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Green bond premiums: A comparison between the primary and secondary debt capital markets

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Abstract

Could green bonds act as a relatively cheap alternative to conventional bonds when aiming to fund sustainable investments? An increased need to allocate funds towards carbon neutral projects in recent years has spurred a rapid growth of the green bond market. However, not enough evidence to support a consensus exists regarding the pricing of green bonds. By examining euro denominated bonds issued between 2015 and 2021, I find that the bond spread negatively correlates with the green labelling of a bond for larger corporate issued bonds, as well as banks in the primary market. I also find that this negative correlation follows through to the secondary market, albeit smaller, by observing the bond spread of the sample set three months after issue. Lastly, green bonds issued by corporates tend to display a greater negative green premium if the bond is externally reviewed by a secondary party. These findings suggest that green bonds can act as instruments to fund sustainable projects while not being financially disadvantageous, and instead potentially be financially beneficial compared to conventional bonds.

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1 Introduction

The aim of this essay is to examine bonds linked to sustainable investments issued both in the financial and non-financial sector, which have seen an uptick in popularity among issuers. This will be conducted by analysing potential discrepancies in pricing between green denominated bonds and conventional bonds issued by corporate- and financial entities in the primary market. Next, the bond pricing in the secondary market of each issue will be applied to the same statistical model as the price of issuance for each bond. The results will then be compared and analysed to further understand the differences and similarities in market behaviours relating to sustainable financial instruments.

1.1 Background

Limiting the environmental impact caused by fossil fuels will be crucial to combat climate change and to transition into a more sustainable economy. An important part of this transition is the acknowledgement of potential costs associated with environmental risks for companies and markets worldwide (White, 1996). With support of national strategies and global agreements such as the 2015 Paris agreements on climate change, limiting the global warming effect to 2 degrees, the financial industry is increasingly incentivised to adjust and decarbonise.

This is also prevalent in the bond market, where in recent years it has become increasingly common to denominate certain characteristics to bonds, similar to the purpose of covenants. Some examples of these labels are "ESG" (Environmental, Social, Governance), "green", and "sustainability" where each of these labels modify the bond in some way. For instance, funds acquired from issuing a green bond should predominantly be used towards projects that have a net positive influence on the environment (Mercer, 2015). The first green bond issued by the European Investment Bank (EIB) in 2007 marked the start of the emerging green bond market, and by 2015 the market amounted to roughly 40bn USD (International Finance Corporation, 2016). By the end of 2016, China had entered the green bond market, adding to the total amount issued that year to 95 bn USD (OECD, 2017), which pencilled a growth of about 100% compared to previous year. Since then, the green bond market has grown rapidly from being a niche market to what could be characterized close to a mainstream market (Liaw, 2020; Monk and Perkins, 2020).

As shown in Figure 1, an extraction from the sample set used in this analysis, the green bond market is projected to continue to grow given the current data.
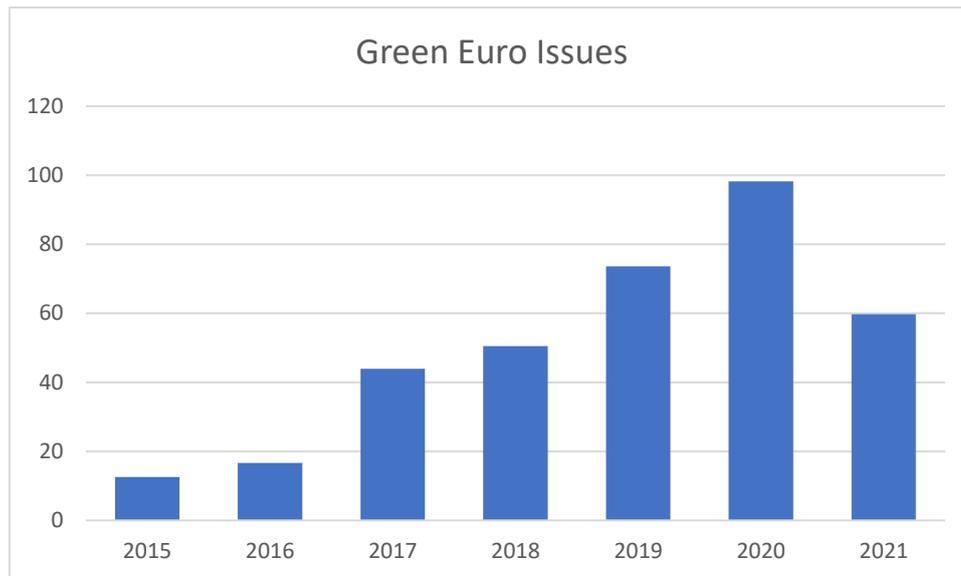
Figure 1. Yearly supply of green bonds issued in euro from 2015 to YTD Q1 2021.

Using environmentally linked bonds as instruments to accelerate sustainable development has become an increasingly popular tool for reaching the goals of the Paris Agreements and the Sustainable Development Goals (SDG). Especially the Nationally Determined Contributions (NDC), a key part of the reporting system of the Paris Agreement, have acted as a growth catalyst for the green bond market globally, partly explaining the growth in supply of green bonds from 2015 and onwards (Tolliver et al., 2019, 2020). Consequently, apart from subsidies and taxes, the green bond market has shown to contribute towards achieving the NDC targets in some scenarios (Fatica and Panzica, n.d.).

Despite the frequent use of the term "green bond" when referring to environmentally focused financial instruments, no current universal definition - legal or otherwise - exists for these types of bonds. However, in 2014, the International Capital Markets Association (ICMA) published a framework to recognise such bonds. Along with the rapid growth of the green bond market, ICMA updated its framework in 2018 to define green- and sustainability bonds based on four core components, with the first component stating that the use of proceeds will exclusively go towards financing Sustainable activities (ICMA, 2014;2018). Furthermore, following the Green New Deal in 2015, the European Commission took upon itself to create a regulatory framework for sustainable- and green investments called the EU Taxonomy. This framework aims to standardise the criteria needed for bonds to receive certain environmentally linked labels, where 100% of the proceeds needs to be aligned with the EU Taxonomy framework (European Commission, 2020).

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1.2 Problem definition and Hypotheses

This thesis aims to research whether there is a statistically significant difference in bond pricing between vanilla bonds – a regular type of bond that holds no special characteristic - and green bonds. A discrepancy could potentially be explained in part due to the perceived additional value that a bond can hold due to having a green label, as the European Commission had no official definitive standardised definition of a euro green labelled bond before 12th of July 2020 (European Commission, 2020).

To analyse this hypothesis, the primary market and secondary over-the-counter market will be examined following the structure of Gianfrate and Peri (2019), with the intent to analyse the sample using robust OLS-regressions. Subsequently the differences and/or similarities between the two markets will be analysed to see whether the behavioural trends persist. The following hypotheses will be explored:

$$H_{0,1}: Green = 0 \quad H_{1,1}: Green \neq 0 \tag{1}$$

$$H_{0,2}: SPO = 0 \quad H_{1,2}: SPO \neq 0 \tag{2}$$

The two hypotheses will be tested in both the primary- and secondary debt market. The first hypothesis aims to find discrepancies in pricing between vanilla bonds and green bonds, while the second hypothesis aims to find discrepancies in pricing between vanilla bonds and green bonds that have been reviewed by a second party, certified. These secondary-party reviews are made by parties external to the issuer, with the goal to independently approve the validity of a green bond denomination and thereby lowering the information asymmetry between investor and issuer. Popular external reviewers include Sustainalytics, Viego Eiris, CICERO, Oekom Research, CBI, and DNV GL (Ehlers and Packer, 2016).

By comparing the primary- and secondary debt market using the same data and methodology, the result might present an educational link between the two markets, which could potentially give insight towards further research within the subject. As the green bond market continues to grow, but remains immature, it can prove difficult to expect a telegraphed result. Given that green bond issuances on the primary market are still comparably few, a statistically significant premium pricing might be more likely to be found on the secondary market as the data might be more consistent and without as many outliers. A second theory supporting that statement

considers the investment goals of portfolio managers to hold a certain percentage of sustainable investments (Sievänen et al., 2013), which could boost green bond premium if investors stray towards secondary market investments rather than primary market purchases. A reason to prefer secondary market investment opportunities could be the desirability to know whether the asset in question show tendencies towards higher liquidity, which might be restricted in a primary market purchases due to market uncertainty.

1.3 Purpose

The primary purpose of this thesis is to analyse whether there are comparative differences, or similarities, between the primary and secondary debt capital markets for green bonds. For instance, if there is no statistical price difference between Green and vanilla bonds in in the primary market, there might be a pricing difference in the secondary market. Hence, it can potentially be lucrative for investors such as pension funds and asset managers to purchase green bonds in the primary market, and thereafter sell the bonds in the secondary market for a profit. Additionally, it is becoming increasingly common for financial institutions and other players active in the debt capital markets to allocate a certain percentage of funds towards sustainable investments (Sievänen et al., 2013; Woods and Urwin, 2010). Therefore, knowing which market to invest in is key to achieve maximum returns.

