current earnings. This is explained by the fact that this type of investors does not choose a company depending on the CSR disclosure, because they are focused just on the green impact of that company, independently from future earnings. Data from the CSR disclosure might be used just to value societal benefits. In fact, when dealing with green economy both investors and managers are aware that costs of the company in green investments might exceed their financial benefits, at least in terms of immediate future. Thus ESG investors are more worried about the social impact of their investments rather than the effective costs of the company. This is also reflected in the behaviour of some managers, which voluntary decide not to report the amount of green investments in their annual reports. Doing so, potential investors can be more attracted in a particular company just because of its activism in a green project, but at the same time, these are not bothered by financial issues (Martin, Moser 2014).

In Europe, ESG investors are particularly supported by the role of the banks. Over 221 public banks offer in fact benefits to this type of investors (Schmit *et al.* 2011: 17, 30). Their multiplayer roles consist mainly of smoothing investment barriers, preventing market failures, and above all mobilise huge capitals to devolve to the green economy. From

the investors' point of view, banks have a pivotal role. As financial institutions, they can design finance mechanisms focusing on specific targets, provide investors financial and technical support, and act as intermediaries between investors and projects to be fund and/or companies (Fig 6.7) (Meadowcroft et al. 2012: 16-19). Concerning the technical support, in fact, banks can involve third parties as an engineer, carbon finance experts or specialists in the field of the green economy (Raingold 2010: 19). As intermediaries between parties, they can link different kinds of investors, such as pension funds, insurance companies, small-medium firms, private banks and building owners. Furthermore, specifically for the low carbon industries often public banks offer loan guarantees, lines of credit and insurance support (Cameron, Blood 2009: 12). Public banks also have the potential of reducing the low-carbon investment risk of the share; sometimes this results in lowering the transition cost. In addition to the just mentioned advantages, we should keep in mind that green bonds are bought and traded mostly by banks. This is because they are long-term and constant investments providing reliable returns. Green bonds are attractive more than other types of bonds because they are simple, transparent and large. These three characteristics make them worthy of attracting a wide range of investors both in the private and public sectors (Raingold 2010:13, 32).

Coming back to the relationship between CSR disclosure and potential investors, a recent study (Barko *et al.* 2017: 18-19, 32, tab.3) has measured investors activism in 660 global companies over the 2005-2014 period. Researchers discovered that a company with a lower ESG score is more likely to be targeted by potential investors. The effect of these investors on each company is modest in terms of accounting performance measures, but a positive effect is instead observable with the sales grow. With regard to this interesting phenomenon, the growing interest of RI investors has reflected also in this type of funds, is superior compared to conventional funds (Kempf, Osthoff, 2007; Zheng, 2011). Just to give an idea, Xingye Green Investment Fund and HSBC Low Carbon Pioneer Fund both rank in the top 3 per cent of 1,242 Chinese public funds. More recently, in China but also in other developed countries where it is measured an increasing presence of retirees, investors in pension funds are encouraged adopting ESG criteria during the investment process.

Public Banks	Type of Bank & Year of Inception	Mission	Domestic Strategic Priorities	Environmental and low-carbon focus
Caisse des Dépôts – France	Development Bank (1816)	A public group and long-term investor serving the general interest and the economic development of the country.	Companies; Social Housing; Universities; and Sustainable Development	Promotes a low-carbon economy; Focus on renewable energy, climate protection, and biodiversity; Sustainable municipal infrastructure; and Responsible investments
Cassa Depositi e Prestiti – Italy	Public/private deposit and investment bank (1850)	Manage the savings of postal workers; Support growth of country in major strategic sectors; Long-term international institutional investor.	Infrastructure; transportation networks; local public services; public building; social housing; energy; communications, SMEs; Export finance; Research and innovation; and Environment	Infrastructure; Transportation networks; Energy efficiency; Renewable energy; and Trans-European networks
European Investment Bank – EU	Investment Bank (1958)	To further the objectives of the EU by making long-term finance available for sound investment	SMEs; Social & Economic Imbalances; Environment; Energy; ICT; and Trans-European networks	Climate change; Environmental Protection; Sustainable Communities; Energy Security; and Trans-European transport, energy, and communications networks
Green Investment Bank – UK	Investment Bank (2012)	To support the delivery of the UK's emission reduction targets through public- private investments that address market failures and investment barriers	Deliver low-carbon future	Renewable energy; Energy efficiency; Transmission of electricity; Distribution of electricity; and Infrastructure
Instituto de Crédito Oficial – Spain	Investment Bank	To promote any economic activity which merits development due to its innovative, social, cultural or ecological significance.	SMEs; Infrastructure;	Energy efficiency; Eco-innovation, Sustainable mobility; Retrofit of housing; Renovation of urban districts and rural areas; Renewable energy; and Climate change
KfW Bankengruppe – Germany	Promotional Bank (1948)	The improvement of the economic, social and environmental conditions in Germany	SMEs; Municipal and social infrastructure; and Sustainability	Housing, home modernization and energy conservation; Renewable energy; Energy efficiency and corporate environmental protection; and infrastructure
Nordic Investment Bank – Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, and Sweden	Investment Bank (1975)	To promote the growth of member countries by providing long- term complementary financing, based on sound banking principles, to projects that strengthen competitiveness and enhance the environment.	Competitiveness: large energy projects, infrastructure, R&D, manufacturing processes, and SMEs.	Environment: clean production, resource management, environmental technology, emission reductions, renewable energy.

