UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

GREEN BOND ISSUANCE AND SHAREHOLDER WEALTH

ANALYZING ABNORMAL RETURNS IN AN ESG CONTEXT

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Abstract

Green bonds have garnered increased interest in financial markets and research, with some studies already demonstrating the benefits for companies in terms of lower cost of debt. However, the immediate effects and signaling value of green bond issuance remain underexplored, particularly concerning the role of a company's existing ESG profile. This study aims to investigate whether companies experience abnormal returns following the issuance of green bonds. Additionally, it examines the effects more closely for first-time issuers, considering ESG ratings as an independent variable. Using an event study approach, we find results consistent with previous research, showing abnormal returns for companies issuing green bonds, with a more pronounced effect for first-time issuers. Moreover, we find that a high ESG rating can enhance abnormal returns. Relating these findings to signaling theory, we argue that investors place significant emphasis on a company's existing reputation and ESG profile rather than solely on the signaling value of green bond issuance.

Keywords: Green Bond, Bond Issuance, ESG Score, Abnormal Returns, Event Study, Sustainable Finance, Signaling Theory

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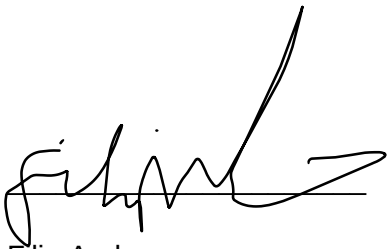

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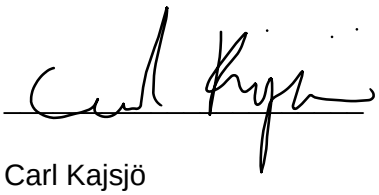

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1. Introduction

Green bonds play a vital role in the transition toward a sustainable future. Since the issuance of the first Climate Awareness Bond in 2007 by the European Investment Bank, the market has grown to become a powerful tool for financing environmentally sustainable projects (EIB, 2022). These bonds are designed to fund projects with positive environmental impacts, such as renewable energy initiatives, energy efficiency improvements, and sustainable infrastructure developments. The growth is further propelled by regulatory initiatives such as the EU taxonomy and European Green Deal with the new EU Green Bond Standard being adopted in November 2023 (European Commission, n.d.). Although the standard is voluntary, it aims to support the low-carbon transition and tackle greenwashing by providing a supervisory framework for external reviewers. It also targets some of the issues with previous standards such as definitions of eligible green projects and costly and labor-intensive review processes (TEG, 2019). With the continued paradigm shift in debt financing and regulatory intervention, there has been an increased interest in studying the effects that green financing has for companies and their stakeholders.

Previous research in the field of green bonds has shown their potential to benefit shareholders. Some scholars have investigated the concept of "greenium", wherein green bonds exhibit a premium and lower yield relative to conventional bonds (Immel et al., 2021; Arat et al., 2023). Additionally, other papers have explored event studies associated with green bond issuances, analyzing the Cumulative Abnormal Return (CAR) surrounding the event date (Baulkaran, 2019; Zhou & Cui, 2019; Tang & Zhang, 2020). Several studies have also identified higher returns for inaugural issuers (Wang et al., 2020; Flammer, 2021). Moreover, the concept of Environmental, Social, and Governance (ESG) scores and their influence on financial performance has garnered increasing attention in the research domain. For instance, companies with higher ESG ratings may benefit from lower costs of debt in comparison to their lower-rated counterparts (Immel et al., 2021).

In this thesis, we undertake a study of green bond issuances in the European market, examining the benefits of such issuances from a shareholder perspective. Employing an event study methodology akin to the aforementioned literature on market reactions to green bond issuances, we also pioneer the incorporation of ESG scores as a determinant in the analysis of abnormal returns. With this, we strive to investigate the role a company's ESG rating plays in conjunction with the issuance of green bonds. The rationale is that investors perceive companies differently based on their ESG profiles and ratings, possibly leading to varying

effects on stock prices following green bond issuance. Therefore, we will examine whether the ESG rating can help explain these stock price reactions, providing insight into how investors value this component.

Hence, the research questions of this paper are as follows:

1. Do companies that issue green bonds experience abnormal returns, and is there a different impact for first-time issuers?
2. How does the ESG score impact the magnitude of these returns, potentially enhancing or diminishing them?"

2. Literature Review

2.1. Signaling theory

Company managers possess more information about their operations than their investors do. This is also true for the assessment of a company's environmental commitment (Lyon and Montgomery, 2015). This asymmetry suggests that firms dedicated to improving their environmental impact have an incentive to distinguish themselves from firms lacking such commitment, thereby informing and attracting investors who value these efforts. In signaling theory, as proposed by Spence (1973) and further developed by Riley (1979), a signal is considered credible when it is costly for someone without the claimed intention to perform. The necessity of incurring a substantial cost makes it impractical to fake a credible signal. From this perspective, applying signaling theory can provide a deeper understanding of the value derived from issuing green bonds.

By issuing a green bond, a firm sends a signal to the market that conveys private information about its environmental commitment and sustainable practices. According to Flammer (2021), this signal is credible because issuing green bonds is a costly process. The funds from the bond are earmarked for sustainable projects, requiring the firm to allocate significant resources toward green investments. The cost is even higher if the bond is certified by a third party, which audits the process to ensure that the funds are invested according to the bond's prospectus. In such cases, the firm incurs costs for the certification itself and for dedicating time and resources to comply with the certifier's standards to maintain the green bond certification. Given the substantial costs, it is unlikely that firms without a genuine environmental commitment would issue a green bond merely to obtain a green label. Furthermore, previous studies have found a positive stock market reaction and improved financial performance when firms act in an environmentally friendly way (Klassen and Mclaughlin, 1996; El Ghoul et al, 2011; Chava, 2014; Kreuger, 2015). Therefore, if corporate green bonds authentically indicate a company's dedication to environmental concerns, it is logical to expect a positive stock market reaction following the issuance announcement.

Connecting signaling value to ESG ratings, it can be argued that when firms with low ratings issue a green bond, the signaling value is more significant because this represents new information to the market. In contrast, firms with high ratings would experience a diminished signaling effect since they have already demonstrated their environmental commitment (Tang

and Zhang, 2020). However, one could also argue the opposite: firms with low ratings might be suspected of greenwashing, which negatively affects the credibility of green signals (Seele and Gatti, 2017). Furthermore, the market might view a green bond issuance from high rated firms as a confirmation of their established environmental dedication, therefore making the signal more powerful (Immel et al., 2021).

2.2. Attributes and implications of green financing

The concepts of green bonds and sustainable finance are gaining traction in both the business and research domains. As this is a relatively new phenomenon, this segment aims to provide a summary of the general research area of green financing. Drawing on literature reviews by Bhutta et al. (2022) and Cortellini and Panetta (2021), several key topics have been identified as relevant for this study.

Firstly, the *performance of the issuer* has been studied, both on sustainability metrics and financial metrics. Several studies have shown the contribution toward fulfilling ESG objectives (Cox et al., 2004; Kim et al., 2014; Saeidi et al., 2015). For financial performance, Flammer (2021) used a comparative study approach with green and conventional bonds and found that green bond financing is associated with better performance in metrics such as ROA and ROE. The share performance in response to green bond issuance has also been studied with an event study approach in multiple studies (Zhou & Cui, 2019; Tang & Zhang, 2020; Flammer, 2021). The results of these are presented in detail in the next segment.

Moreover, green finance research has studied *ownership structure*, where the results of Tang and Zhang (2020) indicate a larger interest from investors in firms that issue green debt. Green bond issuances also gain attention from investors in the short run, consequently more interest and higher returns for investors (Pham & Huynh, 2020). The rise in investor interest could be used in conjunction with other research to explain share performance.

A third topic is the *Cost of Green Bonds and Greenium.* Several researchers have argued that green bonds help reduce the cost of debt, i.e. that green bonds have better financing terms than the conventional alternative (Chava, 2014; Zerbib, 2019; Nanayakkara & Colombage, 2019). This difference in bond financing has given rise to the concept of “greenium”, or green bond premium. Numerous studies indicate that green bonds are priced at a premium compared to traditional bonds, resulting in a yield discount and lower financing costs, translating into a reduced cost of debt for the issuing company (Hachenberg & Shiereck, 2018; Zerbib, 2019).

Lastly, a final topic of interest is the role of *ESG rating*. In a comparative study of green and conventional bonds, Immel et al. (2020) observed a negative premium ranging between 8 to 14 basis points. They also found evidence that a higher ESG score is correlated negatively with the spread. This translates to companies with a high rating from an ESG rating agency being more likely to have lower yield, i.e. cost of debt. Furthermore, the authors also argue that the reason for a higher rating seeing greater benefits is that of attracting more investors as information asymmetry is lower. This was also argued in the event study by Tang and Zhang (2020), namely that companies with a positive ESG profile have lower information asymmetry compared to those not having this rating. However, Immel et al. (2020) highlight the divergence among ESG rating agencies and advocate for a standardized rating method, similar to what Berg et al. (2022) presented in their research.

2.3. Market reaction from Green Bond issuance announcement

Looking at the shareholder benefit of green bonds, we have already seen that the cost of green debt is lower, however shareholders may benefit in other ways. Tang and Zhang (2020) conducted research on a large set of green bond issuances over ten years. Using an event study method, they found that shareholders benefit through higher stock prices, increased institutional ownership, and enhanced liquidity. However, they did not find evidence that green bonds result in a lower cost of debt.

Moreover, Flammer (2021) analyzes the economical effects of green bonds on the issuing firm, looking at the abnormal returns for the firm at and around the issuance date. She finds that the market reacts positively to the issuance announcement and that this reaction is larger for firms with no previous green bond issuances. Further, she concludes that the announcement increases the portion of green and long-term investors and that the overall ESG-rating and therefore the environmental performance of the issuer improves after the announcement. These results are in line with signaling theory which suggests that the issuing firms demonstrate their genuine dedication to the environment by issuing green bonds. Along a similar line of investigation, Baulkaran (2019) finds that the cumulative abnormal returns are positive and significant around the green bond issuance date. Regarding the determinants of abnormal return, Baulkaran (2019) further finds that firm size, growth and Tobin's Q are positively correlated to CAR whereas operating cash flow exhibits a negative relationship with the CAR.