Exploring the perspective from the issuer side of a bond transaction - finding a statistical significance that green bonds inhibit large price differences compared to vanilla bonds would help issuers consider environmentally friendly bonds as financially beneficial. Also, if a large enough difference in pricing between externally reviewed green bonds and regular green bonds is observed, the evidence could act as motivation for issuers to strike a comparatively more attractive deal. For instance, paying to certify a new issue from CBI at a cost of 0.1 bps (Wurgler, 2018) could prove to be financially sound if the price difference exceeds the total cost of certification.

By investigating the hypotheses discussed in the previous section, the variables of interest will act as determinants to explain whether the markets perceive green denominated bonds to be more attractive compared to conventional bonds. With the recent standardised framework for green bond labelling, this thesis can be a catalyst for further research into market perceptions of green debt with regard to the EU Taxonomy and possible effects the Covid-19 pandemic.

2 Literature review

The emerging market of sustainable investing has increased rapidly in recent years, including more than 1,100 institutions committed to have part of their portfolio comprise of sustainable investments (UNEP, 2013). A prominent example is the increase in sustainable investments by pension funds, as highlighted by Studies by Woods and Urwin (2010), and Sievänen et al. (2013). Both examine sustainable investments strategies of Anglo-American and European pension funds, presenting increases in interest particularly among Scandinavian and English pension funds.

Furthermore, Baulkaran (2019) finds that the stock market perceives new green bond issues positively, resulting in positive abnormal returns for the issuer, and by issuing green bonds firms can improve environmental performance (Flammer, 2021). He explains the effect by arguing that sustainable financing enhances value and mitigates overall risk through green project investments. An example that illustrates the effectiveness of sustainable investing through the funding of green bonds are the green bond issues of French energy company EDF, where its green bonds significantly outperformed its vanilla bonds in the year of 2013 (Baulkaran, 2019). The finding is further supported by Schuller et al. (2020), who compare the bond spread of EDF's green bonds over its vanilla bonds in 2019, finding matching results, implying consistency between the stock- and bond market over time.

Another development is the impact of green score ranking of bonds. Yadav et al. (2016) find that investors perceive announcements from high green score ranking firms positively, and after controlling for industry and firm specific effects, firms with repeated green rankings have a significantly higher standardised cumulative abnormal return (SCAR) compared to firms with negative or non-increasing environmental performance.

The increased demand for sustainable investments could partly support evidence of green bonds being issued and trade at a premium, lower yield. Fatica et al. (2020) examine the primary bond market in the US using an OLS regression, reporting a green bond premium among municipal and corporate issuers, while not finding a significant green premium for financial issuers. By studying 121 European green bonds, Gianfrate and Peri (2019) report a negative green premium, seeing a stronger effect for larger corporate issuers. The green premium is shown to persist onto the secondary market, albeit smaller, through observing bond yields at three different dates with an increment of 6 months after issue. Further green premiums are observed in the secondary markets by Zerbib (2017) for bond sizes larger than 100 million USD, and

subsequently a negative premium for both USD and EUR bonds using a matching method comparing synthesised vanilla bonds and green bonds (Zerbib, 2017, 2019).

In contrast, Karpf and Mandel (2017) find no significant green premium when examining a sample ranging from 2005 to 2016, and when analysing volatility of green bonds and vanilla bonds, Pham (2016) concludes that green bonds are riskier based on a sample of daily data from 2010 to 2015. Private investors are cautious to sustainable investing, partly due to short investment horizons and volatility within this the mentioned field (Paetzold and Busch, 2014).

To explain this further, research by Peloza et al. (2012) explore the differences between how stakeholders perceive sustainable investing compared to the corporate reality of sustainability, finding key difficulties for companies to differentiate themselves and their sustainable investments in a meaningful way. The mixed results from previous studies conflict with the consensus that green bonds trade at a negative premium. However, MacAskill et al. (2021) and Liaw (2020) present that the majority of studies considered in their meta-analyses indicate the presence of a green premium, naming differences in methodology and sample time frame as reasonings for mixed results.

Without existing legal frameworks to regulate the labelling of green bonds, frameworks like the EU Taxonomy (European Commission, 2020) and the ICMA Green Bond Principles (GBP) (ICMA, 2018) can only act as guidelines to label financial instruments. Therefore, it is important to recognise the difficulty in defining a tangible benefit that can be explained by the standards of these bonds. For instance, Hyun et al. (2020) do not find a premium of generic green bonds. They do however further compare the premium of those green bonds to CBI certified- and other externally certified bonds, finding a statistically significant difference.

Hyun et al. (2020) go on to conclude that the difference can plausibly be explained by a lesser information asymmetry between investors and issuers. These findings align with Fatica et al. (2020) and Wurgler (2018) who examined a possible green bond premium in US municipal bonds, with results indicating a statistically significant green premium, as well as a stronger green premium effect in CBI certified green bonds.

Like others, Kapraun et al. (2021) observe that investors pay more for certified bonds in both the primary- and secondary market using a matched analysis, as well as an improved performance by green bonds issued on markets with established green segments. Additionally, Bachelet et al. (2019) find a premium for certified green bonds in the secondary market, contrary to non-certified green bonds.

The positive effects on a company's environmental performance following the issuance of a green bond are also found to be stronger if the bonds are reviewed by an external party (Flammer, 2021). External party reviews are utilised by issuers and investors as a way to legitimise green bonds, given the aforementioned lack of legal frameworks for green financial instruments. It also contributes to reduce greenwashing, however, there is still limited capacity in reviewing post-issuance reporting of green bonds (Ehlers and Packer, 2016). Ehlers and Packer (2017) conclude that investors value green bonds to be certified at issuance, although no evidence suggests green bonds outperform vanilla bonds in the secondary market.

3 Methodology

Investment-grade (IG) credit rated issues, characterised as being rated at S&P's BBB-equivalent or higher by the largest credit agencies, are not measured by price or yield. Instead, the common industry methodology to quantify a bond's performance is through a so-called bond spread, while high yield bonds (non-IG) are measured in yield. The pricing of the bond is then measured using the bond spread variable, plus a benchmark rate called a mid-swap.

A mid-swap is the average of bid and ask swap rates. These swap rates are used as benchmark when calculating the interest rate cost of issuing a bond. The bid rate is the fixed rate that is received in an exchange for that floating rate, in this case Euribor, and vice versa for the ask rate. This mid-swap can be viewed as the cost that need to be paid to intermediaries to be allowed issuing, while anything above the mid-swap is paid to whoever purchases the bond.

The bond spread is the difference in yield between the mid swap and the total yield of the bond, expressed in basis points (bps). The main reason why the bond yield is measured in basis points instead of percentage points is due to differences among bond spreads potentially being incredibly small, yet significant.

To avoid conversion complications, the pricing of the bond will be stated in bond spreads, and the mid-swap is implied to always add onto the bond spread to derive the final pricing. The bond spread itself does therefore have a negative correlation with the bond price. An increasing disparity between the bond price and face value - where the bond price is lower than the face value - will have a higher bond spread to compliment a constant yield to maturity often pre-set by the issuer.

3.1 Data

The primary debt capital market will be researched using the data of IG euro-denominated bond issues with an amount issued of at least 50 million euro, spanning from 1st of January 2015 to 28th of April 2021, retrieved from the database InformaGM. The total sample consists of 321 green bonds, where 203 green bonds have been reviewed by an external party. The motivation for the selection of the time span is that 2015 is the year the Green New Deal was struck at the Paris climate summit – sparking further expansion of the emerging market of green denominated bonds. Using a longer time span could also provide a control sample that would skew the results as the green bond market previous to 2015 was not as mature as recent years. Therefore, to avoid the possibility of capturing anomalies among green bonds due to immature

market conditions, samples prior to 2015 will be excluded. Moreover, to account for some outliers and maintaining simplicity, all floating bonds will be excluded.

Instances which are not associated with an International Securities Identification Number (ISIN) will be excluded as these identification codes are used to collect fixed effect data. Table 1 displays the relevant control variables and variables of interest, along with the number of observations, mean, median, standard deviation, min, and max.

Table 1						
Name	N	Mean	Median	SD	Min	Max
Bond Spread	4796	79	63	80	-48	756
Green	4796	0	0	0	0	1
SPO	4796	0	0	0	0	1
Term (Yr)	4796	8	7	4	0	30
Amount (€) (Millions)	4796	765	650	481	50	5000
iTraxxMain	4796	63	61	14	41	121
Stoxx600	4796	375	378	27	288	442
Sector	4796	5	3	4	2	13
Credit Rating	4796	6	7	3	1	10
Callable	4796	0	0	0	0	1
Covered	4796	0	0	0	0	1
Government Backed	4796	0	0	0	0	1
Frequent Issuer	4796	1	1	0	0	1
Subordinated	4796	0	0	0	0	1
ECB Portfolio	4796	0	0	0	0	1

Bond Spread is the outcome variable of the analysis and acts as a proxy for yield. Green, SPO, Covered, Subordinated, Callable, ECB Portfolio, Frequent Issuer and Government Backed are all dummy variables and does therefore have a binary min-max of 0 and 1.

The Green, Term and Amount variables are extracted directly from the InformaGM dataset. Secondary Party Opinion (SPO) data is extracted from the database Dealogic and its deal description variable from a filtered selection of financial and corporate bond issues between 2015 and April 2021. Thereafter, the data points are paired with the original InformaGM dataset based on the ISIN codes of each bond. The remaining variables have been extracted based on the ISIN codes using the Bloomberg Terminal.