Fig 6.7 European Banks active in green economy (after Meadowcroft et al. 2012: tab.6)

6.3 The Green Bond Premium and the Greenium

The last reason to explain the positive impact of Green label as a source of fund for a company is given by two fundamental financial aspects of the GB instruments: the Green Bond Premium and the Greenium.

6.3.1 The Green Bond Premium

The green bond premium is defined as the difference in terms of yield between a green bond and common bond. This parameter shows the discount an issuer obtains from the market if he chooses between a green bond or a standard bond. From an issuer point of view, obtaining a green bond discount, which is a negative green bond premium, means to get finance with lower funding costs.

It is clear that a company which receives fund at lower cost will be rewarded by the market. This is why the negative green bond premium has been chosen as a possible reason to explain the positive effect of the green bond announcement on the share price.

The green bond premium is sustained by literature, in particular, Zerbib (2017) deeply analysed the evidence of the lower green bond yield compared to the standard bond one. His research is conducted on EUR and USD green and standard bonds. It is shown that during the entire 2016, the green bond premium is negative both for the USD bonds and EUR bonds. It is shown a significantly average negative green bond premia equal to -8bps for all the Investment Grade Bonds, -5bps and -2bps for what concerns the USD and EUR bonds with an issued amount larger than 100 USD million and for a reduced sample of below AAA-rating bonds, the green bond premium is respectively equal to -9bps and -4bps for USD and EUR categories.

Following it is possible to see how the Green Bond change during 2016 for the 4 cluster of bonds considered in the analysis.



Fig 6.8 EUR Green Bond Premium in 2016 (Rating<AAA, Issued Amount> USD 100 mln) (Zerbib, 2017)



Fig 6.9 10 USD Green Bond Premium (Issued Amount > USD 100 mln) (Zerbib, 2017)



Fig 6.10 USD Green Bond Premium (Rating< AAA, Issued Amount > USD 100 mln) (Zerbib, 2017)



Fig 6.11 Green Bond Premium (Issued Amount > 100 USD mln) (Zerbib, 2017)

The same results are obtained by Natixis (2017) report which confirms that the negative green bond premium is decreased (increase the difference between standard bond yield and green bond yield) also during 2017.

6.3.2 The Greenium vs the new issue premium

The new issue premium is an extra yield that the issuer offers to the buyer when compared to the seasoned vanilla bond from the same issuer. This new bond has a higher yield and it stands above the yield curve constructed from existing debt. This choice is made by the issuer in order to attract new investments and it is really common the bond market. The Greenium, instead, is an opposite effect. This happens when the issuer offers a new bond with a lower yield and it is discovered as quite usual for the green bond market as discovered from the CBI during the entire 2017. So the Greenium phenomena enhance the possibility for the issuer to receive fund at a discounted price. It is clear that gives an extra impact also on the issuer company's financial performances explaining the positive market reaction to the announcement of green bond issuance. The CBI provides several examples of the presence of the Greenium, in particular, it is chosen the Intesa Sanpaolo IMI green bond because it is also considered in the regression model of this research study.