Furthermore, Wang et al. (2020) concentrate on Chinese green bonds to investigate the stock market responses post-issuance. In contrast to Tang and Zhang (2020), they identify that the positive market reaction is accompanied by a pricing premium on the green bonds, yielding lower cost of debt than conventional bonds. Additionally, they observe that this phenomenon is more pronounced for new issuers, issuers with less concentrated ownership and those held by longer-term institutional investors. Another article investigating the Chinese market for green bonds is the one from Zhou and Cui (2019) who is looking at the stock price reaction, CSR performance and financial performance. Their findings suggest that, except for having a positive effect on the stock price as aforementioned studies, the issuance announcement has a positive impact on operational, financial and CSR performance. The authors conclude that overall, the issuance of green bonds are positive for the firm, both regarding environmental performance and shareholder value but also since it to some extent increases the number of investors.

2.4. Conventional bonds

Since the topic of green bond research is relatively young and small, previous event studies of conventional and convertible bond issuance can serve as guidance in the analysis of green bond issuance. Literature seems to agree that green bond's issuance announcements have a positive impact on the stock price of firms. The observations in the green bond market thereby contrast with the evidence from the non-green corporate bond market, where the evidence is more ambiguous and several studies find a slightly negative response from the stock market.

One of the most cited studies within the topic is the one by Dann and Mikkelson (1984) who examines a sample of 150 issuances of straight debt in the U.S. market. Their results show a marginally negative valuation effect at the announcement date. Along a similar line of investigation, Eckbo (1986) also investigates the U.S. market and a sample of 459 issuances. The author concludes that the announcement of a straight debt issuance yields on average, a slightly negative abnormal return of -0,06%. In general, what can be concluded from the studies observing straight corporate bond issuance is that a straight debt offering most times doesn't yield a significant effect on the share price but if it does, it is marginally positive or negative (Barclay and Litzenberger, 1988; Tang and Singer, 1993; Eckbo et al., 2007).

Another common type of bond is the convertible one which allows bondholders to convert their bonds into a predetermined number of shares at a certain point in time (Fenech, 2008). Dann and Mikkelson (1984) provided early evidence from the U.S. market on

convertible debt issuance and its impact on stock prices. Their study revealed a statistically significant negative two-day CAAR of -2.31%, indicating a notable market reaction following convertible bond offerings. Eckbo (1986) also investigated the announcement effects of convertible bond offerings in the U.S. market, reporting a negative two-day CAAR of -1.25%. Ammann et al. (2006) examined the announcement effects of convertible bonds in Germany and Switzerland, revealing a negative market reaction. Specifically, they observed a significant decline in (CAAR) of -2.43% for German convertibles and -1.03% for Swiss convertibles during the event window (0, +1). Cheng et al. (2005) focused on Japan, analyzing 172 convertible bond issuances between 1996 and 2002. Similar to the findings in other regions, they reported a negative announcement effect with a CAAR of -1.24%. This underscores the universality of the negative market response to convertible bond issuance announcements, irrespective of the geographical context.

2.5. Hypothesis development

From the literature and previous research in sustainable finance, it is evident that abnormal returns often are experienced when firms announce the issuance of a bond. For both green and convertible bonds, previous literature is unanimous that these issuance announcements yield significant abnormal returns. Prior research (Tang & Zhang, 2020; Wang et al., 2020; Flammer, 2021) also found that the abnormal return is greater for first time issuers and can be attributed to a greater signal value. Building on this consensus, and placing particular emphasis on findings related to green bond issuance announcements, the following two hypotheses were formulated:

H1a*: Companies issuing green bonds see abnormal returns around the announcement date.*

H1b*: First-time issuers of green bonds see abnormal returns around the announcement date.*

Moreover, we seek to investigate the effect of ESG rating. Previous research has found that companies issuing green bonds see a benefit from a lower cost of debt (Chava, 2014; Hachenberg & Shiereck, 2018; Zerbib, 2019; Nanayakkara & Colombage, 2019). Additionally, Immel et al. (2020) included ESG rating as a factor and found that higher ESG rating can further reduce the cost of debt, resulting in lower yields and financial benefit for shareholders. The authors suggest that this is because companies with high ESG ratings have already demonstrated their commitment to ESG-related matters, thereby reducing information asymmetry and attracting more investors. In contrast, Tang and Zhang (2020) argue that companies with low ESG profiles may see greater returns due to higher information

asymmetry. Seeking legitimacy in the eyes of investors, these companies' commitment to sustainability attracts new investors, leading to higher share prices. This argument aligns with their findings that the abnormal return is greater for first-time issuers, a conclusion also reached by Flammer (2021) and Wang et al. (2020). Since first-time issuers likely have information asymmetry characteristics regarding sustainability commitment similar to those of low ESG-rated firms, it is probable that they have lower ESG ratings, resulting in a comparable market reaction for both types of issuers. Based on these competing arguments, the following two hypotheses were formulated:

H2a*: Companies with high ESG-rating see abnormal returns around the announcement date.*

H2b*: Companies with low ESG-rating see abnormal returns around the announcement date.*

3. Method section

3.1. Data

The data on green bonds was obtained from Refinitiv and the service "Green Bond Guide", provided by Thomson Reuters Eikon. Screening metrics were green corporate bonds issued between 2015-2023. The sample was limited to publicly traded companies. Selected markets were all European countries. The screening resulted in 3391 bonds in total, whereof 955 bonds had available share price data for the issuing firm. The number of unique companies was 257. After excluding data with missing ESG rating or other values, our final sample was 698 bond issuances.

Moreover, this data was complemented with financial and share price data from S&P Capital IQ - Compustat. For the market-model, historical prices of the stock market index STOXX 600 were retrieved for estimating the market return in the event window. This index was selected for its coverage of the European market as the broad index of traded shares. In line with previous research such as Flammer (2021), we retrieved financial metrics from the fiscal year prior to the issuance date.

We also include ESG score as a parameter, retrieved through Thomson Reuters Eikon. ESG score is a standardized 0-100 rating based on annual reports, CSR reports and NGO websites and assigned by Eikon analysts based on Environmental, Social and Governmental performance (LSEG, n.d.). In our models we use the continuous ESG score as a variable.

We also split the data into high and low ratings with the median as a threshold to analyze subsamples of the dataset. This is also done with first-time issuance, analyzed both as a dummy variable in the large dataset and separately in a sample of unique first-time issuances. The second dummy variable we use is one for financial and real estate operating companies. The reason for this is that these represent the majority of issued green bonds and a dummy can help capture an eventual difference in financial and non-financial companies issuing green bonds. This distinguishment has been made in previous studies in the field as well (Tang & Zhang, 2020; Flammer, 2021). All the variables used in our models are described in Table 1.

Table 1
Definition of Variables.

Table 1 describes the definitions/measures of the variables used in the regression models.

Variable	Definition/measure
CAR	Cumulative abnormal return calculated for the event window, with day zero being the day of the announcement and [ ] brackets the start and end of the window.
ESG score	Refinitiv Eikon's measure of ESG score, ranging between 0 and 100.
ln(Bond Size)	Natural logarithm of the green bond size, denominated in US Dollars. Used as a proxy for firm size.
Coupon	Coupon rate of the green bond at time of issuance.
DtE	Debt-to-equity ratio of the bond-issuing firm.
RoA	Return on assets of the bond-issuing firm.
First Issuance	Dummy variable that takes the value of 1 for the first bond issuance by the firm and 0 for subsequent issuances.
FinReal	Dummy variable that takes the value of 1 if the issuing firm operates in the financial or real estate sector according to the GICS-sector classification.

After eliminating missing observations, primarily due to missing ESG scores, our final sample consists of 698 observations, as shown in Table 2. The summary statistics reveal that both CAR metrics have a slightly negative mean with a high standard deviation, indicating considerable variance in the dataset. The increased standard deviation, as well as the minimum and maximum values for CAR[-5,10] compared to CAR[-2,2], suggests greater volatility in share prices and abnormal returns over the longer event window.

The ESG scores range from 21.7 to 93.2, with most values concentrated around the mean of 67.19. The interquartile range is set between 57.99 and 80.05, meaning half of the observations fall within this range. This concentration around the mean indicates a relatively tight distribution of ESG scores within our sample. Regarding control variables, no significant anomalies are detected. Return on assets ranges from -14.6% to 14.5%, with an average of 2.6%. The debt-to-equity ratio averages around 2.017, with most companies falling between 1 and 2, indicating typical leverage levels for the sampled firms.

Lastly, the dummy variables show that 22.6% of the sample consists of first-time green bond issuances, and 61.3% of the issuances are from companies in the financial or real estate sectors. This sector concentration is important for understanding the industry-specific impacts and responses to green bond issuance.

Table 2

Descriptive Statistics

Table 2 shows full sample size (N), means, standard deviations, min and max values and the distribution of values on 25%, 50% and 75% levels. The data has been cleared of NaN and null values, e.g. ESG score. To eliminate outliers, the data has been winsorized on a 1%-level.

Variable	N	Mean	Std	Min	25%	50%	75%	Max
CAR[-2,2]	698	-0.186	3.168	-9.583	-1.727	-0.100	1.463	9.475
CAR[-5,10]	698	-0.290	6.931	-20.753	-3.956	-0.256	3.408	20.073
ESG Score	698	67.185	16.496	21.702	57.987	70.233	80.045	93.205
ln(Bond Size)	698	19.235	1.316	16.039	18.084	19.638	20.365	21.019
Coupon	698	3.225	2.207	0.125	1.254	2.867	5.024	9.577
DtE	698	2.017	2.124	0.129	0.713	1.185	2.412	10.446
RoA	698	2.561	4.483	-14.633	0.468	1.283	4.551	14.528
First Issuance	698	0.226	0.419	0.000	0.000	0.000	0.000	1.000
FinReal	698	0.613	0.487	0.000	0.000	1.000	1.000	1.000

We also conduct pairwise correlation tests for the independent variables. This was done to test intercorrelation and multicollinearity among variables, see Table 3.