The Variables Green, SPO, Amount, Sector, Callable, Covered, Government Backed, Frequent Issuer, Subordinated and ECB Portfolio are treated as fixed effects, which means these variables do not change over time. Table 2 displays a statistics summary of the variables that can potentially change in the secondary market analysis.

Table 2

Name	N	Mean	Median	SD	Min	Max
Bond Spread	3701	72	58	73	-32	692
Liquidity	3701	7	6	3	-3	46
Maturity	3701	8	7	4	2	30
Credit Rating	3701	6	7	3	1	18
iTraxxMain	3701	63	61	13	41	125
Stoxx600	3701	377	380	26	304	445

Bond Spread is the bid spread retrieved from Bloomberg 3 months after the issue date. The Liquidity variable is a proxy for liquidity that captures the difference between the bid spread and ask spread, recorded 3 months after issue. Maturity is the Term minus 84 days. Credit Rating is mostly similar to the Credit rating in the primary market analysis but captures potential downgrades and upgrades in issuer credit rating in the 3-month window.

Swap Spread is based on the market close bid spread 60 workdays after issue, Maturity is the Term reduced by 84 to account for the progression in bond maturity. The iTraxxMain and Stoxx600 indices are adjusted for the new dates of Swap Spread observations.

3.2 Methodology and analysis

As mentioned, Green is a dummy variable extracted from the original dataset and holds the value 1 if a bond is categorised as green, 0 otherwise. Term is the term to maturity for each bond, measured in years. The SPO dummy holds the value 1 for all green bonds that have been reviewed by a secondary party, which in turn could imply a reduction in information asymmetry is valued by investors. Amount is the total amount issued in millions for each instance in euro.

The Credit Rating variable is sourced from the InformaGM, which in turn sources its credit rating data directly from S&P's Capital IQ, Moody's, and Fitch. The credit rating data from each agency is thereafter compiled using a Visual Basic macro, which pessimistically grades the compiled credit rating by prioritising the lowest rating when 2 or more credit ratings are present for a single issuer. The compiled rating is then converted to display the S&P credit rating scale.

The Sector and Credit Rating variables are designed as categorical variables in Stata and their break-up allocations can be seen in Table 3 and Table 4, respectively, similarly done to Fatica et al. (2020) and Wurgler (2018).

Table 3			
SECTOR	Freq.	Percent	Cum.
Banks	2,270	47.33	47.33
Financial	253	5.28	52.61
Consumers	253	5.28	57.88
Manufacturing	107	2.23	60.11
Basic Materials	183	3.82	63.93
Auto	255	5.32	69.25
Utilities	355	7.4	76.65
Energy	132	2.75	79.4
Technology	268	5.59	84.99
Commercial	242	5.05	90.03
Health	205	4.27	94.31
Real Estate	273	5.69	100
Total	4,796	100	

Table 3 displays each sector and its occuring frequency in the data sample. The corporate category is captured by pooling all sectors with the exception of "Banks" and "Financial".

Table 4			
Rating	Freq.	Percent	Cum. %
AAA	1,006	20.98	20.98
AA+	143	2.98	23.96
AA	129	2.69	26.65
AA-	203	4.23	30.88
A+	353	7.36	38.24
A	457	9.53	47.77
A-	386	8.05	55.82
BBB+	753	15.7	71.52
BBB	806	16.81	88.32
BBB-	560	11.68	100
Total	4,796	100	

Table 4 disaplys the break up of each pooled investment grade credit rating. Note. the AAA rated category captures covered bonds issued by entities rated AAA, although the parent bank itself might not hold the equivalent rating.

The base data for each category in the Sector variable is extracted from the Bloomberg Mnemonic instrument INDUSTRY_SECTOR, and thereafter pooled into the categories displayed in Table 3. Table 4 shows a large portion of the dataset to be AAA rated, however,

the dataset treats entities that issue covered bonds as separate from their parent banks, resulting in a high number of AAA bonds issued as these entities tend to have a high credit rating. A second reason for this is due to higher ratings among banks and larger corporations - notably before the spread of Covid-19 in 2020. It is worth highlighting that this dataset is treated as cross sectional, therefore, an entity can hold two different ratings at two different issue dates. The Credit ratings observed are issuer ratings and not issue ratings; therefore, bonds issued by the same entity on given date will have the same credit rating.

A callable bond will have its term adjusted to the callable date instead of the term estimated based to be the maturity date if the bond is not called, as the industry practice is to calculate callable bond spreads based on the callable date. This industry practice can be reasonably motivated as the general approach is for issuers, especially corporate, to call their bonds in times of low interest rates (Jarrow et al., 2010), a trend that is recognised in the time frame of the sample. The Callable dummy aims to capture the cost of the call option for the issuer, and is therefore assumed to hold a positive correlation with the outcome variable.

While it is desired to include data from as recent as possible, it is important to account for the 2020-2021 Covid pandemic as both equity- and debt markets fluctuate heavily based on speculation during times of uncertainty. To account for this, the iTraxxMain and Stoxx600 variables are included in the regression analysis as proxies for the bond- and stock market, respectively. The European Central Bank (ECB) has been increasing its activity in the primary markets since the start of the Covid pandemic from March 2020 and onwards to combat market volatility. The ECB Portfolio dummy variable aims to capture some of the tightening effect on bond spreads that is influenced by quantitative easing policies, which artificially drives up demand for any bonds eligible for purchase by the ECB (European Central Bank, 2021). The ECB Portfolio dummy holds the value 1 if a corporate bond is- or has been held by the ECB and purchased through the Corporate Sector Purchasing Programme (CSPP) or Pandemic Emergency Purchase Programme (PEPP). The ECB provides limited access to information related to quantitative easing for banks, such as portfolio holdings of the ECB Covered Bonds Purchasing Programmes (CBPP1, CBPP2, CBPP3). Therefore, this thesis does not explore to control for quantitative easing for financial bonds. Previous literature has found evidence that quantitative easing through the CBPPs does affect market conditions (Beirne et al., 2011), suggesting that this is an area open for improvement, and further research is encouraged.

Government Backed bonds are issued by entities that are government guaranteed – meaning the government steps in during financial hardship to avoid bankruptcy and default. All bonds that are corporate hybrids, Perpetuals, and generic subordinated holds the value 1 for the Subordinated variable in the dataset. Covered- and ECB Portfolio bonds are applied to banks only and corporates only, respectively. These two dummy variables might therefore display an unexpected impact on the outcome variable in the main regression due to the average bond spread for non-covered bonds being influenced by corporate issued bond spreads, and vice versa for ECB held bonds and financial issues.

The variable Frequent Issuer is a Dummy variable based on country origin to account for emerging markets (Fatica et al., 2020), if an entity issues a bond from a country which often hosts an entity issuing in Euro, the variable holds the value 1. To clarify, if an entity in the country of origin has issued in total > 20 bonds in the dataset, the country – and therefore the bond - gets pooled into Frequent Issuer = 1, otherwise 0.

The secondary market data is extracted from the Bloomberg terminal using the bond ISINs. Additional to the primary market regression model, the bid- and ask bond spread difference of each bond acts as a proxy for liquidity, similarly done by Hyun et al. (2020), Zerbib (2019), and Febi et al. (2018). Although credit ratings would be assumed to stay largely the same within a 3-month period, the dataset includes the start of the Covid-19 pandemic from March 2020 and onwards, where changes in credit ratings have been mostly downgrades. Due to this skewing effect, credit ratings are gathered again in the secondary market at the date of the new bond spread observation.

Both the primary- and secondary debt market analyses are conducted through a linear multivariate regression, robust OLS, using the statistical software Stata:

$$y_i = \beta_0 + \beta_1 Green_i + \beta_2 \Upsilon_i + \varepsilon \qquad (3)$$

Where Υ represents the fixed effects of the regression. To check for further regression robustness, subsets of the dataset are regressed and analysed to verify the quality of the model chosen. Financial- and corporate bonds are regressed separately to determine the effect of the variable of interest, as well as the control variables.

3.3 Methodology Limitations

It is important to note that the secondary market analysis inhibits some substantial limitations. Due to limited data accessibility and time constraint, the secondary market analysis will only include 1 spread observation per bond, which could also potentially reduce the accuracy of the analysis, as potential spread anomalies will be interpreted as valid data. As there is only 1 spread observation, the dataset can however be treated as cross sectional, again, limiting the potential accuracy of the analysis, but also simplifying enough to fit the time frame. Lastly, the secondary market data, retrieved from the Bloomberg terminal, contain some missing values – possibly due to already matured bonds not having readily accessible bond spread data.

The EU Taxonomy framework has been created as a standardisation tool to easily recognise sustainable financing and avoid "green washing" – a term commonly used to define activities that try to appear environmentally friendly, while not being so. However, this framework was only put in place and enforced starting from the 12th of July 2020 (European Commission, 2020). Before this date, there were only guidelines in place as for what can be constituted as a green bond, which means some bonds might have been denominated with an environmental label as a form of green washing.