Intesa Sanpaolo (EUR) exhibits a slight greenium



Fig 6.12 Intesa Sanpaolo Greenium (Green Bond pricing in the primary market, cbi)

This aspect is more common for private company or government but as shown it is also a presence in the public firms.

6.3.3 How to explain the Green Bond Premium and the Greenium

Green Bond Premium and Greenium are untypical characteristics for debt capital market, but these could be justified. The reasons behind these two phenomena are mainly two: the shortage in the supply of this Green Bond and the high demand for these financial instruments.

The market, in fact, asks for a huge volume of Green Bond and it is shown by the fact that on the secondary market, according to CIB report (2017) and Financial Times (2017) and as shown below by the comparison of the Bloomberg Barclays global aggregate which is one of the most representative index for the financial market and the S&P Green Bond Select that tracks the green bond market performance.



Fig 6.13 Bloomberg Barclays Globale Aggregate vs S&P Green Bond Select (seekingalpha.com/article/4133827-rising-noise-esg-green-bonds)

In the secondary market, in fact, there is a strong request for the Green Bonds because these financial instruments suffer lower volatility compared to other instruments granting more stability during volatile times. Moreover, Green Bonds reach the interests of non-traditional investors, for example, ESG Investors, as shown in the previous chapter, so the demand is incredibly high. On the other hand, the supply is still limited. The reason behind is explained by the long time and high cost in the assessment and certification of the green bond standards. In fact, a bond to receive the green label must be linked to a green project which must be evaluated not only for the financial characteristic, but it is also put under the microscope in terms of ecological impact. This activity is costly, and last long time and so, it is a sort of deterrence for the potential issuer company.

For this reason, there is a really a large bid-ask volume spread. Probably, this will thin by the standardisation of the assessment process and also after the choice of a unique Green Bond certification as a standard. For this aspects, the yield advantage given by the Green bond will last just a few years.

7. Future Research and conclusions

7.1 Future Research and analysis

The purpose of this chapter is to present some potential future alternatives of research based on the results of the analysis of this document.

Studies which are identified hereinafter are either relevant to corporate finance or to financial markets.

The first potential research is represented by the assessment of the economics related to Green Bonds issuance, from an issuer perspective rather than an investor's one.

Companies issuing bonds are interested in the impact this have in terms of potential value creation for the company, since debt allows investing in the short term but has to be repaid with interests in the long run.

By issuing a Green Bond rather than a standard corporate bond, a company can benefit from three positive impacts: (I) as per the results presented in this document a higher share price and more attention and reputation from investors, (II) lower bond yield to maturity and thus lower cost of debt and (III) tax benefits in the form of tax credits or other fiscal incentives.

Interesting could be to combine the impact of these three factors on company's value and measure from a quantitative point of view the valuation premium generated in this way. The second suggested study is more related to the ways of financing socially desirable outcomes and aims at answering the question: how much Governments and Supranational Entities can leverage on Green Bonds to finance a transition to low carbon economy? Climate change is an international issue of global reach, but this change has to be financed aligning this socially desirable outcome to investors' interest in having financial returns. Therefore, a study can be conducted to analyse the value creation for governments when

they raise capital through Green Bonds and finance environmentally friendly projects. Measuring how much value is created is difficult from a quantitative perspective, but research can be done in order to understand the potential value streams better. The third potential analysis is relevant to the benefit from a further study for asset managers and other specialised investors.

If the results of this study are shown to be true, one could model an optimal portfolio strategy to fully capture the value generated by the announcement of the issuance of Green Bonds.

Since the phenomenon of Green Bonds has yet not fully reached its potential and maturity, this strategy at the beginning of its application could find a market which is still not fully reactive and hence leverage on the arbitrage opportunity.

The last potential future analysis is instead related to a phenomenon called the "Greenwashing": it happens when companies do not disclose completely the use of proceeds coming from Green Bonds and issue securities with this "ticket" even if the reality is that the use of proceeds is not compliant to the Principles.

As it is shown in chapter 1, this is possible due to the lack of regulation and standardisation of these securities.

However, like in any other similar situation characterised by information asymmetry, the market necessarily reacts to this lack of transparency by setting a higher yield to maturity to not transparent issuers.

One, to better understand the premium for information transparency, could perform an in-depth analysis of stock returns at the announcement of Green Bonds issuance in case of a company issuing a bond fully compliant to Green Bonds Principles versus the case of a company not disclosing the use of proceeds.