Table 3

Correlation matrix of variables

Table 3 shows a correlation matrix on the variables used in the regressions. *,** and *** denotes significance at the 10%, 5% and 1% level, respectively.

	ESG Score	ln(Bond Size)	Coupon	DtE	RoA	First	FinReal
ESG Score	1.000						
ln(Bond Size)	0.193***	1.000					
Coupon	- 0.202***	- 0.240***	1.000				
DtE	0.031	0.094***	- 0.056**	1.000			
RoA	-0.083**	- 0.037	0.086**	- 0.469***	1.000		
First Issuance	- 0.121***	0.171***	- 0.093**	- 0.072***	0.041	1.000	
FinReal	- 0.197***	- 0.110***	- 0.007	0.172***	- 0.044	- 0.100	1.000

Analyzing the correlation matrix, we put emphasis especially on the 'ESG Score' and 'First Issuance' correlation with the rationale that issuance of green bonds can be interpreted as a commitment to sustainability and positively impact the 'ESG Score'. Hence, first issuers are likely to have lower ESG ratings. Since the correlation is -0.121, we see low risk of multicollinearity and argue that both variables can be used in the regression models. The second relationship of interest is that of 'DtE' and 'RoA', high debt ratio is negatively correlated with return on assets with a coefficient of -0.469. The correlation is significant but not at an alarming coefficient and since both are common control variables in the research field, we chose to include them in the models.

Lastly, we present the data sample at the country and industry levels in Table 4 and Table 5, respectively. Sweden and Norway had the highest number of bonds issued. At the sector level, the Financials and Real Estate sectors were the largest issuers.

Table 4

Green bond issuances by country

Table 4 shows the distribution of green bond issuances by country.

Country:	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Sweden	7	12	11	21	37	32	23	143
Norway			4	9	21	26	18	78
Spain	4	2	7	10	27	13	5	68
France	9	5	11	6	11	7	19	68
Italy	1	2	8	7	9	15	18	60
Germany		1	1	8	17	18	7	52
Denmark	2		5		5	10	16	38
Finland	1		5	3	9	3	16	37
Netherlands		4	3	2	4	9	10	32
Austria		1	3	6	5	11	3	29
Switzerland			4	2	5	5	8	24
United Kingdom	2	2	2	4	7	3	1	21
Ireland				1	3	5	4	13
Portugal			1	2	3	1	2	9
Belgium		1		1	2	1	1	6
Poland				1	3		2	6
Iceland					2	2		4
Greece				1	2	1		4
Slovakia						2	1	3
Hungary						2		2
Slovenia							1	1
Total	26	30	65	84	172	166	155	698

Table 5

Green bond issuance by industry

Table 5 shows the distribution of green bond issuances by industry according to the GICS classification.

Industry:	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**Total**
Financials	5	13	15	29	48	80	66	256
Real Estate	14	12	20	26	56	22	23	173
Utilities	7	4	17	12	22	25	29	116
Consumer Discretionary			5	5	23	7	3	43
Materials			3	5	4	12	14	38
Industrials		1	3	2	8	14	9	37
Consumer Staples				2	6	1	4	13
Communication Services			1	3	2	3	3	12
Energy					2		3	5
Health Care			1		1	1		3
Information Technology						1	1	2
Total	26	30	65	84	172	166	155	698

3.2. Research Design

The chosen method for the proposed research was an event study on the effect of green bond issuance announcement on share price. To conduct the event study analysis, we used the market model to calculate the abnormal returns which is one of the most used models in this area. We estimated the coefficients α_i and β_i of the market model by running an OLS-regression based on the estimation window [-250, -50], looking at daily returns to eliminate the risk of parameters getting affected by event-related information. We proceeded to estimate:

$$R_{it} = \alpha_i + \beta_i \times R_{mt} + \varepsilon_{it}$$

where R_{it} is the return on the stock of company i on day t, R_{mt} is the daily market return, and ε_{it} is the residual. The estimated return on the stock of firm i on day t was then given by:

$$\hat{R}_{it} = \hat{\alpha}_i + \hat{\beta}_i \times R_{mt}.$$

To calculate the daily abnormal return (AR) of firm i on day t we then subtracted the estimated return from the actual return by using:

$$AR_{it} = R_{it} - \hat{R}_{it}.$$

Furthermore, we computed CAR by summarizing the abnormal return for each day in the event window.

$$CAR_i(t1, t2) = \sum_{t=t_1}^{t_2} AR_{it}$$

Lastly, cumulative average abnormal return (CAAR) was calculated for further analysis and one sample t-tests were computed to determine if the CAAR was significantly different from zero:

$$CAAR(t1, t2) = \frac{1}{N} \sum_{t=t_1}^{t_2} CAR_i(t1, t2)$$

In accordance with previous research from Krüger (2015) and Flammer (2021) we accounted for the possibility that actors have received information about the green bond issuance prior to the public announcement date and therefore estimated an event window of [–5, 10] where day zero was the announcement date. However, we also used a shorter window of [-2, 2] to concentrate on the effect of the announcement around the announcement date. Another reason for the suggested event windows was the comparability with previous research (Krüger, 2015; Baulkaran, 2019; Tang & Zhang, 2020; Flammer, 2021). Moreover, the estimation model and calculation of abnormal returns was done using a Python script for calculating expected and abnormal returns.

3.3. Regression Model Description

We performed multiple regressions on the dataset. In Model 1 and Model 3 we ran the regression only with control variables, structured accordingly:

Model 1 [-2, 2] and Model 3 [-5, 10]:

$$CAR\ [\ ] = \alpha + \beta_1\, ln(Bond\ Size) + \beta_2(Coupon) + \beta_3(DtE) + \beta_4(RoA) + \beta_5(First\ Issuance) + \beta_6(FinReal) + \varepsilon_i$$

In the other models we included the independent variable ESG Score to determine whether the rating can explain abnormal returns in the event window. For Model 2 and Model 4 the formula was structured as:

Model 2 [-2, 2] and Model 4 [-5, 10]:

$$CAR\ [\ ] = \alpha + \beta_1\, ln(Bond\ Size) + \beta_2(Coupon) + \beta_3(DtE) + \beta_4(RoA) + \beta_5(First\ Issuance) + \beta_6(FinReal) + \boldsymbol{\beta_7(ESG\ Score)} + \varepsilon_i$$

CAR was the dependent variable, calculated through available share price data. Independent variables included: size of the bond, leverage (DtE) and return on assets (RoA). In addition, the coupon of the bond was included in the regression. Additionally, ESG-rating was included as a primary independent variable. We also stressed the importance of distinguishing between first-time and subsequent issuances and therefore included this as a dummy variable. Lastly, a dummy variable for financial and real estate operating companies was added.

In addition to the presented models, we performed identical regressions for different subsamples. For Model 5-8, we split the sample into low and high ESG-rated companies based on the median of the full sample. In Model 9-16 we ran the regressions on the samples first and subsequent issuances. Lastly, we implemented industry fixed effects for all regressions to account for industry-level differences.

4. Results

4.1. Univariate Analysis

We first present the results of our univariate analysis by running one sample t-tests for the selected windows [-2,2], [-5,10] and samples. All the tests are presented in Table 6.

Table 6
Univariate analysis of CAR

Table 6 describes the univariate analysis of CAR, presenting the mean value of CAR for event windows [-2,2] and [-5,10]. Samples are corresponding to the data used in respective multivariate regressions. * and ** denotes significance at the 10% and 5% level, respectively.

Event window	CAR (%)	Std. Err.	N
[-2,2]	-0.18552**	0.11337	698
[-5,10]	-0.29012*	0.25033	
Low ESG [-2,2]	-0.13911	0.16020	354
Low ESG [-5,10]	-0.50120*	0.36985	
High ESG [-2,2]	-0.23328*	0.17917	344
High ESG [-5,10]	-0.07290	0.37236	
First Issue [-2,2]	-0.17584	0.26878	158
First Issue [-5,10]	0.16471	0.53777	
Subsequent [-2,2]	-0.18853*	0.12771	540
Subsequent [-5,10]	-0.42320*	0.30043	

We find that both full sample windows are significant at 5% and 10%, respectively. The average CAR is negative with 0.20% and 0.37% abnormal loss compared to the market during the event windows for the full sample. Looking at the other samples, we find the average CAR to be significant for the high ESG score sample in the [-2,2] event window and both windows for the subsequent issuances sample.

The results from the univariate analysis of CAAR deviate from previous research in the green bond area since the general conception is that these issuance announcements yield positive CAR's. The results from the univariate analysis therefore contradicts the signaling theory and the argument from Flammer (2021) that the green bond issuance genuinely indicates a company's dedication to environmental concerns and therefore should yield a positive abnormal return. The results from the univariate analysis are more in line with the previous literature on corporate straight debt issuance which have shown, when significant, a small negative or positive effect around the announcement day (Dann & Mikkelson 1984; Eckbo 1986; Barclay & Litzenberger, 1988; Tang & Singer, 1993; Eckbo et al., 2007). Furthermore, the results of the univariate analysis support **H1a** and **H2a** but fail to support **H1b** and **H2b**. In

the following regressions we test the robustness of the univariate analysis and if multivariate analysis can get higher explanatory values for our hypotheses, described in Table 7-9.

4.2. Regression Models

In this segment we present, comment, and analyze the regression output for our data sample and previously described models. First, we show the results of the full sample regression. This is followed by regressions of smaller samples based on ESG or first-time issuance.

Table 7

Abnormal returns of full sample in [-2,2[and [-5,10] event windows.