4 Results and Interpretations

4.1 Primary Market

The regression outcome using the Green- and SPO dummies, as well as the previously mentioned control variables can be seen in table 4. Each variable of interest is accompanied by a second regression only accounting for bonds with an amount equal to- or higher than €500 million, called a benchmark bond size. While the SPO dummy shows a statistically significant negative effect of -7.965 and -9.197 for benchmark and above, the Green dummy variable is not statistically significant at the 0.05 level for all bonds but shows a significant effect of -7.289 for benchmark and above.

Table 5

Amount	All T-statistic	500m+ T-statistic	Amount	All T-statistic	500m+ T-statistic
Green	-5.050*	-7.289***	SPO	-7.965**	-9.197***
	(2.634)	(2.553)		(3.251)	(3.211)
Term	2.378***	2.617***	Term	2.375***	2.615***
	(0.167)	(0.176)		(0.167)	(0.175)
Amount	0.002*	0.005***	Amount	0.003*	0.005***
	(0.001)	(0.001)		(0.001)	(0.001)
iTraxxMain	1.158***	1.196***	iTraxxMain	1.157***	1.195***
	(0.088)	(0.091)		(0.088)	(0.091)
Stoxx600	-0.183***	-0.190***	Stoxx600	-0.184***	-0.191***
	(0.042)	(0.044)		(0.042)	(0.044)
Sector	1.594***	1.051***	Sector	1.591***	1.050***
	(0.280)	(0.285)		(0.280)	(0.285)
Credit Rating	15.683***	15.398***	Credit Rating	15.712***	15.442***
	(0.364)	(0.390)		(0.364)	(0.391)
Callable	6.256***	7.223***	Callable	6.247***	7.210***
	(1.933)	(2.022)		(1.933)	(2.022)
Covered	8.975***	6.866***	Covered	8.980***	7.001***
	(2.044)	(2.194)		(2.035)	(2.188)
Government Backed	-8.949***	-12.895***	Government Backed	-9.289***	-13.352***
	(2.888)	(3.130)		(2.878)	(3.113)
Frequent Issuer	-35.973***	-34.514***	Frequent Issuer	-36.015***	-34.455***
	(2.999)	(3.330)		(3.001)	(3.325)
Subordinated	128.978***	128.609***	Subordinated	128.900***	128.558***
	(5.580)	(5.925)		(5.578)	(5.927)
ECB Portfolio	-14.669***	-13.042***	ECB Portfolio	-14.627***	-12.987***
	(1.914)	(1.960)		(1.914)	(1.962)
Constant	-22.825	-24.300	Constant	-22.212	-24.091
	(20.649)	(21.445)		(20.669)	(21.467)
Observations	4,796	4,266	Observations	4,796	4,266
R-squared	0.672	0.677	R-squared	0.672	0.677

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 displays the regreesions based on the total sample of financial- as well as corporate bonds.

Comparing all four regressions: the lower negative coefficient output of the SPO dummy variable implies a stronger effect on the bond spread compared to the Green dummy. This indicates an appreciation among investors when issuers commission a secondary party opinion on their new environmentally conscious issuances.

Both regression outputs show a positive effect of the Covered dummy, implying that a covered bond would statistically have a higher bond spread compared to its senior counterpart. This fundamental contradiction can be explained by the non-financial bonds captured in the Covered variable which would hold the value 0.

The Amount variable is not statistically significant at an alpha of 0.05 but is however statistically significant when only regressing on instances that have €500m+. This implies that issues with an amount <€500m could negatively correlate with the Swap Spread, or that the effect would be highly disruptive – obscuring the statistical effect of bonds with >€500m.

By splitting the dataset into Corporate- and financial bonds, it is possible to further check the robustness of the data while also examining how different segments are affected by the control variables. Similar to Table 5, Table 6 is broken up into two sections with two regressions each. The table displays results similar to the regressions in Table 5; at an alpha of 0.05, Corporate green bonds do not trade at a significantly lower bond spread compared to its non-green counterpart, while green bonds with a secondary party opinion do.

When only considering observations with an amount larger than €500m, again, both the Green and SPO dummy variables show a negative correlation with the bond spread - indicating a premium at issue for benchmark bonds. As previously observed, the Amount variable is not statistically significant at the 0.05 level, while the variable shows a significant effect for €500m+, further supporting the theory of contradicting effects of the Amount variable depending on the size of the issue. Furthermore, companies where a government guarantees to cover defaults, the protection from insolvency does not seem to affect the bond spread for corporate bonds.

Table 6

Corporates					
Amount	All	500m+	Amount	All	500m+
Green	-6.008	-11.309**	SPO	-12.001**	-16.859***
	(4.560)	(4.539)		(4.884)	(4.922)
Term	2.790***	3.054***	Term	2.782***	3.039***
	(0.230)	(0.228)		(0.230)	(0.228)
Amount	0.007*	0.012***	Amount	0.007*	0.012***
	(0.004)	(0.004)		(0.004)	(0.004)
iTraxxMain	1.762***	1.878***	iTraxxMain	1.758***	1.875***
	(0.148)	(0.160)		(0.148)	(0.160)
Stoxx600	-0.167**	-0.153**	Stoxx600	-0.170**	-0.157**
	(0.070)	(0.073)		(0.070)	(0.073)
Sector	2.989***	1.943***	Sector	2.988***	1.922***
	(0.385)	(0.392)		(0.387)	(0.392)
Credit Rating	16.891***	16.669***	Credit Rating	16.886***	16.673***
	(0.624)	(0.649)		(0.626)	(0.652)
Callable	4.208*	4.309*	Callable	4.263*	4.261*
	(2.382)	(2.530)		(2.381)	(2.526)
Covered	-	-	Covered	-	-
Government Backed	-7.578	-4.639	Government Backed	-7.673	-4.634
	(6.069)	(6.544)		(6.065)	(6.550)
Frequent Issuer	-66.237***	-70.939***	Frequent Issuer	-66.476***	-70.976***
	(6.324)	(7.391)		(6.341)	(7.374)
Subordinated	152.639***	155.808***	Subordinated	153.009***	156.155***
	(10.106)	(10.399)		(10.080)	(10.395)
ECB Portfolio	-10.152***	-9.542***	ECB Portfolio	-10.007***	-9.420***
	(2.117)	(2.157)		(2.114)	(2.162)
Constant	-70.060**	-75.017**	Constant	-68.309*	-72.822**
	(35.117)	(36.938)		(35.123)	(36.855)
Observations	2,273	2,030	Observations	2,273	2,030
R-squared	0.526	0.552	R-squared	0.527	0.553
Robust standard errors in parentheses			Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1			*** p<0.01, ** p<0.05, * p<0.1		

Table 6 displays the regreesions based on the sample of corporate bonds. The Covered dummy variables is omitted as corporates do not issue covered bonds.

The Callable variable does not show statistical significance for any regressions of the corporate sub-sample at the 0.05 level. As mentioned in the previous section, all callable bonds in the dataset have their Term adjusted to the callable date. This discrepancy between dates should practically impact how large the effect on the bond spread could be. Table 7 shows the median difference in number of days between the callable date and the maturity date, where the norm for corporates seems to be roughly 3 months, and 1 year for the equivalent statistic of banks.

Table 7					
Callable Bonds	N	Mean	Median	Min	Max
Corporates	1649	400	91	0	20272
Banks	202	816	365	0	7305

Table 7 displays the total number of callable bonds for each category, as well as the median, and mean number of days differentiating the original marutity date to the callable date.

As seen in the regressions of bonds issued by banks in Table 8, the Callable dummy variable is statistically significant at the 0.05 level in all four regressions, which could be explained by the longer median difference in days between callable- and maturity dates.

Table 8						
		Banks				
Amount	All	500m+	Amount	All	500m+
Green	-6.485***	-6.018***	SPO	-4.710	-2.787
	(2.030)	(2.102)		(2.941)	(3.051)
Term	1.318***	1.430***	Term	1.334***	1.448***
	(0.145)	(0.171)		(0.144)	(0.171)
Amount	0.003**	0.003***	Amount	0.003**	0.003***
	(0.001)	(0.001)		(0.001)	(0.001)
iTraxxMain	0.462***	0.479***	iTraxxMain	0.463***	0.481***
	(0.072)	(0.075)		(0.072)	(0.075)
Stoxx600	-0.219***	-0.227***	Stoxx600	-0.222***	-0.229***
	(0.045)	(0.047)		(0.045)	(0.047)
Sector	-	-	Sector	-	-
Credit Rating	13.890***	13.443***	Credit Rating	13.939***	13.495***
	(0.421)	(0.446)		(0.424)	(0.449)
Callable	19.239***	21.146***	Callable	19.197***	21.102***
	(4.646)	(4.831)		(4.653)	(4.836)
Covered	4.105**	2.802	Covered	4.555**	3.396
	(2.065)	(2.341)		(2.067)	(2.345)
Government Backed	-14.855***	-17.373***	Government Backed	-15.010***	-17.531***
	(2.553)	(2.950)		(2.541)	(2.951)
Frequent Issuer	-15.138***	-11.505***	Frequent Issuer	-15.213***	-11.549***
	(2.263)	(1.944)		(2.267)	(1.946)
Subordinated	88.773***	88.884***	Subordinated	89.049***	89.256***
	(8.003)	(8.870)		(8.000)	(8.866)
ECB Portfolio	-	-	ECB Portfolio	-	-
Constant	36.537*	35.995*	Constant	36.703*	35.422*
	(19.714)	(20.690)		(19.733)	(20.714)
Observations	2,270	2,019	Observations	2,270	2,019
R-squared	0.752	0.748	R-squared	0.752	0.747

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 displays the regreesions based on the sample of bonds issued by banks. The Sector- and ECB Portfolio dummies are omitted.