A last suggested point of development stems from one of the three factors explaining the correlation between Green Bonds issuance and premium and share prices: the attractive-ness these instruments have on ESG / RI specialised investors.

Climate change, intended as a social issue, has started to capture people's attention some decades ago but investors in financial and private equity markets started to invest in environmentally friendly projects since only a few years.

The reason behind this is that traditionally Oil & Gas has always been considered as a more profitable sector allowing higher returns in lower time, but nowadays a stronger financial culture has highlighted the potential of investments in renewables.

The renewable sector, like any other infrastructural sector, is characterised by a low equity IRR but low risk as well, hence perfectly suitable for pension funds or other specialised investors with these characteristics of investments.

It is probably by the combination of these financial needs and the increasing appeal of Green Finance (as an instrument to finance the Green transition) that Environmental Social and Governance (ESG) and Responsible Investment (RI) companies were born. In order to do further research based on the analysis presented in this document, one could make an in-depth analysis of these investors and how intense is their investments activity in green energy shares and bonds.

The final purpose of this analysis could be helpful to understand ESG/RI investor's impact on financial markets and how green securities' prices are sensitive to their decision.

The abovementioned points of future studies are suggested by the authors of this paper and do not represent the only possible alternatives nor have been assessed in detail in order to explain their feasibility and/or effectiveness.

The reader should consider that a lot of research could be done on Green Bonds due to the high potential these instruments have.

Broader research on this argument could be done from standards definition to mechanisms of substitutions to traditional government mechanisms which finance environmentally friendly projects.

7.2 Conclusions

This section summarizes the results of the Research Study, showing the initial objectives of the thesis and if these are reached or not.

The research study drives the reader across different research questions and answers. The main aim of the analysis was to discover if the debt capital markets, in particular, a bond emission could impact the Equity capital markets and moreover to try to understand if the Green bond emission could have a different effect.

It is possible to summarise this first main target as follow:

"Does a bond emission impact on the issuer's stocks value?" "Is it possible to recognize a different effect for green bonds emissions?"

At the end of this research study, the answers are clear. A bond emission could influence the issuer's shares price, but this is not common for every type of bonds. In fact, according to this analysis, that is not true for every bond but it is surely and statically confirmed for the green bonds. The Green Bond effect is discovered positive on the CAR value considering different time periods. This effect, instead, is not confirmed enlarging the event window of analysis. It is not possible to consider the long run effect on the green bond label due to the fact that green bond issuance by listed company started in 2013 and so the sample is not sufficiently large to make a statistically significant analysis.

Summarizing it is possible to state that a green bond emission has a positive short term positive effect which slightly increases the value of the issuer's stocks. Moreover, for the standard bonds, this evidence is not found out. These results push the research to the next question:

"Why does green label give a positive return for the issuer?"

This third question is solved on the base of a deep academic research. According to the review academic and professional literature, the potential reasons behind the positive effects are three:

- The corporate social responsibility transparency increases if the funding of a project is sustained by a Green Bond. In fact, an issuer to receive the green label on a bond must disclose all the information related to the project to be financed and the certification company assess all the information to mark the bond as green or reject it.
- The Green bonds due their ecological characteristic has a larger "audience" compared to the traditional bond. The no traditional investor as ESG ones are interested in funding the green project behind the bond. Meanwhile the traditional investors are interested in the green bond because these presents a lower risky and less affected by the market volatility
- The Green bond allows a lower cost of funding because they have a lower interest rate and it is confirmed also in situation of new issuance. The reason behind the low yield is the high request both on the primary and secondary market. Reducing the problems related to the long time to assess the greenness of the bond and the cost of the valuation, the supply of Green Bond will increase and probably this advantage will be reduced.

These three reasons have opened a wide range of possible future researches.

According to the authors of this research study, it should be interesting to analyse the sustainability of green bonds advantages, the application of this study in the asset management field. Moreover, it must be important to observe the green bond certification markets, in fact, once a single standard will be defined, the practise for the green bond label assessment will be standardized and unambiguous promoting an additional growth

of the Green Bond market particularly in terms of supply.

In conclusion, the thesis reaches the initial target and demonstrate that the green bond brings benefit not only for the environment but also for the wealth of the financial markets and moreover it provides several foods for though that should be interested to deeply analyse.