Table 7 shows the results for the OLS regression models made on windows (-2,2) and (-5,10). All of the regressions are made on the full sample, after adjusting for missing values. Standard errors in parenthesis. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

	OLS regressions (full sample)			
	Model 1	Model 2	Model 3	Model 4
CAR	[-2, 2]	[-2, 2]	[-5, 10]	[-5, 10]
Cons	3.3784***	3.2963***	6.8080**	6.6614**
	(0.937)	(1.141)	(3.443)	(3.376)
ESG Score		0.0162***		0.0290**
		(0.005)		(0.013)
ln(Bond Size)	-0.1795***	-0.2403***	-0.3489*	-0.4575***
	(0.053)	(0.084)	(0.183)	(0.168)
Coupon	-0.1216*	-0.1052	-0.3206**	-0.2914**
	(0.063)	(0.070)	(0.132)	(0.133)
DtE	0.0402	-0.0427	-0.1026	-0.354
	(0.030)	(0.028)	(0.128)	(0.116)
RoA	0.0603***	0.0614**	0.0426	0.0446
	(0.022)	(0.025)	(0.059)	(0.066)
First Issuance	0.0272	0.1422	0.6284**	0.8339***
	(0.270)	(0.293)	(0.292)	(0.317)
FinReal	0.0654	0.1852**	0.3071	0.5211
	(0.052)	(0.094)	(0.594)	(0.600)
N	698	698	698	698
Industry FE	Yes	Yes	Yes	Yes
F-Stat	23.68	10.81	3.41	3.015
R-squared	0.016	0.022	0.014	0.018

In Table 7, we present four regression models on the full sample of green bond issuances. In Model 1 and Model 3, we test only the control variables and in Model 2 and Model 4 we add the ESG Score variable. For the shorter event window [-2,2] we find high

significance for both the intercept and variables ‘Bond Size’, ‘Coupon’ and ‘RoA’. The intercept is positive and significant on the 1% level for both Model 1 and 2. Noteworthy in the results is the coefficient for bond size that is negative, indicating lower CAR for larger bond issuances. This can also be interpreted as higher abnormal returns for smaller issuances or smaller companies. Adding ESG score to the short window, we find significance with a positive coefficient, indicating greater abnormal returns for firms with higher ESG rating.

Moreover, the other window of [-5,10] presented in Model 3 and Model 4 show similar results, albeit less significant on some variables. Noticeable is that the dummy variable of ‘First Issuance’ is significant on the 1% level, indicating a higher return for first timer issuers. This result therefore supports hypothesis **H1b** which states that the abnormal return is greater for first time issuers.

Analyzing the results of the full sample regressions, we find that ESG score positively affects the CAR. This result aligns with Immel et al. (2021) and supports the reasoning that a higher ESG score leads to a lower cost of debt and benefit for shareholders. Linking this to their reasoning, this suggests that investors value a high ESG rating when investing in green bonds. Therefore, having a low rating is not beneficial despite the positive signal value to the market. This finding contradicts the information asymmetry argument presented by Tang and Zhang (2020), which suggests that high ESG-rated firms have already conveyed their environmental commitment to the market, and thus, the stock market reaction should be greater for low-rated firms. In the full-sample regressions we find no results that would support this reasoning. However, relating this to the greenwashing argument presented by Seele and Ghatti (2017), investors may be more skeptical of low-rated firms. Since all of the four models on the full sample yield positive and highly significant intercepts, they all support the **H1a** hypothesis that companies issuing green bonds see abnormal returns around the announcement date. These results are in line with previous research investigating the stock market reaction to green bond issuance announcements (Baulkaran, 2019; Zhou & Cui, 2019; Tang & Zhang, 2020; Wang et al., 2020; Flammer, 2021). The findings also confirm the signaling theory argument that the company manages to convey their commitment to sustainability and gain abnormal returns in conjunction with this.

Table 8

Abnormal returns of Low and High ESG samples.

Table 8 shows the results for the regression models on subsamples 'Low' and 'High' ESG, split on the median of the full sample. Excluding ESG Score as a variable. Standard errors in parenthesis. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

	OLS regressions (Low/High ESG)			
	Model 5	Model 6	Model 7	Model 8
CAR	Low ESG [-2, 2]	High ESG [-2, 2]	Low [-5, 10]	High [-5, 10]
Cons	2.4178	4.9253*	10.8824	6.3129*
	(2.421)	(2.691)	(10.729)	(3.788)
ESG Score	-	-	-	-
ln(Bond Size)	-0.1069	-0.2664*	-0.5239	-0.3408*
	(0.125)	(0.139)	(0.514)	(0.191)
Coupon	-0.0724	-0.2005***	-0.3442	-0.2793*
	(0.080)	(0.066)	(0.293)	(0.157)
DtE	-0.0016	0.0904	0.1019	0.1448
	(0.017)	(0.065)	(0.178)	(0.209)
RoA	-0.0168	0.0911***	-0.2054*	0.1185**
	(0.060)	(0.022)	(0.111)	(0.055)
First Issuance	-0.3152	0.3951	0.2752	1.2363*
	(0.429)	(0.304)	(0.709)	(0.684)
FinReal	-0.2002	0.2509	0.0289	0.477
	(0.143)	(0.267)	(1.305)	(0.354)
N	354	344	354	344
Industry FE	Yes	Yes	Yes	Yes
F-Stat	2.88	109.00	29.25	6.69
R-squared	0.006	0.041	0.026	0.021

In Table 8, we present four regression models for the same windows [-2,2] and [-5,10], divided into samples of ‘Low ESG’ and ‘High ESG’. For Model 5 and 7 of the low rated companies we find no significant results. However, when examining the high rated companies in Model 6 and 8, we find that both intercepts are significant at the 10% significance level.

Regarding the control and dummy variables, the low ESG score models show mostly insignificant results, with only RoA being significant on the 10% level in Model 7. In contrast, the high ESG score models have more significant variables. Model 6 shows a negative coefficient for the coupon rate and a positive for RoA, both highly significant at the 1% level. This suggests that bonds issued with higher coupon rates have lower CAR, while an increase in RoA yields a higher CAR. For Model 8 we find similar results but only RoA yields a

coefficient that is significant on the 5% level. Additionally, this is the only model of the four where the dummy variable for first time issuance is significant at a 10% level.

Linking this to our hypotheses we only find significance at a 10%-level in the subsample of high ESG-rated companies. Controlling at a 5%-level the model fails to support hypothesis **H2a**, namely that companies with a high ESG rating see abnormal returns. For the second hypothesis **H2b** testing low rated companies, we see no significance in this subsample regression, also failing to support this hypothesis. Hence, when analyzing the high and low rated companies isolated, there is no evidence that companies with a specific ESG rating see abnormal returns.

Table 9

Abnormal returns of 'First and Subsequent Issuance' samples.

Table 9 shows the results for the regression models ran on the subsamples of 'First Issuance' and subsequent issuances. Standard errors in parenthesis. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

	OLS regressions (First and Subsequent samples)			
	Model 9	Model 10	Model 11	Model 12
CAR [-2, 2]	*First*	*Subsequent*	*First*	*Subsequent*
Cons	5.5785**	2.9588***	9.4096***	2.6973**
	(2.380)	(1.064)	(2.687)	(1.150)
ESG Score			0.0337**	0.0135*
			(0.017)	(0.008)
ln(Bond Size)	-0.2829**	-0.1560**	-0.5951***	-0.1966**
	(0.111)	(0.065)	(0.176)	(0.094)
Coupon	-0.0925	-0.1352	-0.0807	-0.1219
	(0.166)	(0.114)	(0.167)	(0.117)
DtE	0.1432***	0.1040	0.1613***	0.0108
	(0.044)	(0.048)	(0.055)	(0.043)
RoA	0.0164	0.0588**	0.0030	0.0601**
	(0.054)	(0.028)	(0.053)	(0.030)
First Issuance	-	-	-	-
FinReal	-0.4677	0.1940*	-0.2798	0.3015**
	(0.479)	(0.099)	(0.425)	(0.142)
N	158	540	158	540
Industry FE	Yes	Yes	Yes	Yes
F-Stat	15.85	53.64	12.42	567.8
R-squared	0.016	0.020	0.036	0.024

In Table 9, we present four regressions on the samples for first and subsequent issuances. Similar to the full sample, we exclude ESG rating as a factor in one model and

include it in the next. The presented window is [-2,2] since the longer window [-5,10] yielded no results of interest for these samples. Hence, these regressions are not included in this section but attached in Appendix A.

Looking at the results of the [-2,2] regressions, we find significance for the intercept in all models on either a 1% or 5%-level. Similar to previous models presented, the bond size is a factor that is negative and significant in the regressions for these samples. For first time issuers, the leverage (DtE) is also highly significant but positive. This suggests a higher CAR for companies with greater debt-to-equity ratios. Conversely, for subsequent issuances, RoA is of greater significance and companies with higher return on assets see higher CAR. In Model 11 and Model 12, we include the ESG score as a parameter and find a positive coefficient with statistical significance. Additionally, both models for 'Subsequent' issuances are highly significant. Although we do not delve deeply into this sample, these models provide a useful comparison with the 'First' issuance models.

Analyzing the results, we can compare the intercepts and see that CAR is greater for first time issuers than that of subsequent issuances and in line with other studies (Tang & Zhang, 2020; Wang et al. 2020; Flammer, 2021). Relating this to our previously presented models in Table 7, this further confirms that the abnormal return is greater for first time issuers, supporting **H1b**. Furthermore, in Model 11, we find evidence of a positive influence from ESG rating on CAR. This suggests that companies with a higher ESG rating issuing a green bond for the first time see greater abnormal returns. To exemplify, the model uses a continuous rating of ESG 0-100. In our sample the first and third quartile are 58 and 80, respectively. This translates to a company in the third quartile gaining 0.74 pp greater return compared to a lower rated company in the first quartile. Connecting this to our previous sample analysis and the findings of Immel et al. (2020), this argues that the sustainability reputation and a good ESG rating may attract more investors and greater CAR. For Model 11, the coefficient is positive and significant at a 5%-level, supporting **H2a** to some degree. However, for the subsequent issuances, the ESG score does not meet the requirements and fails to support our hypothesis on ESG score as an explanatory variable for CAR.