Green bonds show a significant negative correlation with the bond spread at the 0.05 level, but the green bonds that have been reviewed by a secondary party do not show a statistically significant correlation to the bond spread. Naturally, the ECB Portfolio variable is omitted as no financial bonds have been purchased through the CSPP. The Covered dummy variable is statistically significant at the 0.05 level in the regressions that capture all values of the Amount variable, but the statistical significance is diminished for the >€500m sample. This could be due to almost half of the bonds with an Amount of <€500m are labelled as covered bonds, as seen in Table 9. Such a substantial reduction in covered bond sample size could potentially impact the overall confidence in the dummy as a statistical measurement in the model. A second potential reasoning is that investors perceive covered bonds and senior bonds at the same credit rating to be equally valuable, therefore instead implying the exclusion of covered bonds that are <€500m shows a more accurate regression of the true effect.

Table 9

Covered	Freq.	Percent	Cum.
0	132	52.59	52.59
1	119	47.41	100
Total	251	100	

Table 9 displays the number of covered- and non-covered bonds for bank-issued bonds with an issue size smaller than €500 million.

4.1 Secondary Market

The secondary market regressions comprise of two additional regressions for each part beyond the structure of the primary market analysis. They show not only the investment grade only results, but also the regressions of all bonds originating from the primary market bond sample set, including the bonds that downgraded to non-investment grade. Table 10 shows that the Green dummy variable correlates negatively with the Bond Spread at the 0.05 level for all regression variations when analysing the total data sample. In contrast to the primary market regressions, the Stoxx600 variable – meant to act as a proxy for macro movements – does no longer hold a statistically significant correlation with the bond spread. This also holds true for the Covered dummy variable, again, for all regression variations at the 0.05 level.

Name	All Amounts	IG Only	>€500m	IG Only
		Table 10		
Green	-5.137**	-5.342**	-5.529**	-5.790**
	(2.607)	(2.616)	(2.639)	(2.652)
Term	2.172***	2.152***	2.370***	2.344***
	(0.180)	(0.181)	(0.187)	(0.188)
Amount	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity	6.241***	6.401***	5.347***	5.583***
	(0.740)	(0.742)	(0.765)	(0.778)
iTraxxMain	0.581***	0.559***	0.631***	0.605***
	(0.095)	(0.097)	(0.098)	(0.100)
Stoxx600	-0.038	-0.044	-0.053	-0.059
	(0.044)	(0.045)	(0.044)	(0.045)
Sector	1.826***	1.913***	1.277***	1.383***
	(0.274)	(0.282)	(0.277)	(0.288)
Credit Rating	8.972***	9.113***	9.698***	9.860***
	(0.710)	(0.719)	(0.764)	(0.774)
Callable	7.584***	7.251***	6.360***	5.972***
	(2.004)	(2.017)	(2.093)	(2.108)
Covered	-6.673*	-5.540	-5.928	-4.500
	(3.848)	(3.935)	(4.126)	(4.242)
Government Backed	-21.213***	-20.043***	-21.145***	-19.464***
	(4.056)	(4.155)	(4.178)	(4.319)
Frequent Issuer	-24.837***	-24.378***	-26.884***	-26.281***
	(3.414)	(3.412)	(3.747)	(3.746)
Subordinated	112.703***	115.845***	113.186***	116.676***
	(6.192)	(6.421)	(6.566)	(6.851)
ECB Portfolio	-12.730***	-13.084***	-11.569***	-11.981***
	(1.812)	(1.817)	(1.838)	(1.846)
Constant	-58.215**	-57.169**	-51.155**	-50.706**
	(23.081)	(23.315)	(23.138)	(23.454)
Observations	3,691	3,701	3,342	3,351
R-squared	0.655	0.658	0.659	0.662

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10 displays the secondary market regressions for the total sample dataset using the Green dummy. Contrary to the primary market regressions, the Green Dummy shows a negative significant correlation with the bond spread at the 0.05 level.

As shown in Table 11, the SPO dummy variable is significant at the 0.05 level for all sub-regressions based on secondary market bond spread observations for the sample including all sectors. The negative coefficient is comparably smaller to the primary market regression of the SPO dummy. Contrary to the Green dummy variable effects, the SPO dummy indicate a stronger negative effect on sub-regressions that include all bond issuance sizes.

Name	All Amounts	IG Only	>€500m	IG Only
SPO	-8.162***	-7.835***	-10.520***	-10.128***
	(3.004)	(2.992)	(2.807)	(2.781)
Term	2.148***	2.168***	2.333***	2.359***
	(.181)	(.180)	(.188)	(.186)
Amount	0.004***	0.004***	0.004***	0.004***
	(.001)	(.001)	(.001)	(.001)
Liquidity	6.409***	6.249***	5.587***	5.351***
	(.742)	(.740)	(.777)	(.765)
iTraxxMain	0.557***	0.578***	0.600***	0.626***
	(.097)	(.095)	(.10)	(.098)
Stoxx600	-0.045	-0.039	-0.06	-0.054
	(.045)	(.044)	(.045)	(.044)
Sector	1.914***	1.827***	1.380***	1.274***
	(.282)	(.274)	(.288)	(.277)
Credit Rating	9.132***	8.990***	9.883***	9.720***
	(.719)	(.710)	(.775)	(.764)
Callable	7.227***	7.560***	5.918***	6.306***
	(2.017)	(2.004)	(2.107)	(2.092)
Covered	-5.568	-6.697*	-4.64	-6.064
	-3.925	-3.838	-4.23	-4.114
Government Backed	-20.347***	-21.504***	-19.875***	-21.537***
	(4.152)	(4.054)	(4.314)	(4.175)
Frquent Issuer	-24.369***	-24.827***	-26.228***	-26.832***
	(3.416)	(3.419)	(3.739)	(3.741)
Subordinated	115.806***	112.668***	116.639***	113.155***
	(6.419)	(6.191)	(6.847)	(6.563)
ECB Portfolio	-13.037***	-12.685***	-11.883***	-11.475***
	(1.819)	(1.814)	(1.845)	(1.837)
Constant	-56.385**	-57.443**	-49.542**	-50.002**
	(23.310)	(23.075)	(23.445)	(23.130)
Observations	3,701	3,691	3,351	3,342
R-squared	0.658	0.655	0.662	0.659

Table 11

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11 displays the secondary market regressions for the total sample dataset using the SPO dummy.

Table 12 displays the corporate regressions accounting for the Green dummy variable, where the Green dummy interestingly negatively correlates with the bond spread at a 0.05 significance level, a statistical improvement to the equivalent primary market regression. Similar to the Primary market regressions however, Table 12 shows the amount not being significant at the 0.05 level for values including all bond issuance sizes, and government backed companies do not hold significant advantage over their counterpart within the corporate sample. The callable

dummy variable does also differ compared to the primary regression, as it is significant at the 0.05 level for regressions including all observations, but not the regressions including benchmark bonds only. In Table 13 we see the trend in Table 12 continued with the SPO dummy variable being significant at the 0.05 level for all regression variations. Furthermore, the trend for Amount, Stoxx600, Callable, and Government Backed bonds are in line with the regressions in Table 12.

	Table 12			
	Corporates			
	All Amounts	IG Only	>€500m	IG Only
Name				
Green	-8.787**	-8.238**	-10.345**	-9.541**
	(4.088)	(4.026)	(4.309)	(4.216)
Term	2.989***	2.970***	3.033***	3.009***
	(.253)	(.252)	(.255)	(.253)
Amount	0.005	0.005	0.008**	0.009**
	(.004)	(.004)	(.004)	(.004)
Liquidity	6.278***	6.138***	5.213***	4.959***
	(1.164)	(1.168)	(1.184)	(1.170)
iTraxxMain	0.711***	0.746***	0.775***	0.819***
	(.140)	(.136)	(.143)	(.137)
Stoxx600	-0.084	-0.066	-0.076	-0.056
	(.072)	(.070)	(.073)	(.070)
Sector	2.321***	2.276***	1.566***	1.494***
	(.364)	(.362)	(.376)	(.373)
Credit Rating	13.290***	12.992***	13.239***	12.893***
	(.995)	(.982)	(1.046)	(1.029)
Callable	4.974**	5.276**	3.741	4.150*
	(2.199)	(2.183)	(2.299)	(2.277)
Covered	-	-	-	-
Government Backed	-5.218	-6.742	-5.222	-6.973
	(6.30)	(6.302)	(6.398)	(6.388)
Frequent Issuer	-43.027***	-43.770***	-53.102***	-54.321***
	(7.324)	(7.337)	(8.438)	(8.440)
Subordinated	135.509***	127.808***	139.545***	130.552***
	(12.318)	(11.584)	(12.945)	(11.918)
ECB Portfolio	-9.095***	-9.116***	-8.579***	-8.609***
	(1.990)	(1.990)	(2.038)	(2.037)
Constant	-79.160**	-84.069**	-64.815*	-69.871*
	(38.458)	(37.770)	(39.182)	(38.172)
Observations	1,966	1,958	1,766	1,759
R-squared	0.547	0.528	0.553	0.535

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12 displays the secondary market regressions for bonds issued by corporates using the Green dummy. Covered dummy variable is omitted. The Stoxxy600 index does not significantly correlate with corporate issued bonds.