References

Allouche, J., Laroche, P., "A Meta-Analytical Investigation of the Relationship Between Corporate Social and Financial Performance", in *Revue de Gestion Des Ressources Humaines* 57, pp. 1–18, 2005.

Al-Tuwaijri, S.A., Christensen, T.E., Hughes, II, K.E. "The Relations among Environmental Disclosure, Environmental Performance, and Economic Performance: A Simultaneous Equations Approach", in *Accounting*, *Organizations and Society* 29, pp. 447-471, 2004.

Aggarwal, P., "Sustainability Reporting and its Impact on Corporate Financial Performance: A Literature Review", *in Indian Journal of Commerce & Management Studies* 4.3, pp.51-59, 2013.

Aupperle, K.E., Archie, B.C., John, D., Hatfield, J.D., "An Empirical Examination of the Relationship Between Corporate Social Responsibility and Profitability", in *Academy of Management Journal* 28.2, pp. 446–463, 1985.

Barko, T., Cremers, M., Renneboog, L., "Shareholder Engagement on Environmental, Social, and Governance Performance", in *ECGI Finance Working Paper* 509, pp.1-56, 2017.

Barnea, A., Heikel, R.L., Kraus, A., "Green Investors and Corporate Investment", in *Structural Change and Economic Dynamics* 16.3, pp.332-346, 2005.

Barth, M.E., Clinch, G., "Scale Effects in Capital Markets-Based Accounting Research", in *Journal of Bu*siness Finance & Accounting 36.3/4, pp. 253-288, 2009.

Becht, M., Franks, J., Mayer, C., Rossi, S., "Returns to Shareholder Activism: Evidence from a Clinical Study of the Hermes UK Focus Fund", in *Review of Financial Studies* 22.8, pp.3093-3129, 2009.

van Beurden, P., Gössling, T., "TheWorth of Values – a Literature Review on the Relation Between Corporate Social and Financial Performance", in *Journal of Business Ethics* 82.2, pp.407–424, 2008.

Bodansky, D., "The Paris Climate Change Agreement: A New Hope?", in *American Journal of International Law*, May 2016.

Boulle, B., "The Dawn of an Age of Green Bonds?", in Green Economy Coalition, March 12, 2014.

Caesaria, A.F, Basuki, B., "The Study of Sustainability Report Disclosure Aspects and their Impact on the Companies' Performance", in *SHS Web of Conferences* 34, pp. 1-5, 2017.

Cameron, J., Blood, D., "Catalyzing Capital Towards the Low-Carbon Economy", in *Climate Council: 03 Thought Leadership Series*, Copenhagen, 2009.

Choi, B.B., Lee, D., Psaros, J., "An Analysis of Australian Company Carbon Emission Disclosures", in *Pa-cific Accounting Review* 25.1, pp. 58-79, 2013.

CICERO, Framework for CICERO's 'Second Opinions' on Green Bond Investments, April, 2016.

Clarkson, P., Overell, M., Chapple, L., "Environmental Reporting and its Relation to Corporate Environmental Performance", in *Abacus* 47.1, pp. 27-60, 2011.

Deegan, C., Gordon, B., "A Study of the Environmental Disclosure Practices of Australian Corporations", in *Accounting and Business Research* 26.3, pp. 187-199, 1996.

De Klerk, M., De Villiers, C., "The Value Relevance of Corporate Responsibility Reporting: South African Evidence", in *Meditari Accountancy Research* 20.1, pp. 21-38, 2012.

De Klerk, N., De Villiers, C., Van Staden, C., "The Influence of Corporate Social Responsibility Disclosure on Share Prices", in *Pacific Accounting Review* 27.2, pp. 208 – 228, 2015.

De Villiers, C., Van Staden, C.J., "Shareholders' Requirements for Corporate Environmental Disclosures: a Cross Country Comparison", in *British Accounting Review* 42.4, pp. 227-240, 2010.

Dhaliwal, D.S., Li, O.Z., Tsang, A., Yang, Y.G., "Voluntary Non-Financial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting", in *The Accounting Review* 86.1, pp. 59-100, 2011.

Dimson, E., Oğuzhan, K., Xi, L., "Active Ownership", in Review of Financial Studies, 28.12, pp.3225-3268, 2015.