4.3. Robustness checks

To test for heteroskedasticity in the model we plotted residuals and compared observed values with predicted values. Presented in Figure 1 and Figure 2 are the plots of the full sample in Model 1 and Model 2, respectively. All other plots are attached in the Appendix. None of the

residual plots show any signs of heteroskedasticity. In addition, we run a Breusch-Pagan test on the sample (see Appendix) and find no evidence of heteroskedasticity, hence we view the dataset as homoscedastic and that the OLS regressions are robust and the correct method to use for these types of regressions.

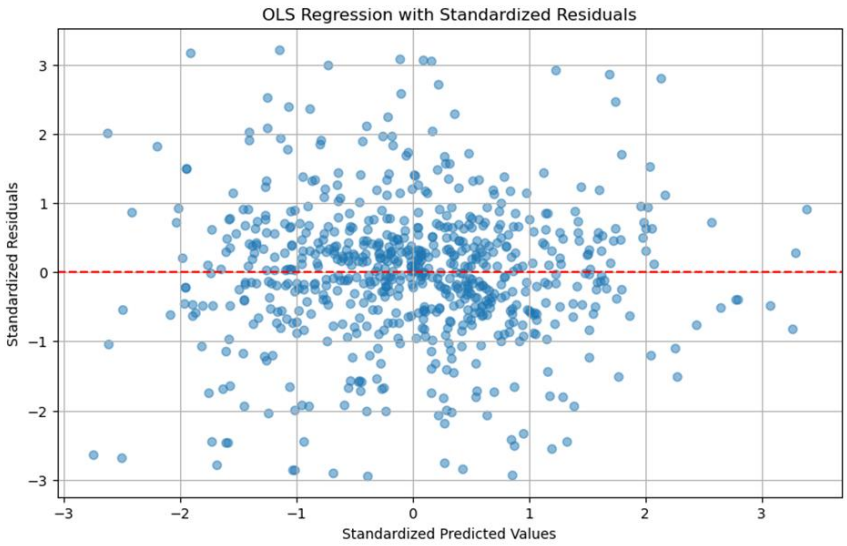

Figure 1

Residuals and predicted values of full sample, [-2,2] event window

The plot shows residuals vs. fitted for regression model 1. This tests if the assumptions of normality and heteroscedasticity can be fulfilled. Heteroskedastic data should be seen in the shape of a cone, whereas homoskedastic data are more centered in a rectangle-like pattern.

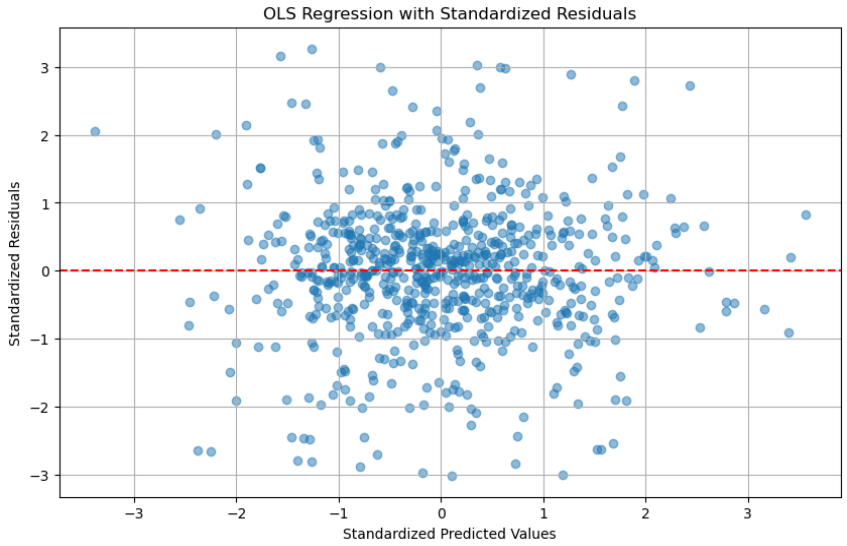

Figure 2

Residuals and predicted values of full sample, [-5,10] event window

The plot shows residuals vs. fitted for regression model 2. This tests if the assumptions of normality and heteroscedasticity can be fulfilled. Heteroskedastic data should be seen in the shape of a cone, whereas homoskedastic data are more centered in a rectangle-like pattern.

5. Conclusion

We find conflicting results regarding abnormal returns for companies issuing green bonds. Previous research (Tang & Zhang, 2020; Flammer, 2021) identified a positive cumulative abnormal return (CAR) in univariate analyses of similar event windows. In contrast, our results indicate slightly negative abnormal returns, ranging from -0.12% to -0.52%. However, when we incorporate multiple variables in OLS regressions, our results show positive CAR and high significance for the full sample. Notably, the size of the issued bond has a substantial impact, with smaller issuances yielding greater abnormal returns. This can also be seen as smaller companies seeing greater abnormal returns. Considering the high significance in both event windows and multiple samples, we find support that companies issuing green bonds see abnormal returns.

Analyzing isolated subsamples, we do not observe that companies with either high or low ESG ratings exhibit positive CAR. However, including ESG score as a variable in our regression models reveals that higher ESG-rated companies tend to achieve higher abnormal returns. Therefore, we find evidence that a high ESG rating can positively influence returns, while low ESG-rated companies do not experience the same benefit.

In relation to signaling theory, this suggests that the signaling value of green bond issuance is less effective for low-rated companies. For higher-rated companies, the signal value is more significant, theoretically indicating a stronger commitment to sustainability. Similar to previous research (Immel et al. 2020; Tang & Zhang, 2020) one possible explanation could be that fewer investors are attracted to the green bond issuances of low-rated companies. This is also an indication that low-rated companies do not see the immediate benefit from green bond issuance, but rather that it can take the form of higher ESG rating in future rating processes (Flammer, 2021).

Furthermore, we examined the effect of first-time issuance on abnormal returns. Although our univariate analysis shows no significance for first time issuers. Our multivariate analysis corroborates previous research, demonstrating that companies experience greater abnormal returns from their initial issuance. Additionally, our models reveal that first-time issuers with higher ESG scores achieve more substantial abnormal returns. Although a first issuance can be a strong signal to the market, investors still appraise the ESG profile and rating of the company before the issuance.

To summarize, this research contributes to the field of green bond issuance by confirming earlier studies on abnormal returns, particularly for first-time issuers. Additionally, it investigates and finds that the ESG rating of a company can influence abnormal returns, with higher-rated companies seeing greater benefits, even among first-time issuers.

5.1. Limitations & Future Research

In our study, we use a large sample of all green bond issuances in Europe. Ironically, this can be a limitation for the research. We do not impose a size requirement or focus on specific sectors. However, using a smaller sample, as done in previous research, would have allowed us to analyze each bond and company individually and better identify anomalies. A second limitation is the use of the broad index STOXX600. Given the data sample's concentration on Nordic companies and real estate and financial sectors, it might have been more appropriate to select individual indices for each sector and country when estimating returns. A third limitation is the divergence in rating methods among ESG rating agencies, which means that using ESG ratings from a different agency and replicating our method could yield different results. This, in turn, negatively impacts the replicability of our study.

Moreover, we identify several areas that future studies could explore in greater depth. Firstly, a more in-depth analysis of industries, ESG ratings and abnormal returns could provide valuable insights. Investigating whether certain industries benefit more from green bond issuances could enhance our understanding of how the market values green bonds.

Secondly, studies that track the long-term performance of companies after issuing green bonds could offer a deeper understanding of the sustained impact on stock prices and cost of debt. This approach would help to distinguish between short-term market reactions and long-term financial benefits.

Lastly, combining green bond research with textual analysis could generate interesting results. By analyzing the content and terms of green bonds, categorizing them, and examining whether certain types of green bond structures are more highly valued by investors, researchers could uncover new dimensions of investor preferences and decision-making processes. This approach could also contribute to voluntary disclosure theory in combination with signaling theory.

In conclusion, future research of these areas can continue to deepen our understanding of green bonds, ESG ratings, and abnormal returns, ultimately contributing to more effective and sustainable financial practices.

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Appendix

Appendix A. Breusch-Pagan Test

Table 10

Breusch-Pagan test for heteroskedasticity

Table 10 displays the results for the B-P test that yield no significance and suggest that the data used in our models is homoskedastic.

	CAR [-2,2]	CAR [-5,10]
LM-statistic	7.87	11.87
LM p-value	0.2477	0.157
F-statistic	1.32	1.50
F p-value	0.2518	0.1573

Appendix B. Regression Models 13-16

Table 11

Abnormal returns of 'First and Subsequent Issuance' samples.

Table 11 shows the results of the [-5, 10] window for first and subsequent issues. The sample is displayed in the appendix since it did not yield any results of interest. Standard errors in parenthesis. ***, ** and * indicate 1%, 5% and 10% significance level, respectively.