Table 13

Name	All Amounts	IG Only	>€500m	IG Only
Corporates				
SPO	-11.912***	-11.316***	-16.199***	-15.338***
	-4.218	-4.149	-4.15	-4.03
Term	2.980***	2.962***	3.016***	2.992***
	-0.253	-0.252	-0.254	-0.253
Amount	0	0	0.007*	0.009**
	-0.004	-0.004	-0.004	-0.004
Liquidity	6.286***	6.146***	5.207***	4.954***
	-1.166	-1.171	-1.182	-1.168
iTraxxMain	0.705***	0.739***	0.761***	0.806***
	-0.14	-0.136	-0.143	-0.137
Stoxx600	(.088)	(.070)	(.082)	(.061)
	-0.072	-0.07	-0.074	-0.07
Sector	2.320***	2.275***	1.559***	1.488***
	-0.364	-0.363	-0.376	-0.373
Credit Rating	13.291***	12.993***	13.245***	12.899***
	-0.995	-0.981	-1.045	-1.028
Callable	4.890**	5.199**	4	4.051*
	-2.198	-2.182	-2.296	-2.274
Covered	-	-	-	-
Government Backed	(5.274)	(6.799)	(5.349)	(7.102)
	-6.287	-6.29	-6.367	-6.357
Frequent Issuer	-42.905***	-43.662***	-53.079***	-54.317***
	-7.353	-7.368	-8.414	-8.419
Subordinated	135.538***	127.857***	139.832***	130.877***
	-12.337	-11.608	-12.96	-11.937
ECB Portfolio	-9.072***	-9.089***	-8.445***	-8.473***
	-1.995	-1.995	-2.042	-2.04
Constant	-76.487**	-81.484**	(60.555)	-65.760*
	-38.468	-37.77	-39.216	-38.191
Observations	1,966	1,958	1,766	1,759
R-squared	0.547	0.529	0.554	0.536

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13 displays the secondary market regressions for bonds issued by corporates using the SPO dummy. Covered dummy variable is omitted. Again, the Stoxxy600 index does not significantly correlate with corporate issued bonds.

Table 14 and Table 15 display the secondary market regressions for Banks, equivalent to the regressions in table 12 and 13 for corporates. What differentiates these two regression tables compared to the primary market regressions for bonds issued by banks are, like the corporate secondary markets, the Stoxx600 variable is not statistically significant in any regression variation. Also, the Covered bond dummy variable is strongly negatively correlated with the bond spread at the 0.05 level. The consensus is that collateralized bonds, such as covered bonds, do trade at a lower spread compared to its vanilla counterpart due to an associated higher issuance credit rating and payment liability structure (Packer et al., 2007). This implied negative correlation with the bond spread is however only observed in the secondary market regressions.

The Green dummy variable is not significant at the 0.05 level for investment grade only bonds when including all values of the Amount variable. Comparing the two bank regressions that target investment grade bonds, we do curiously see a statistical significance for the Green dummy when regressing on benchmark bonds only. The finding suggests that green bonds issued by banks with a smaller issue size do not trade at a premium, higher price, compared to other smaller sized conventional bonds in the same sector, obscuring the statistical significance of benchmark bonds in the sample.

Name	All Amounts	IG Only	€500m+	IG Only
Green	-5.255**	-4.954*	-5.584**	-5.259**
	(2.617)	(2.602)	(2.676)	(2.659)
Term	0.797***	0.822***	1.045***	1.075***
	(.204)	(.203)	(.221)	(.220)
Amount	0.005***	0.005***	0.003**	0.003***
	(.001)	(.001)	(.001)	(.001)
Liquidity	5.724***	5.625***	5.336***	5.216***
	(.992)	(.984)	(1.120)	(1.110)
iTraxxMain	0.278**	0.289**	0.274**	0.287**
	(.115)	(.114)	(.123)	(.122)
Stoxx600	-0.05	-0.051	-0.091*	-0.093*
	(.048)	(.047)	(.048)	(.048)
Sector	-	-	-	-
Credit Rating	5.658***	5.588***	6.450***	6.365***
	(.780)	(.770)	(.911)	(.899)
Callable	16.848**	16.866**	17.350**	17.409**
	(7.168)	(7.190)	(7.360)	(7.386)
Covered	-19.846***	-20.021***	-17.124***	-17.393***
	-3.723	-3.688	-4.393	-4.345
Government Backed	-37.333***	-37.686***	-33.939***	-34.498***
	(4.080)	(4.049)	(4.454)	(4.417)
Frequent Issuer	-6.476***	-6.768***	-4.557**	-4.841**
	(2.119)	(2.098)	(2.032)	(2.003)
Subordinated	95.381***	95.482***	93.572***	93.679***
	(6.875)	(6.875)	(7.266)	(7.271)
ECB Portfolio	-	-	-	-
Constant	-14.097	-13.344	-2.623	-1.798
	(23.812)	(23.713)	(24.540)	(24.418)
Observations	1,557	1,555	1,430	1,428
R-squared	0.733	0.734	0.736	0.737

Table 14

Banks

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14 displays the secondary market regressions for bonds issued by banks using the Green dummy. In line with primary market regressions, the Green dummy is negatively correlated with the bond spread at the 0.05 level, with the exception of the regression using investment grade-only bonds for all issue sizes.

Table 15

Name	All Amounts	IG Only	>€500m	IG Only
			Banks	
SPO	-2.362	-1.887	-3.325	-2.823
	(4.049)	(4.030)	(4.064)	(4.044)
Term	0.821***	0.845***	1.064***	1.095***
	(.202)	(.201)	(.220)	(.219)
Amount	0.005***	0.005***	0.003***	0.004***
	(.001)	(.001)	(.001)	(.001)
Liquidity	5.744***	5.645***	5.356***	5.236***
	(.992)	(.984)	(1.120)	(1.110)
iTraxxMain	0.283**	0.294**	0.282**	0.294**
	(.115)	(.114)	(.123)	(.122)
Stoxx600	-0.049	-0.051	-0.089*	-0.091*
	(.048)	(.047)	(.048)	(.048)
Sector	-	-	-	-
Credit Rating	5.679***	5.606***	6.476***	6.390***
	(.781)	(.771)	(.913)	(.90)
Callable	16.934**	16.944**	17.438**	17.488**
	(7.180)	(7.202)	(7.371)	(7.398)
Covered	-19.406***	-19.580***	-16.709***	-16.977***
	-3.699	-3.663	-4.372	-4.324
Government Backed	-37.340***	-37.675***	-34.060***	-34.599***
	(4.078)	(4.048)	(4.462)	(4.425)
Frquent Issuer	-6.584***	-6.871***	-4.625**	-4.909**
	(2.121)	(2.10)	(2.034)	(2.005)
Subordinated	95.651***	95.763***	93.791***	93.911***
	(6.895)	(6.894)	(7.283)	(7.287)
ECB Portfolio	-	-	-	-
Constant	-15.655	-14.88	-4.742	-3.869
	(23.791)	(23.690)	(24.484)	(24.361)
Observations	1,557	1,555	1,430	1,428
R-squared	0.733	0.734	0.736	0.737

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15 displays the secondary market regressions for bonds issued by banks using the SPO dummy. Similar to primary market results, the SPO dummy is not significant at the 0.05 level for any sub-regression.

5 Discussion

This chapter will discuss the presented results in more detail as well as outline potential market implications. The results present evidence that corporate green bonds reviewed by a secondary party are issued at a -12.0 bps tighter bond spread compared to their vanilla equivalent. In contrast, when including non-certified corporate green bonds in the sample, bonds are not statistically issued at a green premium. With reversed results in the financials primary market, green bonds issued by banks tend to be issued at a premium of -6.5 bps, while green bonds certified by a secondary party are not issued at a statistically significant premium.

5.1 Primary Markets

Previous studies illustrate mixed results when analysing price differences between green- and vanilla bonds in the primary market. Similar to Kapraun et al. (2021) and Bachelet et al. (2019), the findings of this thesis do not show a statistically significant green premium among corporate bonds, where the sample includes bond sizes of both benchmark and sub-benchmark. However, other evidence suggests a green premium among corporate issues can be found regardless of issue size (Fatica et al., 2020), but also when the sample consists only of larger issue sizes (€250m+) (Gianfrate and Peri, 2019). The results presented in this thesis further display a clear significant negative correlation with a coefficient of -11.3 bps for green corporate benchmark bonds in similar fashion to Zerbib (2017), who uses an issue size distinction at >$100m, and Kapraun et al. (2021) who find a green premium for very large issue sizes.