Dixon-Fowler, H.R., Slater, D.J., Johnson, J.L., Ellstrand, A.E., Romi, A.M., "Beyond 'Does It Pay to Be Green?' A Meta-Analysis of Moderators of the CEP–CFP Relationship", in *Journal of Business Ethics* 112.2, pp.353–366, 2013.

Doidge, C., Dyck, A., Mahmudi, H., Virani, A., *Can Institutional Investors Improve Corporate Governance Through Collective Action*. Working paper Rothman School of Management, University of Toronto, 2015.

Ehlers, T., Packer, F., "Green Bonds. Certification, Shades of Green and Environmental Risks", in *G20 Green Finance Study Group*, 2016, pp. 1-11.

Ehlers, T., Packer, F., "Green Bond Finance and Certification", in *BIS Quarterly Review September 2017*, 2017, pp. 89-104.

Friede, G. Busch, T., Bassen, A., "ESG and Financial Performance: Aggregated Evidence from More than 2000 Empirical Studies", in *Journal of Sustainable Finance & Investment* 5.4, pp. 210–233, 2015.

Glemarec, Y., "Catalyzing Climate Finance: A Guidebook on Policy and Financing Options to Support Green, Low-Emission and Climate-Resilient Development", in *United Nations Development Programme*, New York, p.2, 2011.

Griffin, J.J., Mahon, J.F., "The Corporate Social Performance and Corporate Financial Performance Debate: Twenty-Five Years of Incomparable Research", in *Business & Society* 36.1, pp. 5–31, 1997.

Hassel, L., Nilsson, H., Nyquist, S. "The Value Relevance of Environmental Performance", in *European Accounting Review* 14.1, pp. 41-61, 2005.

Healy, P.M., Palepu, K.G. "Information Asymmetry, Corporate Disclosure, and the Capital Markets: A Review of the Empirical Disclosure Literature", in *Journal of Accounting & Economics* 31.1/3, pp. 405-440, 2001.

Hoepner, A.G.F., McMillan. D.G., "Research on 'Responsible Investment': An Influential Literature Analysis Comprising a Rating, Characterisation, Categorisation and Investigation.", in *SSRN Electronic Journal*, pp.1–84, 2009.

Hubbard, G., "Beyond Accounting–Assessing the Impact of Sustainability Reporting on Tomorrow's Business Discussion Paper", in Tomorrows Company. The Institute of Chartered Accountants in England and Wales, 2008.

John, S., "80 Indian Companies Are Now Doing Sustainability Reporting", in *The Times of India*, December 11, 2012.

International Capital Market Association, *The Green Bond Principles 2015*, March, 2015. International Capital Market Association, *The Green Bond Principles 2016*, June, 2016. Kempf, A., Osthoff, P., "The Effect of Socially Responsible Investing on Portfolio Performance", in *European Financial Management* 13.5, pp. 908-922, 2007. KPMG International Survey of Corporate Responsibility Reporting, 2008. KPMG International Survey of Corporate Responsibility Reporting, 2011.

Li, Q., "Responsible Investment in China", in Hebb, T., Hawley, J., Hoepner, A., Neher, A., Wood, D, *The Routledge Handbook of Responsible Investment*, London, 2015.

Marchia, A., *The Value Relevance of Corporate Responsibility Reporting in South Africa*, University of the Witwatersand, 2014.

El Mar Miras-Rodríguez, M., Carrasco-Gallego, A., Escobar-Pérez, B., "Are Socially Responsible Behaviors Paid Off Equally? A Cross-Cultural Analysis", in *Corporate Social Responsibility and Environmental Management* 22.4, pp. 237–256, 2015.

Martin, P., Moser, D.V., "Managers' Green Investment Disclosures and Investors' Reaction", in AAA 2012 Management Accounting Section (MAS) Meeting Paper, 2012.

Margolis, J. D., Walsh, J. P., "Misery Loves Companies: Rethinking Social Initiatives by Business", in *Administrative Science Quarterly* 48.2, pp.268-305, 2003.

Miller, A., Swann, S., "Climate Change and the Financial Sector: A Time of Risk and Opportunity", in *Georgetown Environmental Law Review*, pp.1-30, 2016.

Moody's Investors Service, Green Bonds Assessment (GBA), March 2016, 2016.