	OLS regressions (First Issuance)			
	Model 13	Model 14	Model 15	Model 16
CAR [-5, 10]	*First*	*Subsequent*	*First*	*Subsequent*
Cons	7.0345	6.8985**	13.7428	6.4852**
	(10.762)	(2.868)	(11.779)	(0.022)
ESG Score			0.0591***	0.0213
			(0.018)	(0.145)
ln(Bond Size)	-0.2219	-0.3840***	-0.7686	-0.4480***
	(0.527)	(0.144)	(0.615)	(0.001)
Coupon	-0.5499***	-0.2442	-0.5291***	-0.2231
	(0.197)	(0.215)	(0.175)	(0.299)
DtE	-0.0579	0.1760	-0.0262	0.1767
	(0.191)	(0.145)	(0.194)	(0.193)
RoA	-0.1419	0.0776	-0.1655	0.0797
	(0.146)	(0.065)	(0.157)	(0.247)
First Issuance	-	-	-	-
FinReal	-0.8828	0.4414	-0.5538	0.6112
	(0.950)	(0.543)	(0.838)	(0.297)
N	158	540	158	540
Industry FE	Yes	Yes	Yes	Yes
F-Stat	2.58	6.24	7.21	5.04
R-squared	0.039	0.013	0.054	0.015