As previously stated, secondary party opinions, i.e., external reviews, can act as verification of the degree of "greenness" of a bond. Although this type of certification presents an additional potential cost for issuers, evidence supports a higher issue price for certified municipal- and corporate green bonds (Fatica et al., 2020; Kapraun et al., 2021; Wurgler, 2018; Zerbib, 2019). This amplified effect is also present in this primary market analysis, with a premium of -16.9 bps over vanilla benchmark bonds – and a 5.6 bps discrepancy over non-certified greens. This further supports the necessity of a secondary party opinion review of green bonds (Ehlers and Packer, 2017), confirming the findings of a perceived added value for investors, possibly in the form of reduced information asymmetry by Bachelet et al. (2019 and Liaw (2020), and improved credibility towards sustainable commitments for issuers (Flammer, 2021).

Several studies have demonstrated a statistically significant pricing premium in green bonds issued in the primary market by supranational institutions, with mixed results of financial institutions. Fatica et al. (2020) do not find a statistically significant effect for premiums in

green bonds issued by financial institutions between 2007 and 2018. However, others have presented supporting evidence of an amplified negative green premium for financial bonds (Zerbib, 2019). In a commercial study, Jeroen V. D. Broek et al. (2020) find that green denominated bail-in bonds issued by banks do hold a bond pricing premium over its vanilla equivalent, comparably similar to the bank-focused sub-regression of this paper, which pencils a -6.5 bps and -6.0 bps green premium all issue sizes and benchmark issues, respectively. Interestingly, the coefficient is smaller for benchmark issues, indicating a larger discrepancy among green- and vanilla bonds for smaller issue sizes.

Contrary to externally reviewed green bonds issued by corporates, this thesis does not find a significant premium among externally reviewed green bonds for banks. A possible explanation for this finding could be that due to already existing regulations, highly regarded banks do not see added value to have their green bonds externally reviewed, while the banks that do see the necessity of SPO's are already poorly regarded by investors. Like Fatica et al. (2020) observe a lower number of financial bonds certified by CBI, this paper also finds a lower number of green bonds with a secondary party opinion issued by financial firms, which could partly suggest that the sub sample is inconclusive.

5.2 Secondary Markets

When analysing green bonds in the secondary market, Kapraun et al. (2021), Zerbib (2019), Nanayakkara and Colombage (2019) find a persisting trend for bonds issued by corporates, as well as governments, that a green bonds trade at a green premium. The results of this thesis find a statistically significant negative green premium for corporate issues in the secondary market at -8.5 bps and -10.3 bps for all issue sizes and benchmark sizes, respectively. This this aligns with aforementioned findings, but in contrast to the insignificant results of this thesis' analysis of the primary market corporate bond issues. A possible explanation for this observation could be that investors perceive green bonds as illiquid, where the uncertainty is eliminated post-issuance due to green bonds having similar liquidity as conventional bonds (Febi et al., 2018), an effect amplified when issued to markets with dedicated green segments (Kapraun et al., 2021). Using an older sample from 2005 to 2016, Karpf and Mandel (2017) argue for a green premium to be non-existent but recognise a shifting trend in more recent samples.

For bonds issued by banks, the results also suggest a green premium is present in the secondary market at -5.3 and -5.6 bps. Surprisingly, the investment-grade-only regression for all issue sizes does not show a significant green premium. Although evidence exists of higher volatility

bonds enjoying a larger green premium (Agliardi and Agliardi, 2019; Zerbib, 2019), the limitations of the highly stylised secondary market analysis methodology similar to Gianfrate and Peri (2019) have to be acknowledged. The limited number of green bonds issued by banks, coupled with only one bond spread observation per issue could contribute to inconclusive results.

Similar to the primary market, the negative effect of green bonds with a secondary party opinion persists for the corporate category – consistent with the observation of non-SPO green bonds. Externally reviewed green bonds trade at -11.9 and -16.2 bps for all issue sizes and benchmark sizes, respectively. Corporate green bonds with secondary party opinions trade significantly tighter compared to its vanilla equivalent for both bond size categories, as well as tighter than non-certified green bonds. Investors seem to continue to value certified bonds in the secondary market over non-certified ones (Bachelet et al., 2019; Hyun et al., 2020; Kapraun et al., 2021). Unsurprisingly, like the results of the primary market, externally reviewed green bonds issued by banks show a non-significant negative correlation with the bond spread for all regression variations.

Comparing the results of the primary- and secondary market, the green premium is persistent, but is systematically smaller for the secondary market, in line with the findings of Gianfrate and Peri (2019). Results display a green bond premium of -11.3 bps versus -9.5 bps for corporates and -6.0 bps versus -5.3 bps for banks, which could suggest a reduced demand for green bonds in the secondary market. A lack of reporting related to proceeds could reduce the desirability of green bonds after issue (Ehlers and Packer, 2016), in addition to some market participants not valuing the sustainable value these instruments contribute (Larcker and Watts, 2019). Furthermore, accounting for the widespread quantitative easing by the ECB during the Covid-19 pandemic (European Central Bank, 2021), as evident by the significant negative coefficient in the corporate regressions of the results, the variables of interest continue to display significance in both markets, indicating an improved isolation of the green premium.

5.3 External parties

Independent actors such as the Climate Bonds Initiative and ICMA have been instrumental to the legitimacy of the green bond market by enacting a standardized framework (Monk and Perkins, 2020), differentiating green bonds from green-washed bonds (Ehlers and Packer, n.d.). CBI certified green bonds (Bachelet et al., 2019; Liaw, 2020; Wurgler, 2018), as well as other secondary party reviewed green bonds (Hyun et al., 2020) being issued and trading at a negative

yield premium suggests environmentally conscious investors value add transparency to avoid "green washing", while simultaneously providing reduced cost of capital for issuers (Gianfrate and Peri, 2019; Nanayakkara and Colombage, 2019).

Next steps in progressing the market towards environmentally friendly financial instruments will require actors to work to find a more elaborate, and universally accepted definition of green bonds to further push sustainable development (Nanayakkara and Colombage, 2019). Successfully using green bonds as a tool to combat climate change and help achieve the goals set out in the Paris Agreements (Fatica and Panzica, n.d.) could see a more widespread effect following a standardised framework, as well as an improved ability to enforce accountability by the market.

6 Conclusion

This thesis has explored whether green denominated bonds are issued and traded at a premium compared to conventional bonds, with the aim to contribute towards a more decisive theory in a landscape with historically displayed mixed results. By using previously considered control variables as well as adding a variable to control for bonds purchased by the ECB through the CSPP and PEPP in a more recent sample, this thesis provides a new dimension to the discussion, while supporting existing evidence concerning the presence of a green premium.

Results from a sample of euro denominated bonds show that green bonds issued by non-financial entities are not issued at a statistically significant premium compared to conventional bonds, while green bonds issued by banks display a negative green premium significant at the 0.05 level. Both green bonds issued by corporates and banks show a significant green premium for benchmark bonds at -11.3 bps and -6.0 bps, respectively. Additionally, Green bonds that have been reviewed by a secondary party show a stronger significant green premium at -16.9 bps for corporate benchmark bonds, while banks show no significant green premium for these externally reviewed bonds. The results suggest entities are able to issue larger sized green bonds to fund sustainable projects, amplified with external certification, compared to funding through conventional bonds.

The green premium persists onto the secondary market for benchmark bonds issued, trading at -5.6 bps tighter than conventional bonds issued by banks, and -9.5 bps tighter for corporate benchmark bonds. Green bonds with a secondary party certification trade -16.1 bps tighter than conventional corporate bonds, while it cannot be determined whether externally reviewed green bonds issued by banks trade significantly tighter than its conventional equivalent. These findings indicate that the green bond premium is comparably smaller in the secondary market for both bank- and corporate issued bonds, suggesting a higher confidence in the liquidity of green bonds post-issuance.

The evidence of a green premium can help academic researchers understand the relevance of environmentally friendly debt and its role in allocating the funds necessary to achieve the Sustainable Development Goals and the Paris Agreement. Issuers can capitalise on the perceived favourability of green bonds to more efficiently secure funds, while the evidence could help investors such as pension funds and asset managers when considering buying green bonds in the primary- or secondary market to achieve their sustainable investment targets at the highest profit.