Murray, A., Sinclair, D., Power, D., Gray, R., "Do Financial Markets Care about Social and Environmental Disclosure? Further Evidence and Exploration from the UK", in *Accounting, Auditing & Accountability Journal* 19.2, pp. 228-255, 2006.

Oba, V., "Impact of Corporate Social Responsibility on the Market Value of Quoted Conglomerates in Nigeria", in *Journal of Accounting and Finance* 1.3, pp. 64-70, 2011.

Orlitzky, M., Schmidt, F. L., & Rynes, S. L., "Corporate Social and Financial Performance: A Meta-Analysis", in *Organization studies* 24.3, pp. 403-441, 2003.

Rabah Gana, M., Dakhlaoui, M., "Societal Information Disclosure and The Cost of Equity: The Case of Tunisian Companies", in *Global Journal of Management and Business Research* 11.7, pp. 1-25, 2011.

Raingold, A., Financing the Future: A Green Investment Bank to Power the Economic Recovery, Aldersgate Group, 2010.

Ratanacharoenchai, C., Rachapradit, P., Nettayanun, S., "Sustainability Reports and Its Effect on Firm Value in Thailand", in *Proceedings of 41st International Business Research Conference* 20 - 21 April 2017, Imperial College, London, UK, 2017.

Revelli, C., Viviani, J.L., "Financial Performance of Socially Responsible Investing (SRI): What Have We Learned? A Meta-Analysis", in *Business Ethics: A European Review* 24.2, pp.158–185, 2015.

Rowley, T., Berman, S., "A Brand New Brand of Corporate Social Performance", in *Business & Society* 39.4, pp. 397–418, 2000.

Patten, D.M., "The Relation Between Environmental Performance and Environmental Disclosure: A Research Note", in *Accounting, Organizations and Society* 27.8, pp. 763-773, 2002.

Schadewitz, H., Niskala, M., "Communication Via Responsibility Reporting and its Effect on Firm Value in Finland", in *Corporate Social Responsibility and Environmental Management* 17.2, pp. 96-106, 2010.

Schmit, M., et al., «Public Financial Institutions in Europe. Brussels", in European Association of Public Banks, 2011.

Solomon, J.F., Solomon, A., "Private, Social, Ethical and Environmental Disclosure", in *Accounting, Auditing & Accountability Journal* 19.4, pp. 564-591, 2006.

Standard & Poor's, "Green Evaluation Analytical Approach", in S&P Global Market Intelligence, April 2017, 2017.

Syntao, A Journey to Discover Values 2012 - 2013: A Study of CSR Reporting in China, 2013.

Trompeter, L., "Green is Good: How Green Bonds Cultivated into Wall Street's Environmental Paradox", in *Sustainable Development Law and Policy Brief XVII. 2*, pp.4-11, 2017.

VV. AA, Green Bonds. A Fresh Look at Financing Green Projects, EY Building a Better Working World, 2016.

Yue, H., "Assuming Responsibility", in Beijing Review 2012.

Zheng, R., "Does Social Responsible Investment really work? An Empirical Study on Chinese Case", in *Working Paper*, 2011.

Sarah Bracking (2015) Performativity in the Green Economy: how far does climate finance create a fictive economy?, Third World Quarterly, 36:12, 2337-2357, DOI: 10.1080/01436597.2015.1086263

Michael Flaherty, Arkady Gevorkyan, Siavash Radpour, Willi Semmler, "*Financing climate policies through climate bonds – A three stage model and empirics*"

John A Mathews & Sean Kidney (2012) Financing climate-friendly energy development through bonds, Development Southern Africa, 29:2, 337-349, DOI: 10.1080/0376835X.2012.675702

Patrick Reed, Data-Driven Green Bond Ratings as a Market Catalyst

Andreas Karpf and Antoine Mandel, *Does it pay to be green? A Comparative Study of the Yield Term Structure of Green and Brown Bonds in the US Municipal Bonds Market*

Frank Packer, Torsten Ehlers, Green bond finance and certification

Olivier David Zerbib, The Green Bond Premium

Websites

www.about.bnef.com/new-energy www.borsaitaliana.it www.climatebonds.net www.carbontrust.com www.money.cnn.com www.newsroom.unfccc.int/lpaa/business www.theguardian.com/business www.bis.org/publ/qtrpdf/r_qt1709h.htm seekingalpha.com/article/4133827-rising-noise-esg-green-bonds

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