Appendix C. Plotted Residuals

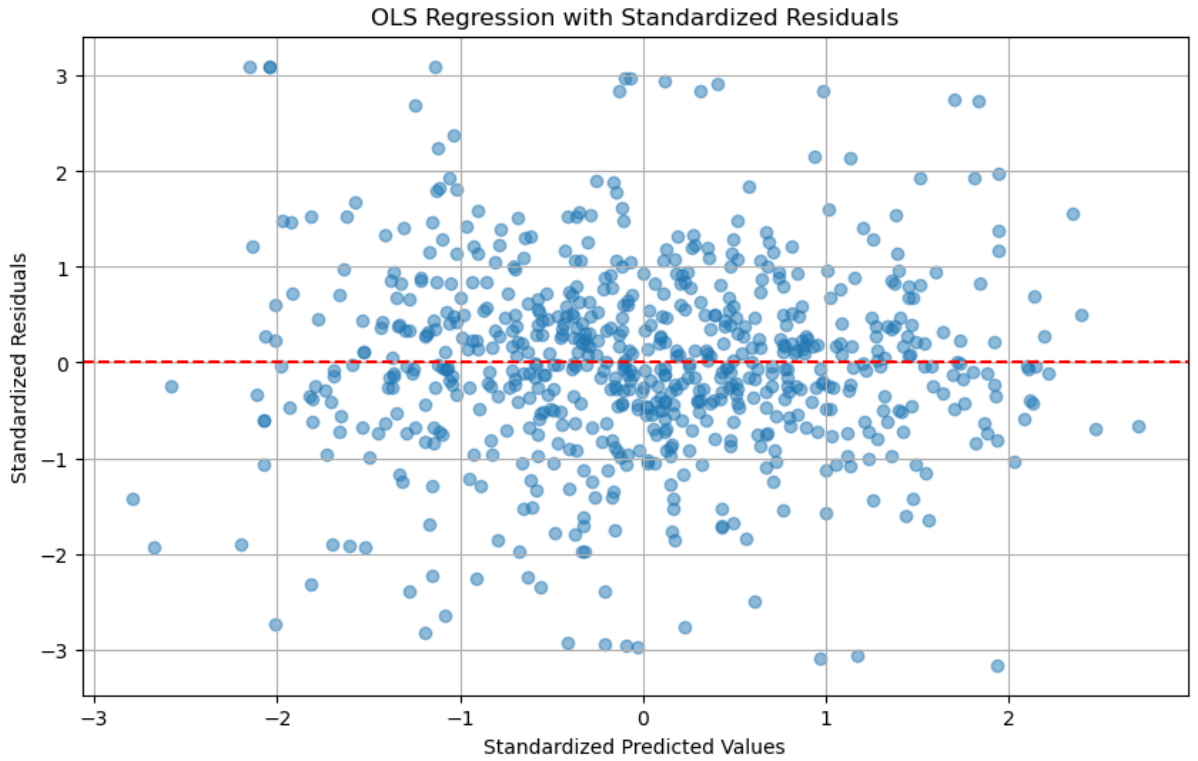

Figure 3 – Residuals Model 3

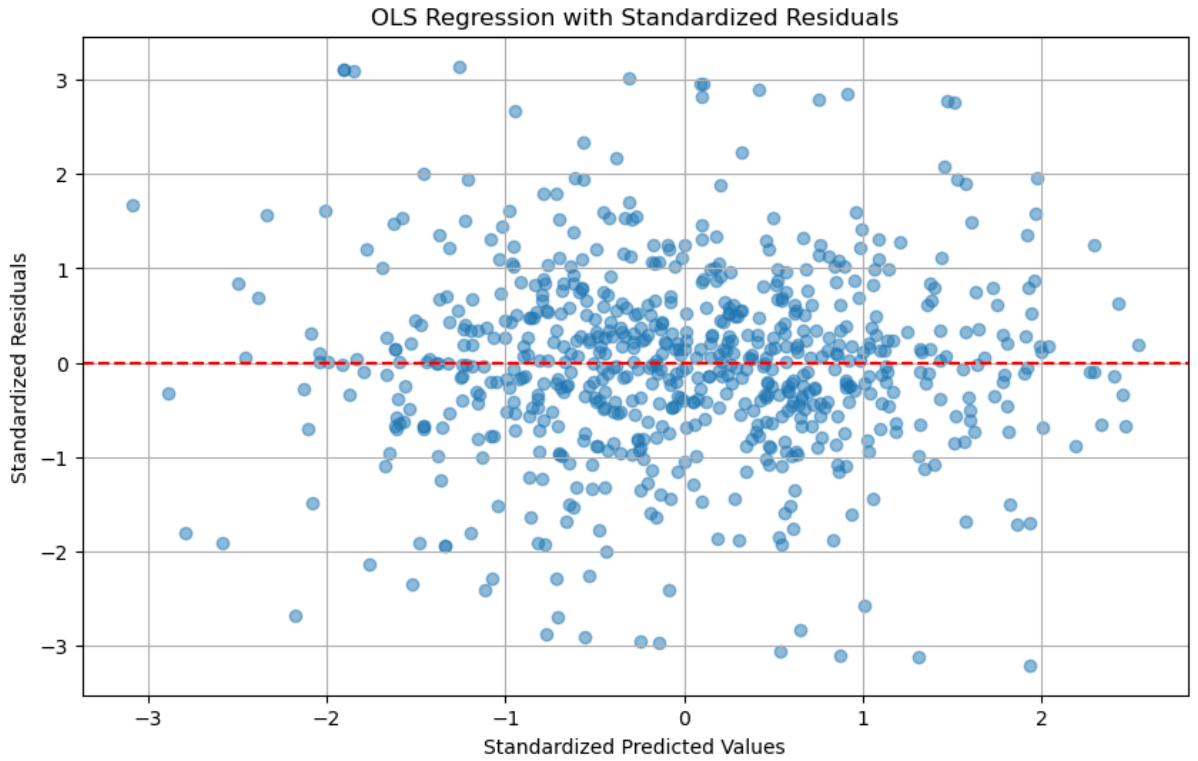

Figure 4 – Residuals Model 4

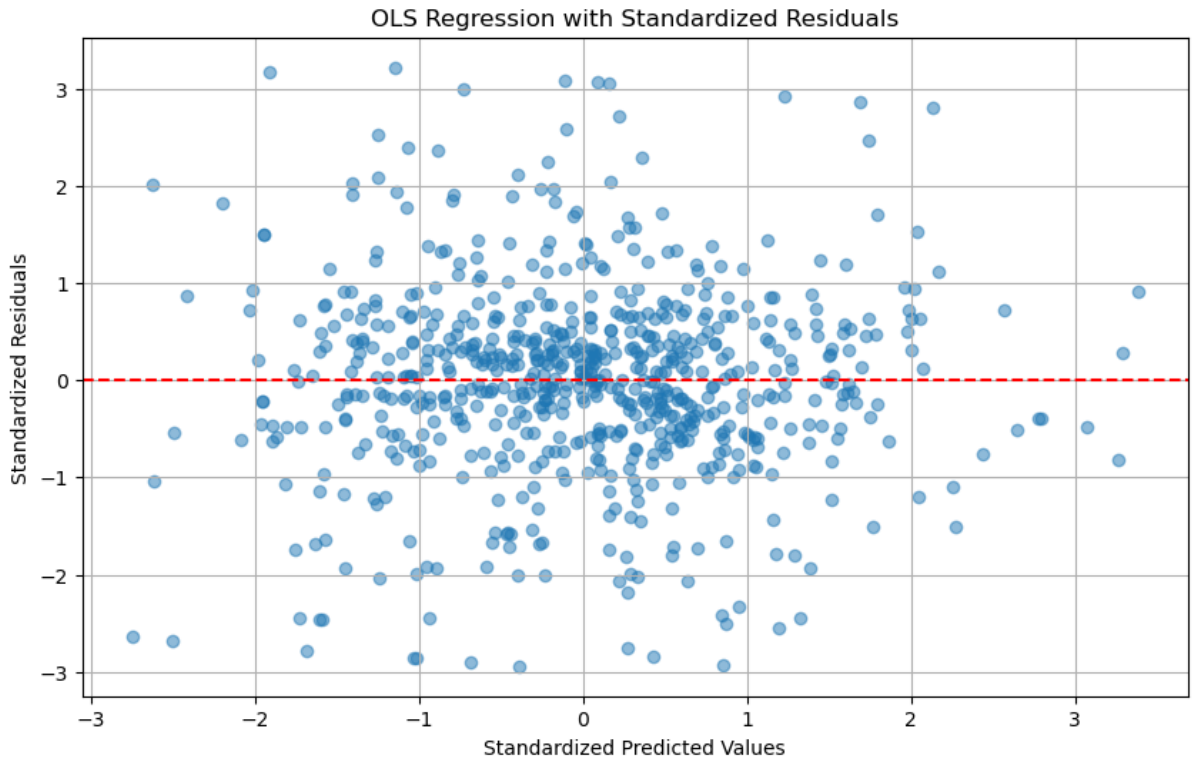

Figure 5 – Residuals Model 5

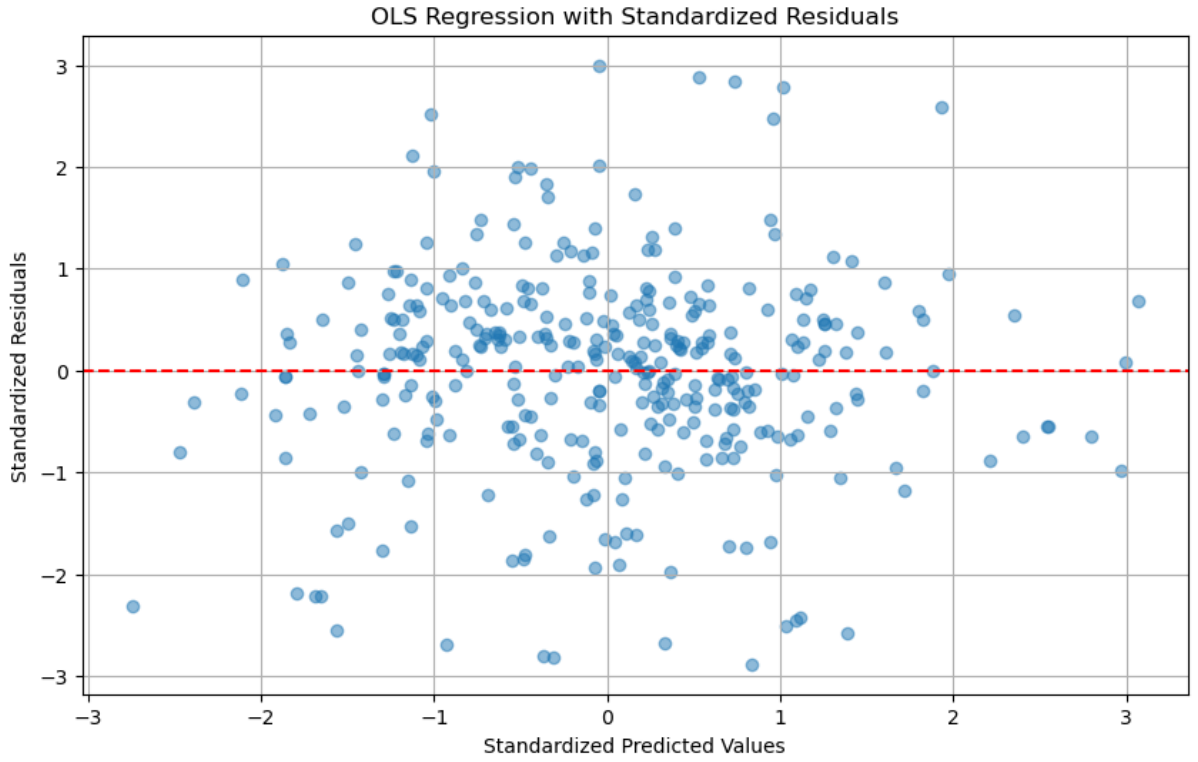

Figure 6 – Residuals Model 6

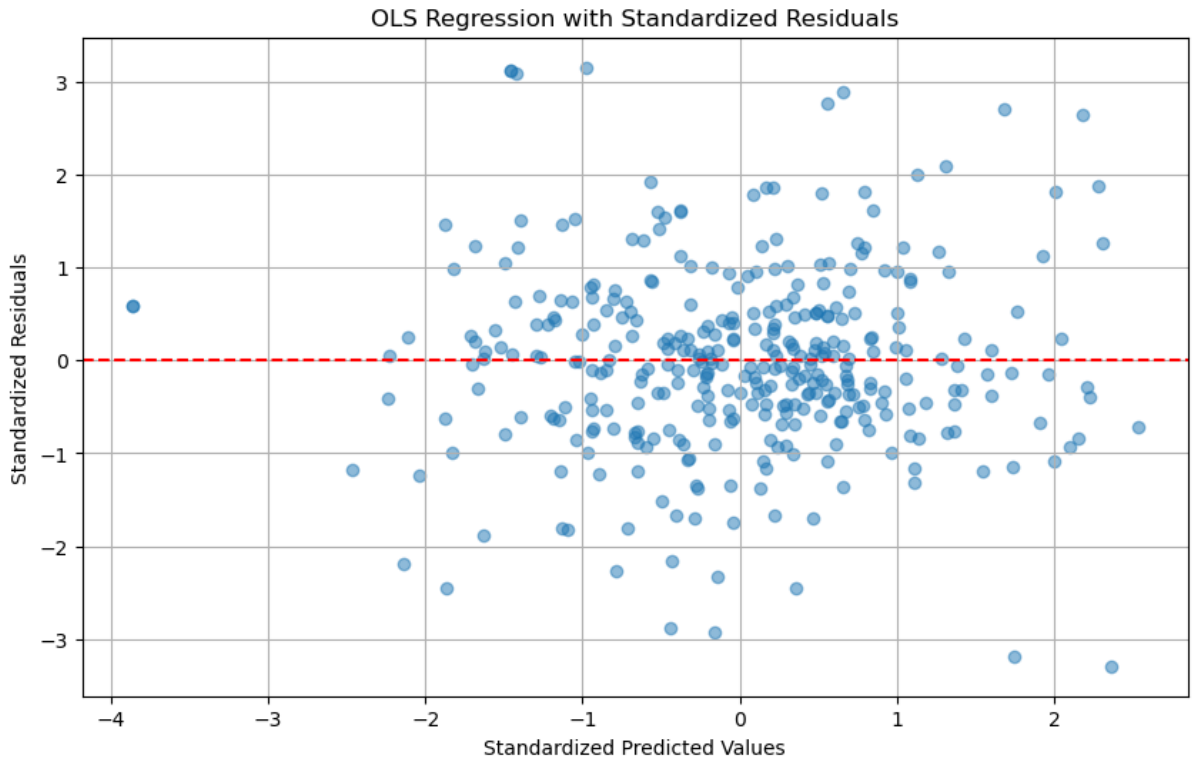

Figure 7 – Residuals Model 7