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Appendix 1

Corporates Name	1 SwapSpread	2 SwapSpread	3 SwapSpread	4 SwapSpread	5 SwapSpread	6 SwapSpread	7 SwapSpread	8 SwapSpread
SPO								-12.001**
								(4.884)
Green							-6.008	
							(4.560)	
Term	1.160***	1.470***	1.748***	1.780***	2.840***	2.788***	2.790***	2.782***
	(.291)	(.276)	(.268)	(.267)	(.230)	(.231)	(.230)	(.230)
Amount	0.028***	0.010**	0.014***	0.013***	0.007*	0.007*	0.007*	0.007*
	(.006)	(.005)	(.005)	(.005)	(.004)	(.004)	(.004)	(.004)
Credit Rating	18.542***	16.142***	15.455***	15.475***	17.155***	16.905***	16.891***	16.886***
	(.772)	(.70)	(.665)	(.662)	(.593)	(.622)	(.624)	(.626)
Sector	2.752***	2.736***	2.962***	2.880***	2.991***	2.962***	2.989***	2.988***
	(.455)	(.440)	(.434)	(.437)	(.386)	(.386)	(.385)	(.387)
Subordinated		140.066***	144.356***	140.937***	153.282***	152.127***	152.639***	153.009***
		(11.306)	(11.237)	(11.285)	(10.110)	(10.123)	(10.106)	(10.080)
Frequent Issuer			-63.417***	-61.729***	-64.400***	-65.782***	-66.237***	-66.476***
			(6.613)	(6.598)	(6.272)	(6.333)	(6.324)	(6.341)
ECB Portfolio				-6.608***	-10.086***	-10.430***	-10.152***	-10.007***
				(2.429)	(2.118)	(2.104)	(2.117)	(2.114)
iTraxxMain					1.768***	1.762***	1.762***	1.758***
					(.148)	(.148)	(.148)	(.148)
Stoxx600					-0.165**	-0.171**	-0.167**	-0.170**
					(.069)	(.070)	(.070)	(.070)
Callable						4.053*	4.208*	4.263*
						(2.380)	(2.382)	(2.381)
Government Backed						-7.295	-7.578	-7.673
						(6.075)	(6.069)	(6.065)
Constant	-90.691***	-67.938***	-9.718	-7.407	-72.977**	-69.402**	-70.060**	-68.309*
	(8.349)	(7.366)	(8.592)	(8.671)	-34.933	-35.084	-35.117	-35.123
Observations	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273
R-squared	0.211	0.337	0.376	0.378	0.525	0.525	0.526	0.527

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Financials	1	2	3	4	5	6	7	8	9
Name	SwapSpread	SwapSpread	SwapSpread	SwapSpread	SwapSpread	SwapSpread	SwapSpread	SwapSpread	SwapSpread
SPO									-4.71
									-2.941
Green								-6.485***	
								-2.03	
Term	0.953***	0.366**	0.640***	0.677***	0.721***	1.369***	1.348***	1.318***	1.334***
	(.192)	(.152)	(.152)	(.150)	-0.147	-0.149	-0.144	-0.145	-0.144
Amount	0	0.001	0.001	0.003**	0.002**	0.001	0.003***	0.003**	0.003**
	(.001)	(.001)	(.001)	(.001)	-0.001	-0.001	-0.001	-0.001	-0.001
Sector	-	-	-	-	-	-	-	-	-
Credit Rating	15.689***	13.391***	13.480***	14.535***	14.134***	14.653***	13.926***	13.890***	13.939***
	(.388)	(.279)	(.278)	(.383)	-0.377	-0.364	-0.423	-0.421	-0.424
Subordinated		99.630***	100.246***	99.677***	92.141***	88.323***	89.408***	88.773***	89.049***
		(8.587)	(8.564)	(8.532)	-8.409	-7.992	-7.991	-8.003	-8
Frequent Issuer			-14.795***	-14.179***	-14.897***	-15.202***	-15.200***	-15.138***	-15.213***
			(2.461)	(2.466)	-2.456	-2.247	-2.274	-2.263	-2.267
Covered				9.560***	9.495***	9.515***	4.843**	4.105**	4.555**
				(1.690)	-1.661	-1.658	-2.068	-2.065	-2.067
Callable					15.491***	19.844***	19.182***	19.239***	19.197***
					-5.057	-4.663	-4.651	-4.646	-4.653
iTraxxMain						0.476***	0.465***	0.462***	0.463***
						-0.073	-0.072	-0.072	-0.072
Stoxx600						-0.221***	-0.223***	-0.219***	-0.222***
						-0.045	-0.045	-0.045	-0.045
Government Backed							-14.831***	-14.855***	-15.010***
							-2.547	-2.553	-2.541
Constant	-26.397***	-18.040***	-7.329***	-18.083***	-16.619***	30.569	36.461*	36.537*	36.703*
	(2.344)	(1.813)	(2.703)	(3.372)	-3.286	-19.812	-19.726	-19.714	-19.733
Observations	2,270	2,270	2,270	2,270	2,270	2,270	2,270	2,270	2,270
R-squared	0.612	0.707	0.711	0.714	0.717	0.75	0.752	0.752	0.752

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Corporates	1	2	3	4	5	6	7	8	9	10
Name	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread
SPO										-11.912***
										-4.218
Green									-8.787**	
									-4.088	
Maturity	1.395***	3.047***	3.014***	3.006***	3.006***	2.996***	2.980***	2.980***	2.989***	2.980***
	-0.282	-0.289	-0.263	-0.261	-0.261	-0.263	-0.253	-0.254	-0.253	-0.253
Amount	0.012**	0.021***	0.006	0.006*	0.006*	0.007*	0.006	0.006	0.005	0.005
	-0.005	-0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
Sector	2.222***	2.102***	2.140***	2.283***	2.283***	2.267***	2.401***	2.401***	2.321***	2.320***
	-0.438	-0.387	-0.37	-0.369	-0.369	-0.367	-0.358	-0.36	-0.364	-0.364
Credit Rating	16.741***	15.280***	13.491***	13.176***	13.176***	13.116***	13.458***	13.460***	13.290***	13.291***
	-1.313	-1.218	-0.965	-0.943	-0.943	-0.966	-0.977	-0.991	-0.995	-0.995
Liquidity		10.714***	8.713***	7.841***	7.841***	7.857***	6.301***	6.302***	6.278***	6.286***
		-1.222	-1.021	-1.063	-1.063	-1.064	-1.156	-1.157	-1.164	-1.166
Subordinated			130.522***	135.863***	135.863***	135.466***	139.574***	139.570***	135.509***	135.538***
			-12.758	-12.824	-12.824	-12.902	-12.302	-12.305	-12.318	-12.337
Frquent Issuer				-37.656***	-37.656***	-38.127***	-44.046***	-44.046***	-43.027***	-42.905***
				-7.326	-7.326	-7.311	-7.395	-7.397	-7.324	-7.353
Covered				-	-	-	-	-	-	-
Callable						1.468	3.976*	3.979*	4.974**	4.890**
						-2.253	-2.224	-2.225	-2.199	-2.198
iTraxxMain							0.729***	0.729***	0.711***	0.705***
							-0.141	-0.141	-0.14	-0.14
Stoxx600							-0.077	-0.077	-0.084	-0.088
							-0.073	-0.073	-0.072	-0.072
Government Backed								0.502	-5.218	-5.274
								-6.348	-6.3	-6.287
ECB Portfolio									-9.095***	-9.072***
									-1.99	-1.995
Constant	-77.217***	-161.609***	-126.739***	-84.060***	-84.060***	-84.282***	-88.525**	-88.554**	-78.473**	-76.487**
	-12.084	-14.57	-11.812	-14.81	-14.81	-14.788	-38.251	-38.345	-38.44	-38.468
Observations	1,966	1,966	1,966	1,966	1,966	1,966	1,966	1,966	1,966	1,966
R-squared	0.249	0.398	0.501	0.516	0.516	0.516	0.541	0.541	0.547	0.547

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Financials	1	2	3	4	5	6	7	8	9	10
Name	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread	bidspread
SPO										-2.362
										-4.049
Green									-5.255**	
									-2.617	
Maturity	0.449	1.022***	0.434**	0.503**	0.532**	0.644***	0.673***	0.830***	0.797***	0.821***
	-0.298	-0.267	-0.218	-0.224	-0.222	-0.217	-0.22	-0.202	-0.204	-0.202
Amount	-0.001	0.003**	0.003**	0.003**	0.001	0.001	0	0.005***	0.005***	0.005***
	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
Sector	-	-	-	-	-	-	-	-	-	-
Credit Rating	11.973***	9.379***	7.267***	7.302***	6.619***	6.575***	6.851***	5.676***	5.658***	5.679***
	-0.759	-0.726	-0.624	-0.626	-0.783	-0.782	-0.81	-0.78	-0.78	-0.781
Liquidity		8.590***	7.040***	6.997***	6.905***	6.851***	5.863***	5.749***	5.724***	5.744***
		-1.188	-0.96	-0.967	-0.963	-0.952	-1.011	-0.991	-0.992	-0.992
Subordinated			105.966***	106.243***	105.468***	95.956***	95.346***	95.835***	95.381***	95.651***
			-7.844	-7.833	-7.748	-7.166	-6.915	-6.857	-6.875	-6.895
Frquent Issuer				-4.072*	-4.793**	-5.342**	-6.640***	-6.587***	-6.476***	-6.584***
				-2.134	-2.166	-2.12	-2.046	-2.12	-2.119	-2.121
Covered					-8.874***	-8.600***	-9.624***	-19.222***	-19.846***	-19.406***
					-3.287	-3.267	-3.321	-3.694	-3.723	-3.699
Callable						15.950**	18.239**	16.914**	16.848**	16.934**
						-7.424	-7.126	-7.182	-7.168	-7.18
iTraxxMain							0.287**	0.286**	0.278**	0.283**
							-0.118	-0.115	-0.115	-0.115
Stoxx600							-0.054	-0.049	-0.05	-0.049
							-0.049	-0.047	-0.048	-0.048
Government Backed								-37.211***	-37.333***	-37.340***
								-4.079	-4.08	-4.078
Constant	-12.699***	-58.809***	-42.990***	-39.771***	-30.321***	-30.600***	-21.503	-15.941	-13.913	-15.466
	-4.098	-6.852	-5.598	-5.943	-7.512	-7.482	-24.578	-23.756	-23.808	-23.786
Observations	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557	1,557
R-squared	0.47	0.567	0.706	0.707	0.71	0.712	0.717	0.733	0.733	0.733

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1