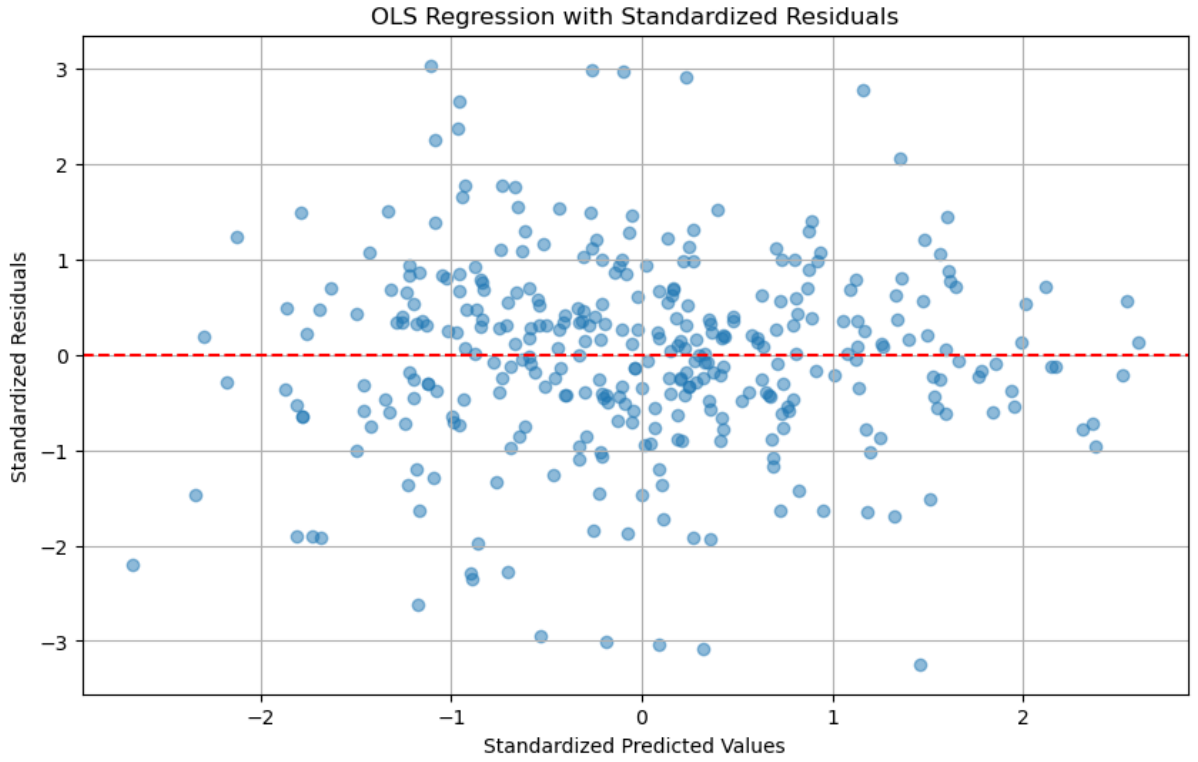

Figure 8 – Residuals Model 8

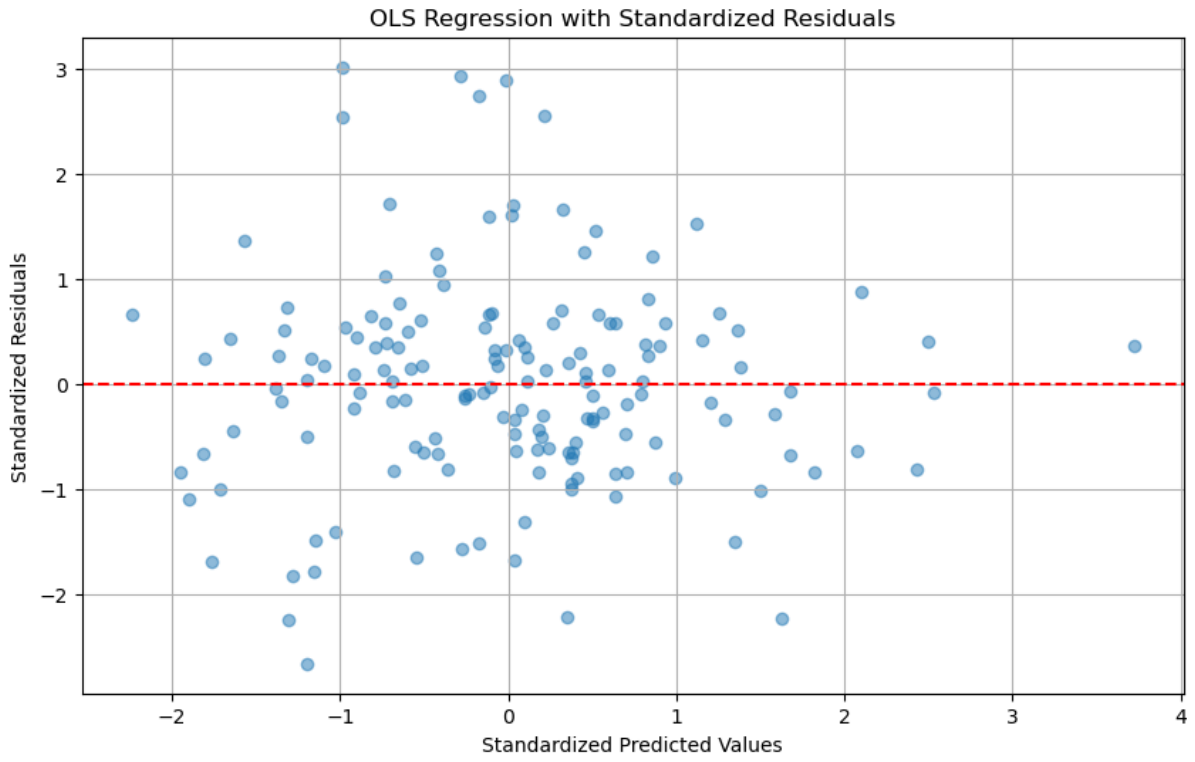

Figure 9 – Residuals Model 9

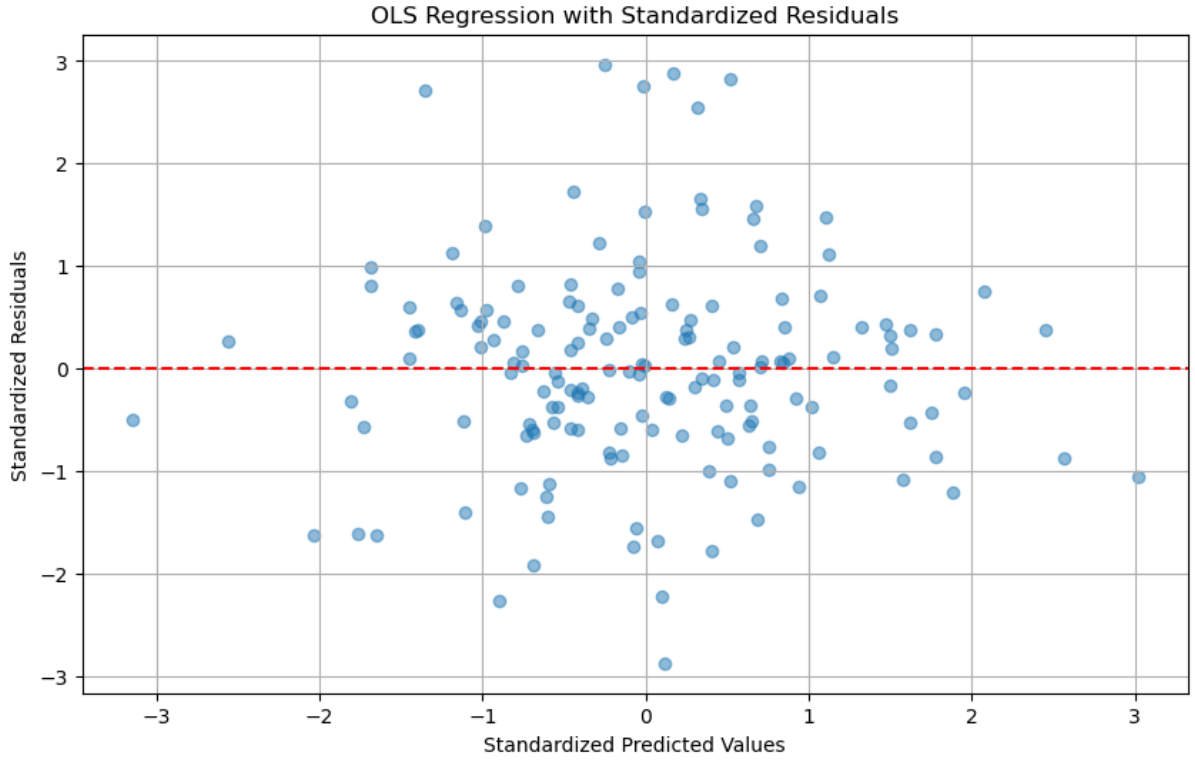

Figure 10 – Residuals Model 10

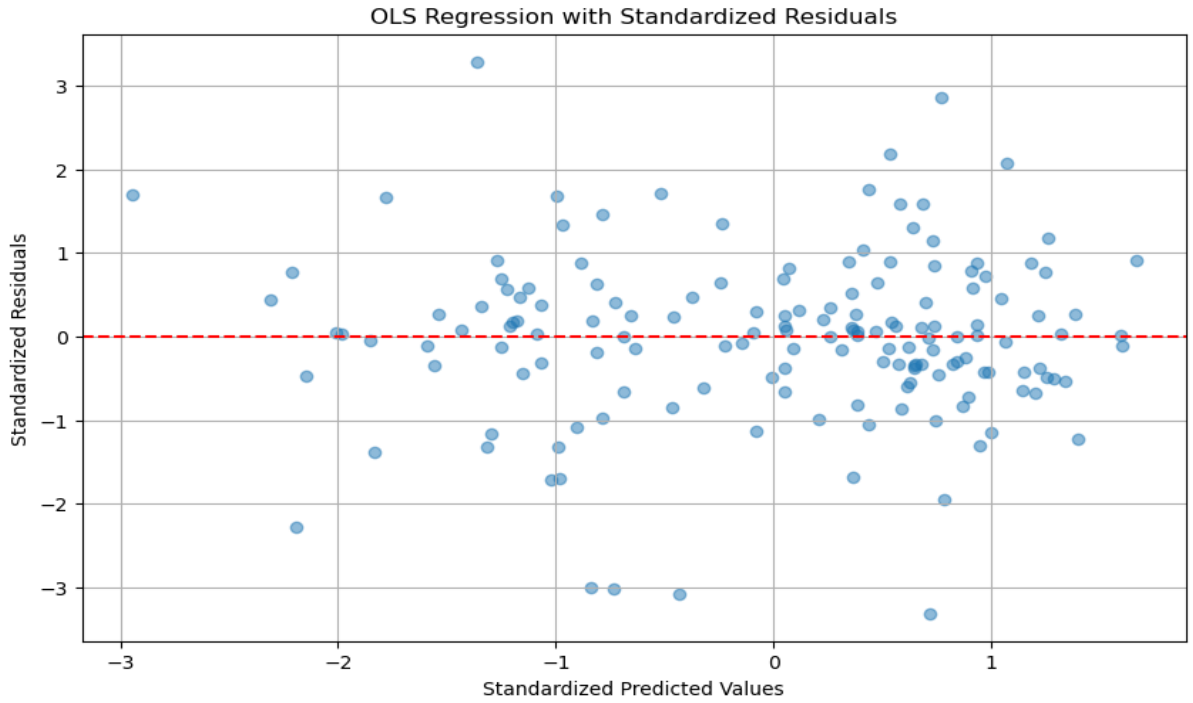

Figure 11 – Residuals Model 11

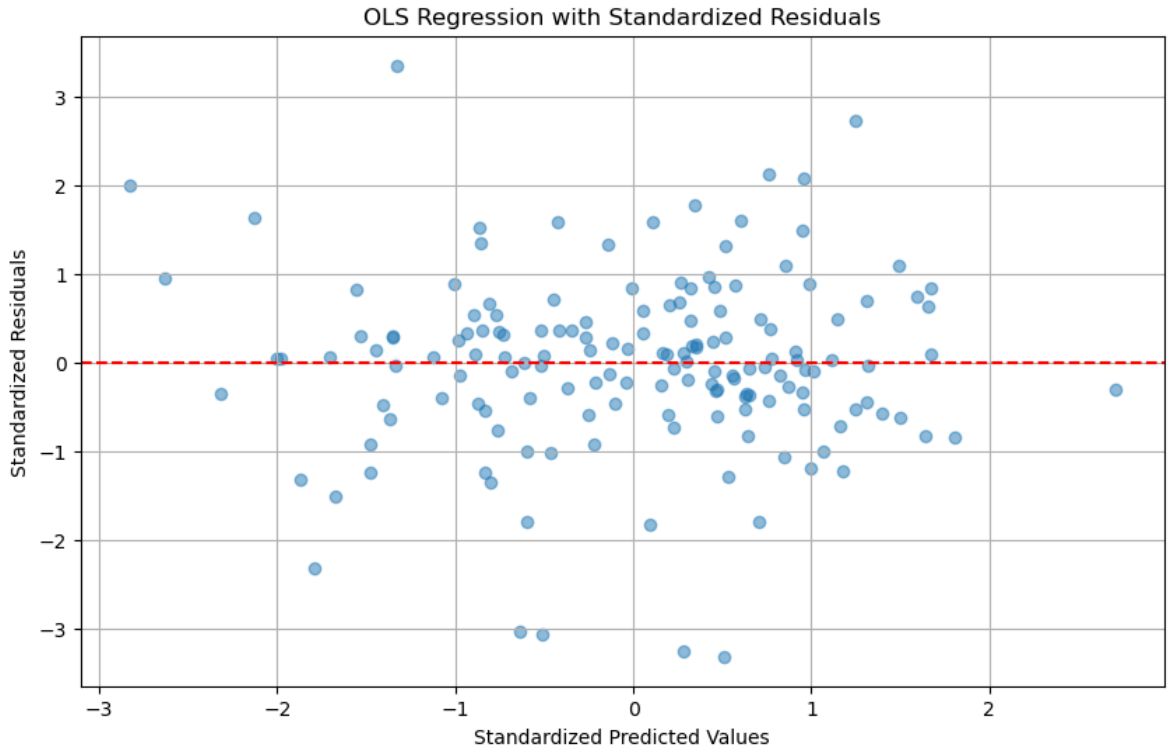

Figure 12 – Residuals Model 12